A NOTE FROM THE LIBRARY & ARCHIVES SERVICE

Modifications to the **Green Book (1954)** Volumes I, V, and VI were published in the **Green Book (1956)** Volume I bis.

For ease of reference, the relevant modifications have been extracted from the **Green Book (1956)** Volume I bis and inserted into the present volume.

THE INTERNATIONAL TELEPHONE CONSULTATIVE COMMITTEE

(C. C. I. F.)

XVIIth PLENARY ASSEMBLY

GENEVA, 4-12 OCTOBER 1954

VOLUME I

List of Delegates.

Minutes of the Meetings of the XVIIth Plenary Assembly.

Organisation of the C.C.I.F.

Recommendations covering letter and graphical symbols and systems of units.

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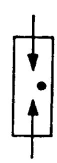
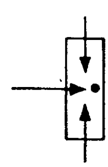
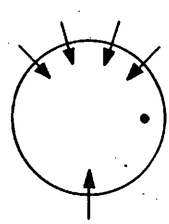
MODIFICATIONS TO VOLUME I OF THE GREEN BOOK

(Graphical symbols)

A. Modifications and additions to the list of graphical symbols in Telecommunication, annexed to Recommendation 5 (List given on page 118 of Volume 1 of the Green Book.)

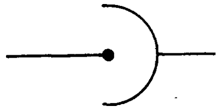
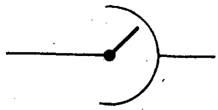
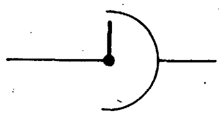
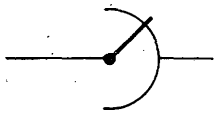
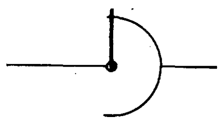
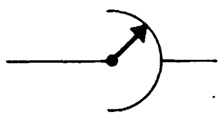
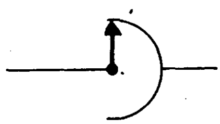
---

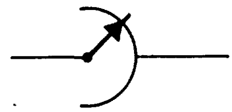
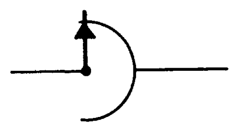
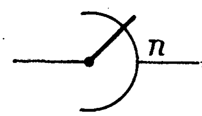
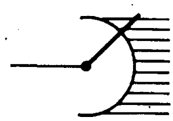
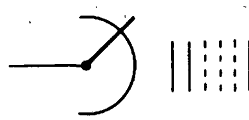
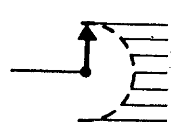
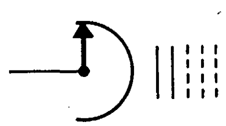
a) Replace symbols 121-123 by the following Table:

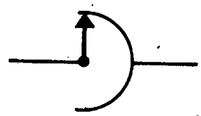
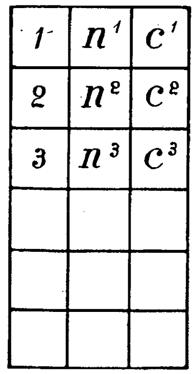
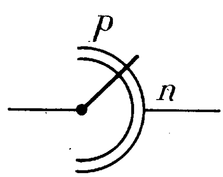
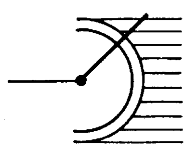
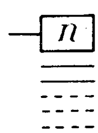
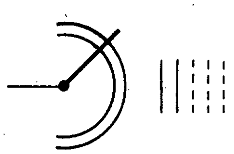
No.	Name	Symbol	Remarks
121	Voltage limiter, general symbol.		
N 121-1	Voltage limiter — air-filled with carbon electrode.		
N 121-2	Voltage limiter — air-filled with metal electrode.		The letter M may be replaced by the chemical symbol for the metal, or by any other conventional sign.
123	Voltage limiter — gas-filled, 2-electrodes.		
N 124	Voltage limiter — gas-filled, 3-electrodes.		
N 125	Voltage limiter — gas-filled, 5-electrodes.		

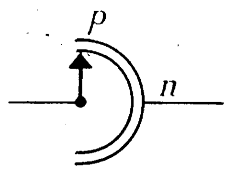
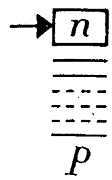
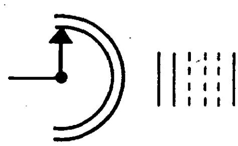
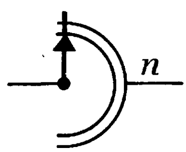
b) (concerns only the French text of the List.)

c) Replace symbols 371 to 377-8 (pages 138 to 140) by the following:

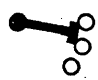
No.	Name	Symbol	Remarks
N 363	Selector, general symbol.		
N 364	Selector without home position, general symbol.		
N 365	Selector with home position, general symbol,		
N 366	Selector, hunter, without home position, free selection.		
N 367	Selector hunter with home position, free selection.		
N 368	Selector, without home position, controlled selection.		
N 369	Selector, with home position, controlled selection.		

No.	Name	Symbol	Remarks
N 370	Selector, without home position, controlled selection followed by a free selection.		
N 372	Selector, with home position, controlled selection followed by a free selection.		
N 373	Examples of application: Selector, hunter, without home position, free selection on a single level (simple form) (3 variants).	  	If useful in this or the following symbols " n " may represent the number of lines per level.
N 374	Selector, with home position, controlled selection with a single type of movement on several levels (simple form) (2 variants)	 	

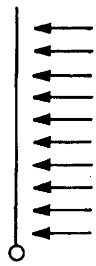
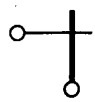
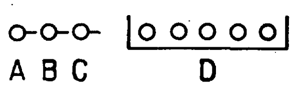
No.	Name	Symbol	Remarks
N 375	The same (detailed form)	 	The numbers 1, 2, 3... indicate the different levels; the numbers n^1, n^2, n^3... are the number of contacts of each level, the numbers c^1, c^2, c^3... are the total numbers of links to the grading.
N 376	Selector, hunter, without home position, free selection with two types of movement on several levels (simple form) (2 variants).	 	If useful in this and the following symbols " p " may represent the number of levels.
N 376-1	The same (detailed form) (2 variants)	 	

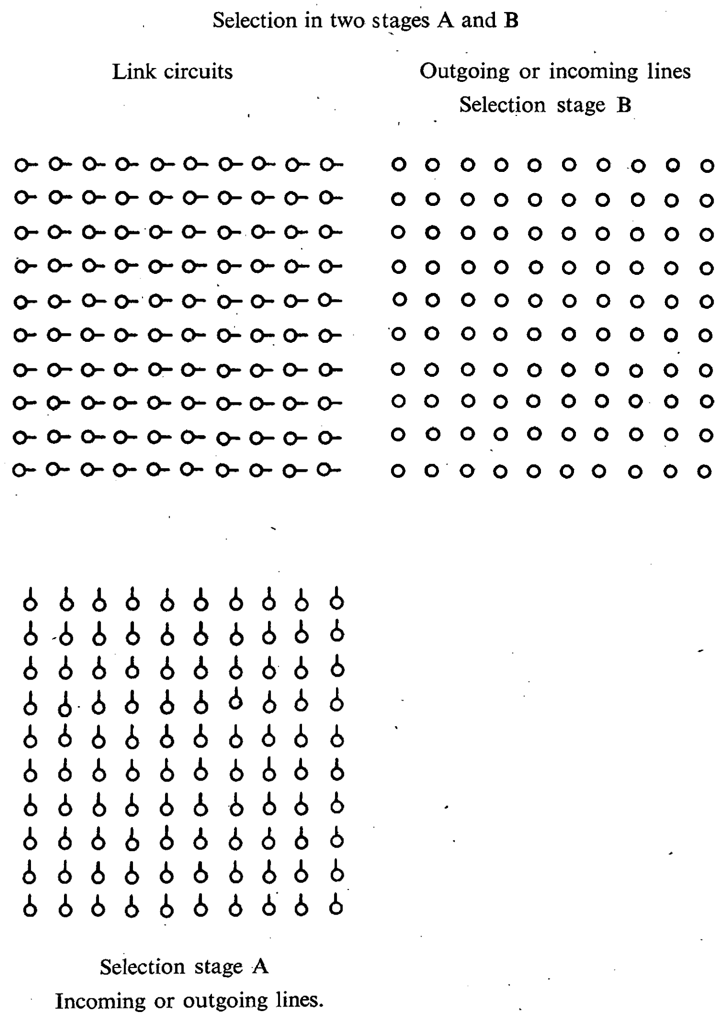
No.	Name	Symbol	Remarks
N 376-2	Selector with home position, controlled selection with two types of movement on several levels (simple form)		
N 376-3	The same (detailed form) (2 variants).	 	
N 376-4	Selector, with home position, controlled selection followed by a free selection with two types of movements on several levels.		

d) The symbols N 377-11 and N 377-12 should be replaced by:

 and  respectively

e) Between N 377-12 and 381 should be added:

No.	Name	Symbol	Remarks
N 378	Part of a crossbar selector		For functional diagrams
N 379	Crossbar selector or unit of a crossbar selector		For link diagrams
N 380	Circuit.		
N 380-1	Method of showing which circuits can be connected to a particular circuit		
N 380-2	Method of showing that all of the circuits A, B and C have access to circuits D		

No.	Name	Symbol
N 380-3	Selection in two stages A and B	

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LIST OF DELEGATES

TO THE XVIIth PLENARY ASSEMBLY OF THE C.C.I.F.

(GENEVA, OCTOBER 1954)

Afghanistan (Ministry of Communications) :

Mr. MOHAMMED HUSSEIN SCHOKOUR (Chairman, Telecommunications), Head of Delegation
Mr. AZIM GRAN (Director-General, Telecommunications).

Federal German Republic (Administration of Posts and Telecommunications) :

Mr. H. BORNEMANN (Ministerialrat), Head of Delegation.
Dr. H. DÜLL (Abteilungspräsident)
Mr. K. WENZLAU (Oberpostdirektor).

Australia (Postmaster General's Department) :

Mr. R. V. MCKAY, Head of Delegation.
Mr. A.W. MCPHERSON.

Austria (Administration of Posts, Telegraphs and Telephones) :

Mr. N. WENINGER, Head of Section, Head of Delegation.
Dr. M. KRASSER (Ministerial Counsellor).
Dr. H. SCHMID (Counsellor).

Belgium (Department of Telegraphs and Telephones) :

Mr. HAEMERS (Chief engineer, Director general), Head of Delegation.
Mr. LAMBIOTTE (Chief engineer), Director of Administration.

People's Republic of Bulgaria:

Mr. N. R. BELOPITOV.

Canada:

(Telephone Association of Canada) :
Mr. G.A. CALDWELL, Head of Delegation, General Engineer.

(British Columbia Telephone Company) :
Mr. R. L. A. VINCE.

Ceylon (Department of Posts and Telecommunications) :

Mr. C.A.R. ANKETELL (Superintending Telecommunication Engineer).

Chile (Chile Telephone Company) :

Mr. L. C. POCOCK, Head of Delegation.
Mr. E. P. G. WRIGHT (Chief Engineer).

China (Telephone Administration) :

Mr. HIONG-FEI TCHEN.

Colombia:

Mr. CARLOS SCHROÈDER GARZON, Head of Delegation
Mr. HELMUTH SCHROEDER GARZON.

Cuba (Cuban Telephone Company) :

Mr. VAN HASSELT.

Denmark (Telephone Administration) :

Mr. GUNNAR PEDERSEN, Head of Delegation.
Mr. K. J. A. LOMHOLDT.
Mr. H. LAURSEN.
Mr. H. L. HALSTRÖM.

Spain:

Mr. J. M. CLARA, Head of Delegation.
Mr. J. M. PARDO (Engineer, Posts and Telecommunications Headquarters).
Mr. E. DEL RIEGO (Assistant Director of Traffic, Compañía Telefónica Nacional de España).
Mr. J. M. REBOLLO (Engineer, Compañía Telefónica Nacional de España).
Mr. R. MORENO (Engineer, Compañía Telefónica Nacional de España).

United States of America (American Telephone and Telegraph Company) :

Mr. H. R. HUNTLEY (Transmission Engineer).

Finland (Administration of Posts, Telegraphs and Telephones) :

Mr. H. JUSELIUS (Director of P.T.T.).

France (Administration of Posts, Telegraphs and Telephones) :

Mr. ROUVIÈRE (Director General of Telecommunications), Head of Delegation.
Mr. MARZIN (Director, National Telecommunication Research Centre), Deputy Head of Delegation).
Mr. COLLET (General Engineer, National Telecommunication Research Centre).
Mr. CHOVET (General Engineer, Telecommunication Headquarters).
Mr. LEPRINCE RINGUET (Director, Long-distance underground lines).
Mr. SUEUR (Chief engineer, National Telecommunication Research Centre).
Mr. TERRAS (Administrator, Telecommunication Headquarters).
Mr. GASTEBOIS (Director, Algerian P.T.T.).

Radio Orient :

Mr. A. ROPER.

Hungarian People's Republic:

Mr. G. RÉVESZ (Head, International Department).

India :

Mr. H. N. SHRIVASTAVA (Additional chief engineer, Posts and Telegraphs), Head of Delegation.
Mr. C. P. VASUDEVAN (Deputy Chief Engineer, Maintenance).
Mr. H. MUKERJEE (Director of Administration, Overseas Communication Service).
Mr. GADADHAR (Assistant Wireless Adviser, Ministry of Communications).

Ireland (Department of Posts and Telegraphs) :

Mr. B. O. MONGAIN (Engineer-in-Chief), Head of Delegation.
Mr. A. J. LITTON (Assistant Engineer-in-Chief).
Mr. W. DAIN (Staff Engineer, Transmission and Main Lines Section).

Italy (Azienda di stato per i servizi telefonici) :

Prof. F. CALVANESE (Head of Delegation).
Grand Officer G. GNEME (Administrative Councillor).
Dr. C. ALBANESE.
Dr. M. FARIELLO.
Dr. E. SACCO.
Dr. A. DANI.
Prof. F. LUCANTONIO.
Dr. G. VERLICCHI.
Dr. F. MESCHINO.
Dr. A. ASCIONE.
Mr. D. ACHILLI.

Japan:

(Ministry of Postal Services) :

Mr. SHINJI SHOJI (Controller of Telecommunications), Head of Delegation.

(Nippon Telegraph and Telephone Public Corporation) :

Dr. S. KOJIMA.

(Kokusai Denshin Denwa Co.) :

Mr. Y. TSURUOKA.

Lebanon (Telephone Administration) :

Mr. E. STOCKER (Engineer, expert in the Telephone Administration).

Luxembourg (Administration of Posts, Telegraphs and Telephones) :

Dr. E. RAUS (Director General, P.T.T.), Head of Delegation.
Mr. C. KNAF (Department Head, Telecommunication Section).

Mexico (Sociedad Teléfonos de México) :

Dr. M. VOS, Head of Delegation.
Mr. F. MARKMAN (Engineer).
Mr. C. G. MÅNSSON (Engineer).

Norway (Telecommunication Headquarters) :

Mr. LEIF LARSEN (Director of Traffic), Head of Delegation.
Mr. O. NYSTOG (Chief Engineer).

Pakistan:

Mr. N. MIRZA.

Netherlands (Administration of Posts, Telegraphs and Telephones) :

Mr. A.J. EHNLE (Senior Director, General Affairs and Radio), Head of Delegation.
Mr. R. P. VAN DIJK (Inspector, Special Services).
Mr. H. L. VAN LOMMEL (Engineer-in-Chief, Special Services).
Mr. T. PERRY (Inspector, Special Services).
Mr. J. T. VISSER (Engineer-in-Chief, General Services).
Mr. W. C. DE WRIES (Engineer-in-Chief, General Services).

People's Republic of Poland (Ministry of Posts and Telegraphs) :

Mr. Z. SZPIGLER (Director General), Head of Delegation.
Mr. U. DIETRICH (Department Vice-Director).
Mr. B. LISOWSKI (Adviser, Ministry of Posts and Telegraphs).
Mr. B. JARKOWSKI (Chief Engineer).

Roumanian People's Republic (Ministry of Posts and Telecommunications) :

Mr. B. POSTELNICU (Engineer), Head of Delegation.
Mr. M. GRIGORE.

United Kingdom of Great Britain and Northern Ireland (General Post Office) :

Mr. R. J. P. HARVEY (Director, Radio and Accommodation), Head of Delegation.
Mr. D. BARRON (Assistant Engineer-in-Chief).
Mr. S.A. MANSER (Deputy Director, External Telecommunications Executive).
Mr. E. A. PETCHE (Senior inspector, Operations Branch, External Telecommunications Executive).
Mr. B. T. PHILPOTT (Head of Branch, Accountant general's department).
Mr. R. H. FRANKLIN (Staff Engineer, Main Lines Branch, Engineering Department).

Sweden (Royal Board of Swedish Telecommunications) :

Mr. S. R. NORDSTRÖM (Chief Engineer), Head of Delegation.
Mr. G. SVEDHEM (Director of Operations).

Switzerland (Administration of Posts, Telegraphs and Telephones):

Mr. A. WETTSTEIN (Engineer, Director, Telephone Division), Head of Delegation.
Mr. A. LANGENBERGER (Engineer, Head of Telephone Services), Deputy Head of Delegation.
Prof. W. FURRER (Engineer, Head of the Research Institute).
Mr. C. LANCOUD (Head of Lines, T.T. Division).
Mr. F. LOCHER (Engineer, Technical Assistant, T.T. Division).
Mr. A. KASPER (Engineer, Head of the Audio-Frequency Section, Research Institute).
Mr. MUNZ (Head, Traffic and Tariffs Section, Telephone Division).
Mr. H. JACOT (Engineer, Head of the Amplifier and Transmission Section, Telephone Division).
Mr. C. SCHENK (Head of the Operations Section, Telephone Division).
Mr. H. KÖLLIKER (Head of the Protection Section, Line Department).

Czechoslovakia (Administration of Posts, Telegraphs and Telephones) :

Mr. F. KROUTL (Engineer, Head of Division).
Mr. K. BOHAC (Head of Section).
Mr. BOHUSLAV SIMEK (Engineer-in-Chief).
Dr. J. MERHAUT.

U.S.S.R. (Ministry of Postal and Electrical Communications) :

Mr. P. AFANASSIEV (Director of Department), Head of Delegation.
Mr. P. MICHAÏLOV.
Mr. S. VASILIEV.
Mr. N. AKINFIEV.
Mr. G. BORODZIOUK.
Mr. V. FEDOROVITCH.
Mr. O. DOBROVOLSKI-DOLIVO.
Mr. B. IASTREBOV.
Mrs. V. BESCHEKOVA.

Federal People's Republic of Yugoslavia (Headquarters, Posts, Telegraphs and Telephones) :

Dr. R. PETROVIĆ (Engineer), Head of Delegation.
Mr. B. LUKIĆ.

International Telecommunication Union :

Dr. M. A. ANDRADA (Secretary-General).
Mr. H. TOWNSHEND (Assistant Secretary-General).

International Telegraph Consultative Committee (C.C.I.T.) :

Mr. H. TOWNSHEND (Interim Director).
Mr. J. M. BESSEYRE (Senior Counsellor).

International Radio Consultative Committee (C.C.I.R.) :

Dr. B. VAN DER POL (Director).
Mr. L. W. HAYES (Vice-Director).
Mr. J. VAN DER MARK (Counsellor).

European Broadcasting Union (E.B.U.) :

Mr. Y. ANGEL.

C.C.I.F. Secretariat :

Mr. G. VALENSI (Director C.C.I.F.).
Mr. J. LALOU (Counsellor).
Mr. R. CHAPUIS (Engineer).

MINUTES

OF THE MEETINGS OF THE XVIIth PLENARY ASSEMBLY

(GENEVA, 4-12 OCTOBER 1954)

MINUTES

OF THE FIRST MEETING OF THE HEADS OF DELEGATIONS

(Geneva, 4 October 1954)

approved by the Plenary Assembly

The Heads of Delegations to the XVIIth Plenary Assembly of the C.C.I.F. met at Geneva (Maison des Congrès) at 10 o'clock on Monday, 4th October 1954, under the Chairmanship of Mr. WETTSTEIN (Switzerland).

Mr. WETTSTEIN welcomed the Heads of Delegations.

Draft programme for the meetings of the Plenary Assembly

The Director of the C.C.I.F. said that an agreement had already been reached during the course of the Study Group meetings concerning a choice of signalling system and this question was therefore likely to take less time than had been envisaged in the draft time-table which had been sent out with the invitations to the Plenary Assembly.

On the other hand, it would be desirable to reserve, in the time-table for the meetings of the Plenary Assembly itself, sufficient time for the treatment of important organizational questions, particularly :

1. Examination of reports on the activities of the C.C.I.F. ;
2. Possible fusion of the C.C.I.F. and C.C.I.T. ;
3. New organization of the C.C.I.F. Study Groups ;
4. Nomination of the future Director of the C.C.I.F.

Taking account of these considerations, the Meeting of Heads of Delegations proposed for adoption by the Plenary Assembly the draft time-table, which with the modifications of detail introduced by the Plenary Assembly, appears as an Annex of the present minutes.

It is emphasized that the General Programme of Interconnection, in conformity with the decision taken by the Administrative Council of the I.T.U., is now a common work of the three C.C.I.'s and has not to be submitted for the approval of the C.C.I.F. Plenary Assembly. Nevertheless, this Programme will be presented for information during the second meeting for Operating and Tariffs.

If the number of questions to be treated so requires, a meeting could be held on Tuesday, 12th October in order to deal with the question of Organization ; and the closing session could be deferred to Wednesday, 13th October.

Modifications to be carried into texts relating to the organization of the C.C.I.F.

(Yellow Book, *Volume I* ter, *Florence, 1951, pages 87 to 108)*

A. *Extracts from the International Telecommunication Convention and from the annexed Regulations.*

It is desirable to replace the extracts from the International Telecommunication of Atlantic City, 1947 and from the annexed General Regulations, which now appear on pages 87 to 97 of Volume *I* ter of the *Yellow Book*, by texts brought up-to-date in conformity with the International Telecommunication Convention of Buenos Aires, 1952, and from the corresponding General Regulations. The up-to-date texts are given in pages 91 to 103 of the present publication. It is recalled that the more important changes are the following :

(a) The *normal* interval between two successive meetings of the Plenary Assembly should be three years (in place of two years) ; it is not obligatory to have a Plenary Assembly of the C.C.I.F. a year in advance of the meeting of the International Telegraph and Telephone Conference ; whenever possible the Plenary Assembly should be held at Geneva.

(b) The Directors of the three C.C.I.'s and the Vice-Director of the C.C.I.R. must all be nationals of different countries, in order to distribute the posts geographically amongst the Member or Associate Member countries of the Union.

(c) The Telephone Administrations of all countries which are Members or Associate Members of the Union are *of right* Members of the C.C.I.F. ; it is the same for the Private Operating Companies, subject to the approval of the " recognized " authorities. Article 13 of the Buenos Aires Convention and Chapter 20 of the annexed General Regulations, specify in what conditions participation in the work of the C.C.I.F. involves participation in the extraordinary expenses of the C.C.I.F.

(d) The role of the Plenary Assembly has been better stated in Chapter 12 (of the Buenos Aires General Regulations) than in Chapter 9 (of the Atlantic City General Regulations). The Plenary Assembly should designate by name, for each Study Group the Group Chairman who will preside, and also a " deputy Group Chairman " who will assume the duties of Chairman if, in the interval between two meetings of the Plenary Assembly, the " Group Chairman " cannot function.

(e) Chapter 17 (of the Buenos Aires General Regulations) defines better than Chapter 14 (of the Atlantic City General Regulations) the respective duties of the C.C.I.F. Plenary Assembly and of the Administrative Council of the Union in respect of financial matters. In comparison with Chapter 17 (of the Atlantic City General Regulations), Chapter 20 (of the Buenos Aires General Regulations) contains greater clarification concerning the extraordinary expenses of a C.C.I. Firstly the accounting period corresponds to the time between the end of a Plenary Assembly and the end of the next following Plenary Assembly, and this period is *indivisible.*

A formal declaration of participation in the extraordinary expenses is not required of Administrations, but notification of a wish to participate in the work of the C.C.I.F., or effective participation in a meeting of a Study Group of a Plenary Assembly, entails for an Administration its participation in the C.C.I.F. extraordinary expenses for the whole of the period specified (from one Plenary Assembly to the next). In future there will be a provisional account of the annual extraordinary expenses of the C.C.I.F., which will be communicated to those interested by the General Secretariat of the Union.

B. *C.C.I.F. Recommendation completing the provisions of the Convention and the General Regulations.*

After having examined the proposals from the meeting of the Heads of Delegations, the C.C.I.F. XVIIth Plenary Assembly approves the text which, taking account of the provisions of the International Telecommunication Convention of Buenos Aires, 1952, and the attached General Regulations, appears on pages 103 to 107 of this publication and replaces the recommendations now appearing on pages 98 to 102 of Volume I*ter* of the *Yellow Book* (Florence, 1951).

Moreover, the Plenary Assembly decided to carry the following modifications into the text which appears on pages 102 to 105 of Volume I*ter* of the *Yellow Book* (Florence 1951).

The C.C.I.F. Recommendations entitled " Expenses incurred by meetings of C.C.I.F. Study Groups " and " Sharing in the extraordinary expenses of the C.C.I.F. " (pages 102 and 103 of Volume I*ter* of the *Yellow Book*) are deleted because this question is completely resolved by Article 13 of the Interntional Telecommunication Convention of Buenos Aires, 1952, and by Chapter 20 of the General Regulations annexed to the said Convention.

The Recommendation entitled " Technical collaboration between the C.C.I.F. and International Technical Organizations dealing with questions which could be of interest to international telephony " (page 104 of Volume I of the *Yellow Book*) is the text appearing on page 108 of this publication.

The C.C.I.F. Recommendation entitled " Committee for liaison between the various International Organizations concerned with questions relating to electricity " (pages 104 and 105 of volume I*ter* of the *Yellow Book*) is deleted because, in fact, this " Liaison Committee " which functioned before 1939 on the initiative of the International Electrotechnical Commission, has not met since 1946.

Finally, the C.C.I.F. reçommendation entitled " System of units " (page 105 of Volume I*ter* of the *Yellow Book*) is placed among the technical recommendations of the C.C.I.F. and not in the part entitled " Organization of the C.C.I.F. ".

Budget Committee

The Budget Committee is constituted as follows :

Chairman : Mr. RAUS (Luxembourg)

Afghanistan	Mr. AZIM GRAN
Spain	Mr. CLARA CORELLANO
France	Mr. TERRAS
India	Mr. GADADHAR
Italy	Mr. SACCO
Federal Republic of Germany	Mr. WENZLAU
United Kingdom of Great Britain and Northern Ireland	Mr. B. T. PHILPOTT
Switzerland	Mr. LANGENBERGER
I.T.U. General Secretariat	Mr. H. TOWNSHEND assisted by Mr. PRÉLAZ

This Committee met on Wednesday 6th of October at 3 p.m. with the following programme :

1. Examination of the expenses of the Plenary Assembly itself.
2. Examination of the estimated expenses for the C.C.I.F. until the next Plenary Assembly.
3. Arrangements to be made for the sharing of expenses.

Report on the activities of the C.C.I.F. from 1952 to 1954

The meeting of the Heads of Delegations proposes that the Plenary Assembly approves this report. Annex 1, in respect of which account should be taken of the corrigendum which has been distributed, should also be sent to the Budget Committee in order to enable them to study the sharing of the extraordinary expenses.

Report on the financial needs of the C.C.I.F.
until the XVIIIth Plenary Assembly

After a general examination of this report, the meeting of the Heads of Delegation entrusted its detailed examination to the Budget Committee which would make a report on the subject during a later session.

Possible fusion of the C.C.I.F. with the C.C.I.T.

The existing documentation on this subject comprises :

1. The document entitled " Possible fusion of the C.C.I.T. and the C.C.I.F. ".
2. The 1st series of comments concerning the possible fusion of the C.C.I.T. and the C.C.I.F.
3. The draft recommendation proposed by the U.S.S.R. Delegation which constitutes document " C.C.I.F. — XVIIth Plenary Assembly — Document No. 1 ".

The meeting of the Heads of Delegation proposed that this question should be dealt with by the Plenary Assembly during the session on Tuesday the 6th October, at 3 p.m., which would be devoted to organisational questions.

Extension of the term of office of the present Director of the C.C.I.F.

The meeting of the Heads of Delegation asked the Chairman to present to the Plenary Assembly with the unanimous approval of this meeting, the proposal of the Swiss Telephone Administration in favour of prolonging the term of office of Mr. Valensi, the present Director.

The meeting closed at 6.30 p.m.

ANNEX

Time-Table for the sessions of the XVIIth C.C.I.F. Plenary Assembly

(Geneva, October 1954, Maison des Congrès, Room B)

Tuesday, 5th October 1954	1000—1200	Opening meeting
	1500—1830	Organizational questions (1st meeting)
Wednesday, 6th October 1954	1000—1200	Operations and Tariffs (1st meeting)
	1500—1830	Transmission (1st meeting)
Thursday, 7th October 1954	0930—1200	Meeting devoted to choice of a signalling system and to signalling and switching questions
	1500—1900	Operations and Tariffs (2nd meeting)
Friday, 8th October 1954	1000—1200	Protection
	1500—1800	Transmission (2nd meeting)
Saturday, 9th October 1954	1000—1200	Organizational questions (2nd meeting)
	1500—1800	Organizational questions (3rd meeting)
Monday, 11th October 1954	0930—1030	Vocabulary and symbols
	1130—1230	Organizational questions (4th meeting)
	1500—1830	Meeting of Heads of Delegations to prepare a draft showing membership of C.C.I.F. Study Groups, 1955 and 1956
Tuesday, 12th October 1954	1000—1200	Closing meeting

MINUTES
OF THE OPENING SESSION
OF THE XVIIth PLENARY ASSEMBLY OF THE C.C.I.F.

(Geneva, 5 October 1954)

The session opened at Geneva, Maison des Congrès, on 5 October 1954, at 10 o'clock.

Mr. ANDRADA, Secretary-General of the I.T.U., welcomed the Delegates of the Administrations and the Representatives of the recognized Private Operating Agencies taking part in the XVIIth Plenary Assembly of the C.C.I.F. He assured them that the Secretary-General of the Union desired to put at their disposal all his available resources to facilitate their heavy task. He wished them complete success in their work. *(Vigorous applause.)*

Mr. Valensi, Director of the C.C.I.F., announced that the Meeting of the Heads of Delegations proposed to designate Mr. Wettstein (Switzerland) as Chairman of the XVIIth C.C.I.F. Plenary Assembly ; he would be aided by the Vice-Presidents indicated below, who would take the chair at certain sessions of the Assembly :

Mr. Mirza (Pakistan), for sessions devoted to questions dealing with organisation ;
Mr. Harvey (United Kingdom), for sessions devoted to operating and tariffs ;
Mr. Rouvière (France), for the meeting devoted to the choice of a signalling system and to questions concerning signalling and switching ;
Mr. G. Pedersen (Denmark), for the sessions on transmission ;
Mr. Afanassiev (U.S.S.R.), for sessions dealing with protection ;
Mr. Albanese (Italy), for the session devoted to the vocabulary and symbols.

This proposition was adopted with applause.

Mr. Wettstein took the chair and made the following speech :

" Mr. Secretary-General, Ladies and Gentlemen,

" An unwritten rule requires that a national of the host country be designated as chairman of the C.C.I.F. Plenary Assembly. This honour fell to Switzerland at Montreux, in 1946, during the XIVth Plenary Assembly of our organisation. This well-founded tradition has just been lost, since a great change has taken place since 1952. As you know, the last Plenipotentiary Conference of the International Telecommunication Union has redrafted the General Regulations appended to the International Telecommunication Convention. In Chapter 13, it is laid down that, as far as possible, the Plenary Assembly of the C.C.I.F. shall meet at the headquarters of the Union.

" This new provision of the General Regulation causes me to appreciate even more the honour you do me in appointing me as Chairman of this XVIIth Plenary Assembly, an honour which I owe to my country. I thank you for the confidence that you have shown in me.

" Ladies and Gentlemen,

In taking my place as Chairman, I would like, in the name of the Swiss P.T.T., to wish you a very cordial welcome to Geneva. May this autumn weather, unfortunately rather early, still offer you some fine days that will allow you to enjoy as pleasurably as possible the few moments of leisure that our frequent and long discussions may leave you. Let us hope that the sun will not hide itself too much and that it will warm us as often as possible and invite you to admire the beautiful Genevese surroundings, this corner of the Lake which was the centre of attention of the whole world during the last Asiatic Conference, this beautiful Jura, these majestic Alps and particularly the imposing Mont-Blanc which, with its 4810 metres is the highest peak in Europe and belongs to our great and friendly neighbour, France.

" Ladies and Gentlemen, you have already seen the long list of work that we have to undertake and deal with between now and 12 October next. You will agree with me that this programme is extremely heavy. To bring it to a successful conclusion, I shall be assisted by the five Vice-Chairmen that you have just elected with applause.

" In advance, I would like to thank these Gentlemen for their valuable collaboration.

" In wishing entire success to the work of the XVIth Plenary Assembly, I would like to express to you all, Ladies and Gentlemen, my profound gratitude for your esteemed and distinguished cooperation in our work for the greater well-being of international telephony, a powerful instrument and a bond of agreement and understanding between peoples. " *(Loud applause.)*

Mr. Valensi read the list of the those having taken part in the work of the C.C.I.F. and who had died since the XVIth Plenary Assembly at Firenze, 1951 :

Mr. Henry, Director General of the Belgian Telegraph and Telephone Administration,
Mr. Verlooy, who had taken part in the work of the C.C.I.F. as an Expert in the Netherlands Delegation,
Professor Baev, of the U.S.S.R. Administration,
Mr. D. Popović, former Director of the Telegraph and Telephone Division of the Jugoslavian Administration,
Mr. de la Chevrelière, of the Société Radio-Orient.

All the delegates rose and stood for a minute in silence, in memory of their deceased colleagues.

Mr. Valensi then read the list of persons, having taken part in the work of the C.C.I.F., who had retired since the XVIth Plenary Assembly :

Messrs. Stauber (Austria),
Dehard (Belgium).
Parfondry (Belgium),
Van Mierlo (Cuban Telephone Company),
R.E. Smith (Cuban Telephone Company),
Holmblad (Denmark), Chairman of the 8th Study Group of the C.C.I.F.
J.W. O'Neill (Ireland), Engineer in Chief of the Irish Administration,
Bevacqua (Italy),
Neher (The Netherlands), Director General of the Netherlands P.T.T.
Möckli (Switzerland), Director of the Telephone and Telegraph Division of Switzerland who was in the C.C.I.F. from its beginning and who, for a long time directed the work of the 6th Study Group.

It was decided to send them, by telegram, cordial greetings from their colleagues present at the XVIIth Plenary Assembly of the C.C.I.F.

* * *

The draft minutes of the first meeting of the Heads of Delegations (4 October 1954) was approved with several modifications.

It was mentioned that the documents to be examined during the meetings devoted to questions dealing with organisation were the following :

" XVIIth Plenary Assembly of the C.C.I.F., Geneva 1954 — Report on the activities of the C.C.I.F. from 1952 to 1954 ".

" XVIIth Plenary Assembly of the C.C.I.F. — Geneva 1954 — Decision of the Administrative Council of the I.T.U. concerning the General Programme of Interconnection — Observations concerning the work of the various Study Groups of the C.C.I.F. ".

" Possible amalgamation of the C.C.I.T. and the C.C.I.F. ".

" Meeting of the Heads of Delegations — First series of observations concerning the possible amalgamation of the C.C.I.T. and the C.C.I.F. ".

Furthermore, the questions to be dealt with during these meetings were as follows :

1. Examination of the report on the activities of the C.C.I.F.
2. Possible amalgamation of the C.C.I.T. and the C.C.I.F.
3. Responsibilities of the various Study Groups of the C.C.I.F.
4. Procedure to be followed for the election of a new Director of the C.C.I.F.

A discussion took place on the publication of the printed works of the C.C.I.F. after the XVIIth Plenary Assembly. Mr. VALENSI pointed out that the Committee which was at present sitting to establish the general plan of these works was only concerned with the work intended to replace the *Yellow Book* and, to a certain extent, the *Directives* or *Recommendations* concerning protection. The report of this Committee will be examined at the second meeting of the Heads of Delegations and at the closing meeting of the Plenary Assembly. The " General Programme of Interconnection 1954/1958 " will include two parts : the first, which contains information on existing or planned telecommunication networks, is the work of a special Committee comprising, in addition to delegates of sovereign Administrations, specialists from the C.C.I.F., the C.C.I.T. and the C.C.I.R. ; it will not be submitted to the Assembly for approval but only for examination. The second part, which should comprise summaries of C.C.I.F. Recommendations, should be established by a " Working Party " after the end of the Plenary Assembly, taking into account the modifications which will have been introduced into these Recommendations.

* * *

The following declarations were made before the Plenary Assembly :

Declaration of the Delegation of the U.S.S.R.

" In view of the presence of the Representative of the Kuomitang in the Plenary Assembly now sitting, the delegation of the U.S.S.R. declares, in the name of its Administration :

" The representative of the Kuomintang cannot represent China since it is only the delegates of the People's Government of the Chinese People's Republic which have the legal right to represent China.

" The Chinese People's includes more than a quarter of the population of the whole world, it controls telecommunications in the interior of the country as well as outside it for the maintenance of political, cultural, commercial and other links with many countries. The situation where representatives of the Chinese People's Republic are not admitted to take part in the work of organisms of the I.T.U. is irregular and in contradiction to the essential aim of the Union which is to extend the scope of international collaboration in the field of telecommunications.

" Furthermore, in the name of its Administration, the delegation of the U.S.S.R. draws the attention of members of the Plenary Assembly to the fact that the German Democratic Republic adhering to the International Telecommunication Convention and, consequently, being a member of the I.T.U., finds itself systematically prevented from participating in the work of telecommunication bodies, which is illegal and runs counter to the essential aim of the I.T.U. directed toward the extension of international collaboration in the field of telecommunications.

" The representatives of Western Germany cannot represent the whole of Germany, and this is why their presence and the absence of representatives of the German Democratic Republic during the work of the Plenary Assembly is illegal.

" The German Democratic Republic is situated in the centre of Europe, it has communications with a large number of countries, the recent work of C.C.I.F. Study Groups has shown the necessity for communications with the German Democratic Republic is increasing and that the practical necessity obliges us to take account of the abilities of the German Democratic Republic in the matter of maintaining normal relations between countries.

"I ask you to include this declaration in the minutes of the Plenary Assembly."

Declaration of the Czechoslovakian Delegation to the XVIIth Plenary Assembly of the C.C.I.F.

" The Czechoslovakian delegation notices with considerable regret that China, a great country of the world, including 600 million inhabitants, Member country of the I.T.U., is not represented at the XVIIth Plenary Assembly of the C.C.I.F. The person who pretends to represent China has not the right to represent it since the legal representatives of China must be accredited by the central government of the People's Republic of China.

" Regarding the representation of Germany, I allow myself to draw the attention of delegates to the minutes of the various Study Groups which met at Geneva previous to this Plenary Assembly, where the point of view of the Czechoslovakian Administration was put forward ".

Declaration of the Polish Delegation

" In view of the absence of representatives of the German Democratic Republic and of the Chinese People's Republic at the XVIIth Plenary Assembly of C.C.I.F., the Polish Delegation on behalf on their Administration makes the following statement :

" The Polish Administration is convinced that the absence of the above mentioned representatives undoubtedly reacts deleteriously on the interests of the C.C.I.F. itself and on its work in connection with the development of international cooperation in the field of telecommunications.

" Many telecommunication lines of great international importance to our own and other countries cross the territory of the German Democratic Republic. Moreover, the progress which has taken placein the field of telecommunications in the German Democratic Republic and their great experience in this field, should be utilised by the C.C.I.F. for the mutual advantage of us all.

" The C.C.I.F. cannot complete its work unless representatives of such a great country as the Chinese People's Republic take part in our common task.

" The Polish Delegation is convinced that this problem will be solved in the near future and that representatives of these two countries will be invited to take part in the work of C.C.I.F.

" It is quite clear that the representatives of the German Federal Republic and those of Kuomintang cannot be considered as the representatives of the whole of Germany, nor of China ".

Declaration of the Roumanian Peoples Republic concerning the representation of Germany

" The delegation of the Roumanian People's Republic supports the declaration of the U.S.S.R. Delegation, concerning the representation of Germany, considering that the German Democratic Republic, which has duly adhered to the Telecommunication Convention, should be considered as a member of the I.T.U. and that, in consequence, the fact of inviting participation in the work of the C.C.I.F. by representatives of the German Federal Republic—who cannot represent the whole of Germany—without, at the same time, inviting representatives of the German Democratic Republic, is illegal and prejudicial to international collaboration in the domain of telecommunications ".

Declaration of the Roumanian Peoples Republic concerning the representation of China

" The Delegation of the Roumanian People's Republic considers the presence of the Kuomintang representative as illegal, since he does not in reality represent China and that the only legitimate representatives of China are those nominated by the Central People's Government of the Chinese People's Republic, this latter being furthermore, the only authority having the possibility of applying the recommendations of the C.C.I.F. throughout the immense territory of China ".

Declaration of the Hungarian Delegation

" Mr. Chairman,

" In the name of the Administration of the Hungarian People's Republic I must declare that the presence of the persons pretending to represent China is illegal.

" It is quite clear that only Representatives nominated by the Central Government of the Popular Republic of China can and ought legally to take part in our work, since that they only have the possibility of engaging themselves in the interest of telecommunications of taking decisions and above all of assuming responsibility towards the Union and the Administrations.

" It is for this reason that my Administration requests that the Plenary Assembly takes the necessary steps so that the real representatives of China may participate in the work of the C.C.I.F.

" Furthermore, since the German Democratic Republic is Member by full right of the Union and in spite of this, has not been invited to this conference, my Administration does not recognize the representatives of the authorities of Bonn, as representatives of the whole of Germany ".

Declaration of the Bulgarian Peoples Republic

" The delegation of the Bulgarian Republic asks the Chairman of the XVIIth Plenary Assembly of the C.C.I.F. that the following declaration be appended to the minutes of the 1st meeting of this Assembly and asks that the text be included in the final report.

" The Delegation of the Administration of the Bulgarian People's Republic supports the declarations made by the Delegations of the U.S.S.R., Czechoslovakia, Poland, Hungary and Roumania.

" The Delegation of the Bulgarian People's Republic considers that the People's Republic of China should take part in the work of the organs of the I.T.U. since this country represents a third of the population of the world and that it should not be forgotten that the essential aim of the I.T.U. is to further international collaboration in the field of telecommunications.

" Furthermore, the Bulgarian delegation regrets the absence of representatives of the German Democratic Republic since the representatives of the German Federal Republic do not represent the whole of Germany ".

At the end of these declarations, Mr. Tchen Hiong Fei, Head of the Chinese Delegation, made the following declaration :

" The Delegation of the Chinese Republic considers that it in no way enhances the prestige of a C.C.I.F. Plenary Assembly to arrange for the appearance in the minutes of its meetings, declarations which are outside the scope of its jurisdiction. The International Telecommunication Convention of Buenos Aires 1952, as that of Atlantic City 1947, of which the Government of the Chinese Republic is itself signatory, has well defined the prerogatives of the C.C.I.F. and the role of its Plenary Assemblies. However, sharing in the general feeling, which is also its own, not to bear unduly on a point of order which is essentially and evidently political, it wishes to declare formally that :

" 1. The C.C.I.F., as the whole of the I.T.U., has not to acknowledge any political party of any Member country or associate Member of the Union. In fact, the Kuomintang which means the People's Party, is the most important political party entering into the composition of the Chinese Government. The delegation of the Chinese Government represents the Chinese Telecommunication Administration ;

" 2. The Delegation of the Chinese Republic present at this Plenary Assembly is the only legitimate representation of China to take part in its work. Only the Government of the Chinese Republic which, by the way, is legally represented in the various organisms of the I.T.U., is competent to nominate representatives of China to all the meetings and conferences of the Union and its organisms ".

Remarking, on the one hand, that he was speaking at this first session of the Plenary Assembly, which was still in its opening period, the Head of the Chinese Delegation expressed his entire satisfaction and his gratitude to the Director of the C.C.I.F. and his assistants for the sound preparation for the meeting of the Plenary Assembly, the first to be held at the headquarters of the Union and paid hommage to those who had actively taken part in the important work of the various Study Groups, which had already been accomplished.

The meeting was adjourned at 12.30 hours.

MINUTES
OF THE FIRST MEETING DEVOTED
TO QUESTIONS OF ORGANISATION

(Genèva, 5 october 1954, afternoon)

The meeting opened at 3 o'clock under the chairmanship of Mr. MIRZA (Pakistan).

I. Approval of the report on activities presented by the Director the C.C.I.F.

The Plenary Assembly, in conformity with the proposal made to it by the meeting of the Heads of Delegations, took note with approbation of the " Report on the activities of the C.C.I.F. from 1952 to 1954 " presented by the Director of the C.C.I.F.

On the proposition of the Delegate of the UNITED KINGDOM, the Plenary Assembly decided with acclamation, to insert in the Minutes of this meeting a unanimous expression of appreciation of the effective contribution to the work of the C.C.I.F., which had been made over many years by Miss Félix, Administrative Secretary in the C.C.I.F. (who will retire on the 31st December 1954).

II. Possible fusion of the C.C.I.T. and C.C.I.F.

The documents forming a basis of discussion are :

" XVIIth C.C.I.F. Plenary Assembly — Geneva 1954 — Possible fusion of the C.C.I.T. and the C.C.I.F. ",

" XVIIth Plenary Assembly — Geneva 1954 — First series of comments concerning the possible fusion of the C.C.I.T. and the C.C.I.F. ",

XVIIth C.C.I.F. Plenary Assembly — Geneva 1954 — Document No. 1 " — Draft Recommendation proposed by the U.S.S.R. Delegation ".

The CHAIRMAN recalled that this question was the subject of long discussion during the Plenipotentiary Conference of Buenos Aires 1952 and during the VIIth C.C.I.T. Plenary Assembly at Arnhem in 1953.

It was now to be ascertained if the C.C.I.F. Plenary Assembly was in favour of a fusion of the C.C.I.F. and the C.C.I.T. and, in the event of the Plenary Assembly being in favour of fusion, to examine in what conditions it should be brought about.

The following exchange of views took place.

The Delegate of BELGIUM considered that, before ascertaining whether a majority would decide for or against, it would be useful to define a formula which would be acceptable to those in favour of fusion and which would be likely to meet with a large measure of agreement.

He thought that this might consist of a unified C.C.I. in which would be envisaged :

1. Three categories of Study Groups entrusted with the study of questions
   (a) purely telephone
   (b) of common interest to telephony and telegraphy
   (c) purely telegraph ;
2. A common Secretariat
3. A common Plenary Assembly the meetings of which could take place in three successive phases :
   (a) a first phase for the examination of purely telephone questions,
   (b) a second phase for the examination of mixed questions,
   (c) a third phase for the examination of purely telegraph questions.

The text of the Belgian Delegation's proposal was handed to the Chairman.

The Delegate from the UNITED STATES OF AMERICA recalled that the American Telephone and Telegraph Company was not in favour of fusion. Without wishing to repeat the arguments contained in the document which had been submitted to the Plenary Assembly, he remarked that before introducing a radical change in the organs of the I.T.U., it was necessary to be certain that the advantages which might result would be decisive and unquestionable. He did not believe this had been proved. He feared that with fusion, telegraphy would loose its proper character and be submerged into the vast domain constituted by telephony. If it were a matter of improving cooperation between different specialists, that could be obtained by minor modifications in the present organisation of the C.C.I.T. and not by a complete change in the structure.

The Delegate of the UNITED KINGDOM shared this opinion. He briefly referred to the background to the problem, commenting the divergent views shown by the 1st series of replies from Administrations and on the different suggestions made in these replies as to how fusion should be achieved. Before recommending the fusion of the two C.C.I.'s we should be quite certain that there was overlapping between the functions of the two C.C.I.'s and that a duplication of effort existed. He considered that the gain in efficiency from a unified C.C.I. had not been demonstrated.

The Delegate of the U.S.S.R. thought that fusion could end only in positive results as good for the telephone service as for the telegraph service. It was necessary to avoid the division between specialists on telegraph and telephone questions. Artificial separation now existed between the organs responsible for these two questions and could even retard the development of the telegraph technique.

Without completely neglecting the question of economy, which could result from fusion, as much for administrations as for the I.T.U., he thought that the essential point for consideration was that such a fusion would facilitate the development of telephone technique and perhaps, that of the telegraph technique even more.

The ITALIAN Delegate recalled that the Italian administration, as shown in document " XVIIth Plenary Assembly—C.C.I.F.—First series of comments concerning the possible fusion of the C.C.I.T. and the C.C.I.F. " explained the reasons for which it was in favour of the fusion of the C.C.I.T. and the C.C.I.F., and the terms of the additional Protocol No. II annexed to the International Telecommunication Convention of Buenos Aires 1952, page 126. He thought that the proposal made by the Belgian Delegation ought to be considered as entering into the framework of this Protocol if the Plenary Assembly pronounced in favour of fusion.

The Delegate of FRANCE said that the experience acquired by his Administration in the national service had shown him the value which could be obtained from bringing the telephone and telegraph services together as closely as possible. In consequence, the French Administration declared itself fully in favour of a fusion of the two C.C.I's as completely and as quickly as possible.

The Delegate of SPAIN wondered why the arguments advanced in favour of the fusion of the C.C.I.F. and of the C.C.I.T. are not also invoked in favour of a fusion of the C.C.I.F. and C.C.I.R., for there was no more justification in the one case than in the other. To wish to add the telegraph problems to the load represented by the already numerous telephone problems seemed wrong ; especially since in nearly all countries international telephony was the business of a single and well defined organisation, whereas the telegraph services were often set up on a very dispersed network and, in addition to Administrations, belonged to a large number of private operating companies.

The Delegate of CUBA underlined the importance of current developments in international telephony such as the coming extension of telephony over metallic circuits between North America and Europe and the introduction of semi-automatic operation in Europe. When the C.C.I.F. was so busy it was not the right time to modify its organisation so as to become burdened with new tasks.

The DANISH Delegation thought that a fusion of the two C.C.I.'s :

(a) would increase the effectiveness of the work of the two C.C.I.'s,

(b) would facilitate the participation of Administrations in this work,

(c) could be of economic advantage for Administrations and private operating companies and, in the long term, for the I.T.U.

(d) would facilitate relations with other international organizations.

The Delegate of CZECHOSLOVAKIA said that the rapid development of telecommunications required increasingly specialised techniques ; but that specialisation could be very dangerous if close cooperation was not assured between specialists in different telecommunication problems. Realisation of that perfect cooperation was the essential object of the fusion of the two C.C.I.'s. It was not so much the economy which would be realised in the expenses of Secretariats or Plenary Assembly that must be considered; that which was important was to have cooperation in order to arrive as quickly as possible at a solution of the problems posed.

During the course of the discussion, the Delegates of CANADA, COLUMBIA and MEXICO pronounced themselves against fusion.

The Delegates of INDIA and ROUMANIA indicated that they were in favour of fusion.

The SWISS Delegate announced that his Administration, which had pronounced itself in favour of the *statu quo* at Arnhem in 1953, because it then considered the question to be premature and insufficiently studied, considered now after a profound study, that a fusion in conditions such as those proposed by the Belgian Delegate would be in the interests of the Union.

On an intervention by the Delegate of Ceylon, Mr. TOWNSHEND, Interim Director of the C.C.I.T., recalled that the terms of the Additional Protocol No. II annexed to the Buenos Aires Convention (1952) asked the two Consultative Committees to be guided in deciding upon their recommendation, by the interests of the Union as a whole.

The NETHERLANDS Delegate recalled that his Administration was opposed to the fusion and he asked the Plenary Assembly to hear the view of two members of the Netherlands Delegation speaking as Group Chairman of C.C.I.F. Study Groups.

Mr. PERRY, Group Chairman of C.C.I.T. Study Group No. XI cast doubt on the economies which could result from fusion. He considered that telephone and telegraph tariffs were very different. Herecalled the extremely rapid progress which had been made in finalising the rules relating to subscribers' international telegraph service and the corresponding tariffs. This work had been handled so quickly only because it had been done by specialists and the meetings had been attended by a very restricted number of participants. A fusion of the two C.C.I.'s risked loss of these two reasons for the efficiency shown by the C.C.I.T.

Mr. VAN LOMMEL, Group Chairman of C.C.I.T. Study Group No. II confirmed this latter point of view and drew attention to the serious repercussions which fusion could have on the future development of telegraphy and the telex service. The text of this statement is attached as an annex.

The U.S.S.R. Delegate observed that an unified C.C.I. could include completely specialised Study Groups.

Mr. VALENSI, Director of the C.C.I.F., intervened at this stage in the discussion. He said he did so quite without bias for he was at the end of his career and would soon leave the Union. But having participated for thirty years in C.C.I.F. meetings and in numerous meetings of the C.C.I.T., he felt that he ought to make the following remarks :

In listening to the various opinions expressed, he had the impression that quite different things were being discussed. He would like to reduce the problem to simple and concrete proportions of which he gave two examples :

(a) The C.C.I.F. Plenary Assembly was now being held without any assistance from the Secretariat of the C.C.I.T. The situation at Arnhem was exactly the opposite. That resulted from the present separation of the two Secretariats. If the technicians of the two Secretariats of the C.C.I.T. and the C.C.I.F. were together in the same office and under the same Director the existing qualified staff would be more fully used.

(b) It was preferable for international organisations representing the users of telecommunication to have to cooperate with a single C.C.I. dealing with telegraph or telephone questions which were largely analogous.

The organisation of one C.C.I., would certainly not prevent a high degree of Study Group specialisation ; C.C.I.F. experience proved that. On the other hand, there was no doubt that there was more and more similarity between the technical problems handled by the C.C.I.T. and the C.C.I.F. ; a fusion would be to the advantage of both. The study Group dealing with telephone signalling questions could, for example, profit from the profound experience of the C.C.I.T. on the subject of voice frequency signal distortion. Inversely, it would be interesting for the telegraph service Representatives to be fully associated with the study of line transmission characteristics, since in fact they were only regarded as the users of lines, the specification for which fell entirely on the C.C.I.F.

After this general discussion the CHAIRMAN proposed that the Plenary Assembly should pronounce on the question of principle as to whether a fusion of the two C.C.I.'s was in the interest of the Union as a whole or whether the *statu quo* was to be preferred.

The Chairman put the question to a vote.

The vote took place by nominal call on the question : " Is fusion in the best interest of the Union ? ".

The following were in favour of fusion : Afghanistan, Germany (Federal Republic), Belgium, Bulgaria, Denmark, Finland, France, Hungaria, India, Ireland, Italy, Luxembourg, Norway, Pakistan, Poland, Roumania, Sweden, Switzerland, Czechoslovakia, U.S.S.R., Yugoslavia ;

The following were against fusion : Australia, Austria, Canada, Chile, China, Colombia, Cuba, Spain, United States of America, Japan, Mexico, Netherlands, United Kingdom ;

Abstention : Ceylon.

The Chairman declared that the fusion was adopted by 21 votes against 13 and 1 abstention.

* * *

The CHAIRMAN suggested that the meeting should proceed to an examination of the methods of fusion. Should one propose that there should be two distinct Plenary Assemblies or a mixed Plenary Assembly ? What Organisation should be proposed for the Study Groups and for the Specialized Secretariat ?

The ITALIAN Delegate remarked that the principle of fusion having been adopted, one could not propose methods which would not be in conformity with Additional Protocol No. II of the Buenos Aires Convention. In particular, the unified C.C.I. could have only one Plenary Assembly, the organisational details of which would be in accordance with the provisions completing the General Regulations attached to the Convention.

Mr. TOWNSHEND remarked that Protocol No. II of the Buenos Aires Convention specified that there could be only a single directing organ called " Plenary Assembly " for an unified C.C.I. ; but there was nothing to prevent that Plenary Assembly from holding separate meetings for telephony and telegraphy.

The CHAIRMAN put for discussion the proposal of the U.S.S.R. Administration, according to which the Director of the C.C.I.F. and the Interim Director of the C.C.I.T. should prepare commentaries on the subject of the organisation of Study Groups and submit them to the Plenary Assembly of the unified C.C.I.

Mr. VALENSI suggested that the two Directors should propose to the Administrative Council the convening of a joint meeting of all the Group Chairman of the C.C.I.T. and of the C.C.I.F. in order to make a preliminary examination (for information) of the best methods of regrouping the Study Groups, in the event of fusion being decided upon.

Mr. TOWNSHEND remarked that the Plenary Assembly of the C.C.I.T. at Arnhem had already approved a report indicating which Study Groups were concerned with purely telegraph matters.

The UNITED KINGDOM Delegate remarked that the Administrative Telegraph and Telephone Conference, or the Administrative Council, would find itself faced with two divergent proposals from the Plenary Assemblies of the C.C.I.T. and the C.C.I.F. It seemed premature to envisage detailed methods for a fusion, the principles of which had not yet been finally decided.

The ITALIAN Delegate emphasised that the C.C.I.F. Plenary Assembly should itself assume responsibility for the reorganisation of the Study Groups. The proposals of the Plenary Assembly should be presented to Administrations in order to assist them in framing their proposals to the Administrative Conference.

The Delegate of CZECHOSLOVAKIA throught that the Plenary Assembly ought to recommend that the two Directors convene a meeting of Group Chairmen.

The CHAIRMAN asked that the Administrative Conference should be presented with a complete picture of what an unified C.C.I. could be and that a working party should be entrusted with this study.

The Belgian Delegate thought that there should be presented at that busy time only the broad outlines of an organisation without entering into details.

The Swiss Delegate remarked that under the terms of Protocol No. II of the Buenos Aires Convention, § 3, the Administrative Council could perfectly well take a decision in 1955.

Mr. Valensi thought that a detailed study which could only be made by experts should not be attempted. It would suffice to adopt a recommendation on three points :

1. The fusion of the C.C.I.F. and the C.C.I.T. was in the interest of the Union (principle already adopted) ;

2. Unification of the specialised Secretariats of the two C.C.I.'s, under the control of one Director, on the basis of the proposals of the C.C.I.T. at Arnhem (Report of Working, Party B).

3. It would fall to the lot of the unified C.C.I. to establish the additional provisions which might be envisaged in the General Regulations :

(a) A Plenary Assembly the meetings of which might be in three phases (telegraph questions, mixed questions, telephone questions),

(b) Three categories of Study Groups, entrusted with the study of :
- purely telegraph questions,
- questions of common interest,
- purely telephone questions.

Mr. Townshend remarked that if the Administrative Council decided to convene the Administrative Conference, this Conference could not meet before the autumn of 1956 ; but it was urgent to decide the fate of the C.C.I.T. the present organisation of which was not in accordance with the Convention.

The Chairman declared that in the absence of opposite views, Mr. Valensi's proposal was adopted.

The meeting closed at 6.30 p.m.

ANNEX

Speech by Mr. Van Lommel

" Thank you for allowing me, Mr. Chairman, to say a few here, not as a delegate of the Netherlands, but as Chairman of a committee of the C.C.I.T. which has about one-third of all C.C.I.T. questions on its study programme.

" I have listened carefully to the discussions and I must ask you to consider very carefully the fact that your decision here might have serious effects on the future development of telegraphy and especially of telex. It is not a question here of how to decide in view of the interests of a given Administration but it is a question of how to decide in the best interests of international cooperation and of the best functioning of the I.T.U.

" Mr. Chairman, telegraphy has been a more or less settled public service for quite a number of years but now the situation has completely changed and in my opinion a fusion might hamper the free development of telegraph services, including telex.

" What do we see in every big organization? We see specialization, to obtain the maximum output and efficiency and it is thanks to the work of highly specialized people from the engineering and exploitation sides that the telex service has become a big service in so short a time with an enormous growth and yet only in my opinion, in its beginning stage. This will have its repercussions on the old public telegraph service, which will use in a not too far future, certain " telex methods " as Mr. Perry has already indicated. You will have heard that a number of countries have already decided fully to automatize the international telex traffic between their subscribers. This can be done now because of the quality of our transmission channels and teleprinters and because of the development of telegraph switching technique using electronics to a great extent.

" The ground for international cooperation in these three big fields has been paved by the work of a rather small number of telegraph experts, in some cases with the aid of telephone experts where necessary. They have been organized in still smaller committees and this could come to quick conclusions. They made up draft recommendations adopted by the plenary meetings and now telex is one its way to a big development. International telex traffic has been introduced and even the automatization thereof, at least in one direction, is already considered.

" Mr. Chairman, telegraphy and telephony indeed go together a certain way in that we use the same component parts and we sork on the same basic principles, but after that we go different roads leading to our different fields and only specialists can now handle the indeed very complex problems specific to each field.

" Committee A of the C.C.I.T., whose report was unanimously adopted by the VIIth Plenary Assembly, came to the conclusion that the existing study groups of the C.C.I.T. would have to be maintained. § 2 of the C.C.I.T. resolution dealing with this question was adopted by a great majority (24 to 3, with 2 abstentions). A combined C.C.I. would therefore consist of a big number of committees and sub-committees. A combined plenary meeting would be very heavy to handle. It would be a waste of time for a lot of people or else it would degenerate to a mere formality.

" I certainly do hope that the decision you are going to take will be based on *full* knowledge and understanding of the problems under study in the C.C.I.T. and will be in the best interests of the Union, in the interests of both telegraphy and telephony. "

MINUTES

OF THE SECOND AND THIRD SESSIONS DEVOTED TO QUESTIONS OF ORGANISATION

(Geneva, 9 October 1954)

The 2nd and 3rd Sessions devoted to questions of organisation were held at Geneva, Maison des Congrès, 9th October 1954 from 10 a.m. to 1 p.m. and from 3 p.m. to 6 p.m. under the chairmanship of Mr. Mirza (Pakistan).

The minutes of the 1st meeting devoted to questions of organisation (5-6 October 1954) were approved subject to several minor modifications, which have been included in the above text.

Mr. VALENSI stated that in the report of the Budget Committee it should be added (by agreement with the leader of the Japanese delegation) that the Nippon Telegraph and Telephone Corporation would pay a one unit contribution to the extraordinary expenses of the C.C.I.F. (subject to subsequent confirmation). On the other hand, the Budget Committee had only made a small modification to the Report on the financial requirements of the C.C.I.F. which had been sent to the Heads of delegations, and which anticipated new arrangements or changes of function in the specialized Secretariat of the C.C.I.F.

I. Proposed recommendation regarding the fusion of the C.C.I.T. and the C.C.I.F.

The Plenary Assembly examined the draft recommendation concerning the fusion of the C.C.I.T. and the C.C.I.F.

The U.S.S.R. delegate asked that detailed examples should be given showing that the new techniques of telegraphy and telephony were getting ever closer together, and that the reference should not be limited simply to telegraph switching and automatic telephony. Further, be proposed that the paragraph referring to meetings of the Plenary Assembly should be deleted, on the grounds that it was for the future Plenary Assembly to decide how its meetings should be held.

The delegate from UNITED STATES OF AMERICA requested that an indication should also be given of the way in which telegraph and telephone techniques differed.

The FRENCH delegate proposed that it should simply be stated " considering that the new techniques of telegraphy and telephony are getting closer and closer together ".

This last proposition was adopted by the Plenary Assembly.

The SPANISH delegate suggested that a recommendation should be made comprising only two points :

1. Fusion of the C.C.I.T. and the C.C.I.F. was recommended,
2. The new C.C.I. should set up its own internal rules.

The UNITED KINGDOM delegate stated that the vote which had resulted in a majority of 21 to 13, with one abstention, referred solely to the principle of fusion, and not to the detailed methods of working of a unified C.C.I.

The ITALIAN delegate observed that, the principle of fusion being accepted, it could only be carried out in conformity with the additional protocol II appended to the Buenos Aires Convention.

The delegate of CEYLON made it clear that when he had abstained, it was on the matter of the principle of fusion, and that he would not abstain from a discussion of the details of application.

The CHAIRMAN suggested that a working party should prepare a draft recommendation taking into account the remark which had been made.

The CUBAN delegate asked that the draft recommendation should bring to notice, perhaps in a note, the distinction between the Plenary Assembly, the controlling body of a C.C.I., and meetings of this Plenary Assembly.

The FRENCH delegate proposed that there should be no immediate discussion, either of matter of detail for the structure of the Secretariat of a unified C.C.I., or of the condition under which a unified C.C.I. would work.

The RUMANIAN delegate that it would be necessary to make two recommendations : one relating to the principle of fusion, which had been adopted by 21 to 13 with one abstention ; and another recommendation (concerning the methods of fusion) which could perhaps be unanimously adopted by the Plenary Assembly.

Mr. VALENSI said that according to the terms of Additional Protocol II, appended to the Convention of Buenos Aires, § 2 *d*, " The study groups and the specialized secretariats of the C.C.I.T. and of the C.C.I.F. shall be replaced by study groups and a single specialized secretariat of the amalgamated organ in a manner to be determined by the Administrative Telegraph and Telephone Conference in the light of the recommendations made by the Plenary Assemblies of the C.C.I.T. and the C.C.I.F. ". The C.C.I.T. had fulfilled this mandate : the VIIth Plenary Assembly at Arnhem had given a recommendation on the principle, but had also indicated in details its conception of the fusion. The propositions of the C.C.I.T. could be taken on a basis for discussion, to see to what extent they could be agreed to by the C.C.I.F.

A first recommendation would refer only to the principle of fusion. A second recommendation would indicate the opinion of the XVIIth Plenary Assembly of the C.C.I.F. as regards the meetings of the Plenary Assembly of a unified C.C.I. and on the structure of its specialized Secretariat. A study should be made to see which Study Groups should be purely telephonic, which purely telegraphic, and which should be of mixed character.

The ITALIAN delegate stated that he would not be able to agree to the Appendices to the recommendation of the VIIth Plenary Assembly of the C.C.I.T. contained in the Arnhem 1953 documents.

The UNITED KINGDOM delegate considered that the recommendation should be framed in very general terms.

Mr. TOWNSHEND throught that consideration should be given as to what sort of recommendation would be of most help to the Administrative Council and to the Telegraph and Telephone Conference. The VIIth Plenary Assembly of the C.C.I.T. had given its opinion in the following form :

(a) a general recommendation against the principle of fusion,

(b) a proposal according to which in the case of fusion the Plenary would hold separate meetings for telegraph and telephone questions,

(c) proposals for the organisation of the Secretariat in the case of fusion and for the organisation of Study Groups dealing solely with telegraph questions in the unified C.C.I.

The XVIIth Plenary Assembly of the C.C.I.F. could issue a similar recommendation in the following form :

(a) a recommendation on the principle of fusion (the attitude of the C.C.I.F. was evidently different from that of the C.C.I.T.),

(b) a proposal regarding the meetings of the Plenary Assembly, which might or might not be in agreement with the proposal of the C.C.I.T.,

(c) a document indicating in detail the points on which the Plenary Assembly of the C.C.I.F. was not in agreement with the recommendation made by the C.C.I.T. at Arnhem and the Appendices to that recommendation.

A Working Party proposed by the Chairman was set up to this end. It consisted of Messrs. Haemers (Belgium), Clara (Spain), Marzin (France), Gneme (Italy), Harvey (United Kingdom), Nordstrom (Sweden), Langenberger (Switzerland) as well as Mr. Valensi, Director of the C.C.I.F., and Mr. Townshend, interim Director of the C.C.I.T.

This group was authorised to produce two different recommendations, one relating to the question of principle on which a vote had already been taken, and a complementary recommendation in reply to the mandate given to the Plenary Assembly of the C.C.I.F. by Protocol II of the Buenos Aires Convention, and containing suggestions for the meetings of the Plenary Assembly of a unified C.C.I., for the organisation of the Secretariat and for the constitution of Study Groups.

II. Organisation of the work of C.C.I.F. Study Groups

The Chairman said that the comments made by the Director of the C.C.I.F. on the subject of the organisation of the work of the Study Groups were contained in the second part of the Document entitled : " XVIIth Plenary Assembly of the C.C.I.F. — Geneva 1954 — Decision of the Administrative Council of the I.T.U. — Remarks concerning the work of the various Study Groups of the C.C.I.F.". It indicated that three essential points should be examined :

1. At present it was the 3rd Study Group which was responsible for the study of the transmission characteristics not only of metallic circuits, but also of broad band radio relay links. It was proposed to entrust the study of questions relating to broad band radio relay links to a Study Group which would be responsible for questions for which cooperation with the C.C.I.R. was necessary, except for question concerned with broadcast or television transmissions.

2. Was it necessary to replace the Sub-Committee for Rapid Operation by a " Committee for the supervision of operation ", which would be autonomous and charged initially with the organisation of semi-automatic operation in Europe ?

3. Should the Permanent sub-committee for maintenance be considered as a study group directly responsible to the Plenary Assembly and no longer subordinate to the 3rd Study Group ?

Several delegates urged, at the beginning of the discussion, that such changes were perhaps not absolutely necessary since in the event of a fusion of the C.C.I.T.

and the C.C.I.F., further reorganisation would have to be considered. Mr. Valensi said that it was essential to give well defined duties to the Study Group of the C.C.I.F., because the fusion, if decided upon, could not take place befoe 1957. He stressed also the practical nature of the decisions which should be taken, because it was impossible to continue to have study groups containing, during their meetings, nearly 200 persons and which were, therefore, extremely ponderous.

The U.S.S.R. delegate said that, in addition to the three points mentioned by the Chairman, it would be necessary to examine a fourth point, the simplification of the organisation chart of the C.C.I.F. and the suppression of a certain number of committees or sub-committees which could be regarded simply as temporary working parties attached to the responsible study groups.

These four points were examined in succession by the Plenary Assembly.

Point 1.

The United Kingdom delegate considered that it would be preferable to leave to the 3rd Study group all those matters which were at present devolved on it.

The Cuban delegate concurred in this view and considered that it would be better for questions relative to broad band radio relay links to be treated in the same committee as that which dealt with questions relative to metallic circuits.

The delegate of the United States of America drew the attention of the Plenary Assembly to the need for having a study group responsible for all aspects of transmission problems. The equivalent of circuits could be determined in different ways according to the type of circuit concerned. The new conditions arising from the connection in series of several circuits for semi-automatic operation would soon pose some difficult transmission questions. It was desirable that such overall problems should be controlled by a single responsible committee.

Mr. Valensi considered that if that suggestion was followed, it would be necessary to modify the organisation chart which he had submitted, to combine in one responsible committee, the committee responsible for the general characteristics of circuits (at present the 3rd study group) and the committee responsible for the systems connecting subscribers to the exchanges which served them (at present the 4th study group); that unified committee would pose specific problems to the " Sub-committee for trials of the quality of telephone transmission " which would be composed of members of the laboratories studying accoustic matters and telephone measurements.

The Swiss delegate thought that a committee concerned with overall transmission problems would have to be responsible for studies which would have to be undertaken respectively by subordinate study groups corresponding to those which were at present the 3rd, 4th and 5th Study Groups.

Mr. Valensi observed that coordination between these three Committees was at present achieved satisfactorily, because before a Plenary Assembly met, representatives of the 3rd and 5th Study Groups, on the one hand, and representatives of the 4th and 3rd Study Groups, on the other hand, held joint meetings to finalise texts regarding general transmission questions. It seemed undesirable to complicate the existing organisation, which would be clarified by showing, on the organisation chart, the links which in fact existed between Study Groups.

After considerable discussion, the Plenary Assembly decided to entrust the 3rd Study Group with general transmission problems, and the 5th Study Group with problems which needed to be dealt with in cooperation with the C.C.I.R. (except for broadcast and television transmissions, always dealt with by the 3rd Study Group). The new organisation chart of the C.C.I.F. which is included in this publication shows the desirable linkages between Study Groups.

Point 2.

The UNITED KINGDOM delegate considered that the Sub-Committee for Rapid Operating methods, with no great increase in its present responsibilities, could undertake the work indicated in the document for the " Committee for the supervision of operation ".

The SWISS delegate thought that the existence of such a Committee was of great importance, even during the period when semi-automatic operation was only just beginning. In effect, those responsible for the introduction of international semi-automatic operation, which was an extremely important matter, should meet at fairly frequent intervals. It would be necessary for the representatives of the 6th and 8th Study Groups, who now met together in the Sub-Committee for Rapid Operation, to be joined by certain members of the 7th Study Group, because tariff questions would need to be examined, and questions of finance were of primary importance in setting up those automatic installations.

The FRENCH delegate observed that, even if that " Supervising Committee " could not, at the moment, carry out the role which would fall to it later, there was nevertheless a need for an organ of cooperation which, while leaving Administrations with their full sovereignty, could set up a programme for the introduction of international semi-automatic equipment, record the agreements reached by Administrations in that respect, and perhaps set up a timetable for the placing in service of such automatic installation.

The Sub-Committee for Rapid Operating methods could carry out their task, operating questions in the manual rapid service being in future entirely the responsibility of the 6th Study Group.

The U.S.S.R. delegate considered that the task of supervising semi-automatic operation was proper to the 6th Study Group. The task of arranging for any coordination considered necessary should be given either to that committee, or to a sub-committee which would be subordinate to it.

After intervention by the delegates of SWEDEN and of SPAIN, the Plenary Assembly decided to retain, with its present title, the Sub-Committee for Rapid Operating Methods, this Sub-Committee being made subordinate to the 6th Study

Group. It should comprise, in addition to representatives of the 6th and 8th Study Groups, several members of the 9th Study Group (Maintenance committee) (see below). The duties of the Sub-Committee for Rapid Operating Methods would be defined as follows :

— Preliminary study of question of international rapid operation (in particular, semi-automatic operation) ;

— Coordination of equipment planning for semi-automatic operation ;

— Coordination of the maintenance of international automatic installations.

Point 3.

The Plenary Assembly decided that the Permanent Sub-Committee for Maintenance should become a Committee. That new maintenance committee would be called the 9th Study Group of the C.C.I.F., with the duties shown on the new organisation chart of the C.C.I.F.

Mr. VISSER, Chairman of the Permanent Sub-Committee for Maintenance, thanked the Plenary Assembly for the mark of confidence which they had given to the Sub-Committee of which he had been the Chairman. He recalled that this sub-committee had been started in 1926, and that, since then, it had maintained a harmoniously balanced title, on the one hand the term " Sub-Committee ", and, on the other hand, the quality of permanence. It was certain that the new 9th Study Group would live up to that which had so far been the motto of the subcommittee : " Je maintiendrai ".

Point 4.

In conformity with the proposal presented by the Delegate of the U.S.S.R., the Plenary Assembly decided to delete from the C.C.I.F. organisation chart :

the Sub-Commission for the Mediterranean Basin,

the Sub-Committee for the Middle East and South Asia,

and not to show the International Mixed Committee (C.M.I.).

The delegate of the U.S.S.R. also asked for the deletion of :

(a) the Committee for the revision of Directives for protection against disturbances,

(b) the committee for the revision of Recommendations for protection against corrosion,

(c) the committee for the revision of the International Telephone Regulations,

(d) the committee for the revision of international tariffs.

Mr. VALENSI referring to Chapter 18 of the General Regulations annexed to the International Telecommunications Convention (Buenos Aires, 1952) observed that the Committee for the revision of the International Telephone Regulations could, in no circumstances, be considered as a working group of the

6th and 7th Study Groups. The members of this Committee of revision acted in the capacity of experts in a personal manner, committing neither their respective Administrations, nor the C.C.I.F.

Valid arguments were also in favour of maintaining the other Committees the suppression of which was now requested.

The Plenary Assembly supported this point of view.

The Delegate of the FEDERAL GERMAN REPUBLIC remarked that Resolution No. 292 of the Administrative Council had given the title " C.C.I.F. Committee for the General Programme of Interconnection " ; it has been suggested during the second session on Operating and Tariffs, that the term " Plan " should be adopted in place of "Programme" in order to designate the work which was jointly prepared by the three C.C.I.'s. For the moment the designation indicated by the Administrative Council must be kept, but it would be desirable for the Director of the C.C.I.F. to draw the attention of the Administrative Council to the desirability of changing that designation and of adopting the following : " C.C.I.F. Committee for the General Interconnection Plan ".

III. Publication of works of the C.C.I.F. in languages other than French

A note from the Delegation of IRELAND asked the XVIIth Plenary Assembly to reexamine the possibility of publishing the Recommendations *(Green Book)* in English.

The Delegate of SPAIN supported the proposal of Ireland and he thought that the arguments put forward in this proposition applied also to the Spanish language.

The CHAIRMAN speaking as the Delegate of Pakistan supported the proposal of Ireland. In his capacity as Chairman he thought that the Plenary Assembly ought without doubt to examine also the question of publishing the works in Spanish.

Mr. VALENSI expressed a desire for the C.C.I.F. Recommendations to be published in all languages that proved possible. He explained how, in accordance with the decisions of the Administrative Council, subscriptions for English and Spanish editions of the works of the C.C.I.F. were received.

Mr. TOWNSHEND, Assistant Secretary General of the I.T.U., described in detail the procedure followed by the I.T.U. General Secretariat for the publication of works of the C.C.I.F. Circular letters were sent, for each work, indicating the probable price in each language. If the number of subscriptions for a language was insufficient to permit of publication at a reasonable price, the work was not published in that language.

The Delegate of CEYLON asked for a careful distinction between the costs of translation and the costs of production. The costs of translation ought not to be included in the net cost of printing a volume. Actually the C.C.I.R. and the C.C.I.T. published not only in French, but in English and Spanish, and he did not see why the

C.C.I.F. did not do the same. If the price of publication of works was too high, there should at least be a text suitably translated and duplicated. On the other hand the Administrative Council could decide to subsidise the publication of C.C.I.F. works in languages other than French if such publication incurred a deficit, in the same way as had been done for C.C.I.R. publications (propagation curves).

The UNITED KINGDOM Delegate confirmed that there should be a clear distinction between the costs of translation and the costs of publication. Publication of the works of the C.C.I.F. was at present covered by Administrative Council Resolution No. 190. The enquiry made by the I.T.U. General Secretariat in order to obtain subscriptions for the works of the C.C.I.F., should be effected under exactly the same conditions for works in English and Spanish as for works in French. The resulting situation might then be completely different from the present one.

The Delegate of SPAIN indicated that the Spanish Delegation, in order to facilitate the work of the Assembly, would not require documents to be available in Spanish. That should not place the Spanish text in an inferior position in the matter of the publication of printed works.

Mr. TOWNSHEND observed that the Plenary Assembly could quite well decide to establish the manuscript of works of the C.C.I.F. in English and Spanish. It would suffice if the corresponding expenses were foreseen in the budget of extraordinary expenses of the C.C.I.F. But that was not to say that the works would published in those languages ; the decision for publication would depend solely on be the number of subscribers.

Mr. VALENSI asked the Plenary Assembly to indicate clearly whether it desired a Spanish translation of the works of the C.C.I.F. after the XVIIth Plenary Assembly. A translation of those works into English was almost complete since all the basic documents for discussion presented to the Plenary Assembly were in French and English, as well as the minutes of the sessions.

The SPANISH delegate declared that the cost of a Spanish translation could be estimated by taking an amount equivalent to that which was foreseen in the extraordinary budget for the Plenary Assembly for translations in the English language.

Mr. VALENSI remarked that there was a risk that the amount would be insufficient because a large part of the C.C.I.F. texts came fromt exts originally in English for which no translation had been necessary, and no Spanish version of those texts was available.

The delegate of CUBA said that his private operating Company could undertake the translation of Volume VI of the C.C.I.F. *Green Book* (Operating and Tariff Recommendations) free of charge. *(Applause.)*

The delegate of the U.S.S.R. explained that the language problem was not new ; it is covered by Article 14 of the Telecommunication Convention and Chapter 14 of the annexed General Regulations. There was an existing Administrative

Council Resolution concerning the publication of C.C.I.F. documents in languages other than French (Resolution 190) ; it would be desirable to ask the Administrative Council to re-examine the question. The Secretary-General should ask all Administrations which took part in the Union in what language they wanted the works of the C.C.I.F. and for what quantities they desire to subscrive. Such an inquiry could give different results from those previously obtained.

The Chairman in his capacity as the delegate of PAKISTAN asked if it would not be desirable for one country to speak for all countries which might be interested in an English language edition by inquiry directly of the Administrations of those countries by drawing their attention to the value of an English publication of the works of the C.C.I.F.

The delegates of IRELAND and of the UNITED KINGDOM thought that that could not be the responsibility of an Administration but that it was the function of the General Secretariat of the I.T.U.

The delegate of ITALY asked the Assembly to give careful attention if an increase in the extraordinary expenses would be incurred, because the general opinion of Members of the Administrative Council was that expenses should be reduced. He supported the proposal which had been made to ask the Administrative Council to examine the question afresh.

Mr. TOWNSHEND observed that it was laid down that the Plenary Assembly should make a careful estimate of the extraordinary expenses and that there could be no increase in the authorised expenditure which had not been duly approved at the right time by the Plenary Assembly.

The UNITED KINGDOM Delegate then emphasized that the Administrative Council should reexamine the problem, particularly in respect of the method employed for ascertaining the number of subscribers for each language.

The Plenary Assembly decided to ask the Administrative Council to review the whole question of the publication of the works of the C.C.I.F. in languages other than French, with a view to achieving the aims which the Plenary Assembly had in mind.

IV. Extension of the term of office of the Director of the C.C.I.F.

(Mr. VALENSI withdrew from the meeting).

The CHAIRMAN, informed the Assembly that the meeting of the Heads of Delegations has asked its Chairman to present to the Plenary Assembly the proposal of the Swiss Administration in favour of the prolongation of the services of Mr. Valensi, the present Director, with the unanimous approval of that meeting.

The Delegate of the U.S.S.R. said that his Administration thought that there should be an extension of the services of Mr. Valensi, whom all had known for thirty years, and all knew what he had done for the development of international telephony ; he supported the proposal of the Swiss Administration.

The BELGIAN Delegate proposed that the prolongation of the services of Mr. Valensi should be effected not for a two year period but until the end of the next Plenary Assembly.

The CHAIRMAN asked the Assembly to pronounce first of all on the two year extension.

The Plenary Assembly decided with acclamation to extend Mr. Valensi's term of service.

The UNITED KINGDOM Delegate regretted that the terms of the Rules for the personnel of the I.T.U. were strict and did not allow prolongation of office beyond the period of two years which had been decided. Otherwise, he would have been the first to ask for this extension to be until the end of the next Plenary Assembly and to support the proposal of the Belgian Delegate which could not, unfortunately, be accepted by the Assembly.

Mr. VALENSI returned to the meeting and was informed of the decision of the Plenary Assembly. He spoke as follows :

" Gentlemen, your applause touches me very much ; I have given a great number of years of my life to the C.C.I.F. and I am ready to give another two years ; I thank you very much and I am profoundly touched by this expression of confidence."

Procedure to be followed in electing a new Director

The UNITED KINGDOM Delegate remarked that the question was complex and should be examined with great care. The election of directors was exclusively a function of the Plenary Assembly of their C.C.I. and, in accordance with normal arrangements, the next Plenary Assembly of the C.C.I.F. would not take place before 1957, when Mr. Valensi would already have retired. It should also be noted that on the occasion of its next Plenary Assembly in 1956, the C.C.I.R. must elect a new Director in succession to Mr. Van der Pol, whose period of service had been renewed for a two year period expiring in 1956. It seemed that the Director of the C.C.I.R. could be nominated in 1956 in accordance with normal procedure. As regards the C.C.I.F., the final decision to be taken would depend on the possible fusion of the C.C.I.T. and the C.C.I.F., a question which must be settled by the Administrative Council or by the Administrative Telegraph and Telephone Conference. Finally it should be noted that in accordance with the Convention, the Directors of the C.C.I.'s must all be nationals of different countries. It seemed that the present Plenary Assembly ought to invite the Administrative Council, during its next session in 1955, to define the procedure to be followed for the election of Directors of the C.C.I.F. and C.C.I.R. and to request the Secretary, General of the I.T.U. to collect nominations for these posts, specifying that separate lists of candidates should be established for the case where the C.C.I.T. and C.C.I.F. remained separate and for the case of their fusion.

Mr. TOWNSHEND, Assistant Secretary-General, speaking in the name of the Secretary-General of the I.T.U., made the declaration reproduced in the Annex. M. Townshend made it clear that that declaration applied solely to the procedure for the election of a new Director and not to the method to be followed for obtaining nominations.

The ITALIAN Delegate proposed that the Administration Council be invited to take all appropriate measures, and at the same time to draw attention to the proposals of the Secretary-General which are reproduced in the Annex. It being understood that, when the decision of the Administrative Council was known, Administrations could, if they judged it to be necessary, demand a meeting earlier than the next Plenary Assembly of the C.C.I.F.

On the proposal of the CHAIRMAN, the Assembly decided to invite the Administrative Council to take all the necessary measures for the election of a new Director, taking account of the decisions which would have been taken on the subject of the fusion of the C.C.I.T. and the C.C.I.F., and the various considerations given in detail by the Delegate of the United Kingdom and in the declaration made in the name of the Secretary-General of the I.T.U.

The session closed at 6.05 p.m.

ANNEX

Note on the election of the Director of the C.C.I.F.

(Presented by Mr. Townshend, Assistant Secretary-General, in the name of the Secretary-General of the I.T.U.)

1. Under the provisions of the Convention of Buenos Aires (Article 7, § 4 *c)* the Directors of the C.C.I.s must be elected by their respective Plenary Assemblies.

2. The actual election of the Director of the C.C.I.F. cannot take place until a decision has been reached as to whether the C.C.I.F. and the C.C.I.T. are to be amalgamated or not. Under the Buenos Aires Protocol No. 2, the Administrative council has power to decide the question of amalgamation definitely at its Spring meeting in 1955, but since it will faced with opposing recommendation by the C.C.I.T. and C.C.I.F. Plenary Assemblies, it seems very possible that the Council will not itself take the decision but will refer the matter to the Telegraph and the Telephone Conference (see Protocol 2 of the Convention). The date of that Conference may be known after the 10th session of the Council which has to make a recommendation to Administrations on it. The earliest possible date for the Conference is the autumn of 1956.

3. If in fact the Conference is held in 1956, much the best procedure would be for the Conference to summon a formal one-day meeting of the Plenary Assembly to make the necessary election ; this could be done as soon as the Conference has decided for or against amalgamation. If the decision were in favour of amalgamation, a joint session of the C.C.I.T. and C.C.I.F. and interim arrangements for carrying out the work of the C.C.I.F. could be made until the amalgamation actually took place. If the decision were against amalgamation, the C.C.I.F. Plenary Assembly alone would elect a Director of the C.C.I.F. (in the later case, something would have to be done about the C.C.I.T., but that question is not considered in this note as it does not arise urgently).

4. In the event of the date of the Telegraph and Telephone Conference being postponed until after 1956, and the decision whether or not to amalgamate the 2 C.C.I.'s being postponed accordingly, there seems no alternative but to make interim arrangements for the post of the Director of the C.C.I.F., without prejudice to the higher staffing of either the C.C.I.F. alone or of an amalgamated C.C.I., after the decision on the question of amalgamation has been taken.

5. In the event of the Administrative Council itself taking a decision either in favour of or against amalgamation, instead of leaving the decision to the Telegraph and Telephone

Conference, the procedural position would not be very different, since the Plenary Assembly or Assemblies, which alone can constitutionally elect a director, could not be called together without incurring substantial additional expenditure, except during the meeting of the Telegraph and Telephone Conference.

The only difference would be that the exact nature of the task to be performed—viz. the election of either a Director of the C.C.I.F. or a Director of a combined C.C.I.—would be known earlier.

6. It would seem that the best course for the XVIIth Plenary Assembly of the C.C.I.F. to take, when it considers the question of the election of a successor to Mr. Valensi, would be for the Assembly to invite the Administrative Council.

(a) to arrange for a special meeting of the Plenary Assembly of the C.C.I.F., or of the Plenary Assemblies of the C.C.I.F. and C.C.I.T. jointly (according to the decision taken on the question of amalgamation) to be held simultaneously with the meeting of the Telegraph and Telephone Conference with an agenda limited to carrying out the necessary election, and

(b) in the event of the decision being taken to postpone the Telegraph and Telephone Conference to a later year than 1956, also to make interim arrangements for carrying on the work of the C.C.I.F. after Mr. Valensi's retirement until definite arrangements can be made, following a decision being taken on the question of amalgamation.

MINUTES
OF THE FOURTH MEETING DEVOTED
TO QUESTIONS DEALING WITH ORGANISATION

(Geneva, 11 October 1954, morning)

The 4th meeting devoted to questions dealing with organisation took place at Geneva, Maison des Congrès, from 11.00 hours to 12.30 hours under the chairmanship of Mr. Mirza (Pakistan).

The following matters were on the agenda :

I. Report of the Budget Committee of the C.C.I.F. and Report on the financial requirements of the C.C.I.F. until the XVIIIth Plenary Assembly.

II. Recommendations relative to the amalgamation of the C.C.I.T. and the C.C.I.F.

III. General plan of the printed works of the C.C.I.F. to be published after the XVIIth Plenary Assembly.

I. Report of the Budget Committee and the Report on the financial requirements of the C.C.I.F. until the XVIIIth Plenary Assembly

The Chairman and Mr. Valensi indicated that a certain number of drafting corrections or corrections of a purely material nature were to be made to the documents serving as a basis of discussion, namely " Report of the Budget Committee of the C.C.I.F. ", and " Report on the financial requirements of the C.C.I.F. until the XVIIIth Plenary Assembly ".

Amongst these corrections, of which the complete list was given to the Assembly it may be pointed out that the following apply to the document "rReport on the financial requirements of the C.C.I.F. until the XVIIIth Plenary Assembly" :

(a) delete the two last paragraphs of page 4, relating to the extraordinary expenses of the other C.C.I.'s ;

(b) replace, in the title of the Annexes 3 and 4, the words " Draft budget for ordinary expenses " by the words " Estimates of ordinary expenses ".

The Plenary Assembly first examined the " Report of the Budget Committee of the C.C.I.F. " (reproduced on pages 80 to 84 of the present document).

Mr. Townshend read the note below from the Secretary-General of the I.T.U. describing the procedure for the establishment of the budget of the I.T.U. (this note is reproduced in an annex).

Mr. Valensi thanked the Secretary-General for having provided that description. In conformity with § 6, of chapter 17 of the General Regulation appended to the Convention (page 94), he had prepared for the Plenary Assembly a report on the financial requirements of the C.C.I.F. until the next plenary Assembly. Once this report had been approved by the Plenary Assembly, the Director would transmit it to the Secretary-General to be used as he thought fit. Thus the procedure conformed strictly with the regulations.

The Delegate of the United Kingdom thought that the note of the Secretary-General of the I.T.U. had made perfectly clear to members of the Assembly the procedure to be followed. The Report on the financial requirements of the C.C.I.F. until the XVIIIth Plenary Assembly, which the Budget Committee had approved, had announced an alteration of a post and the creation of a post. The attention of the Assembly was drawn to this fact. The decision on the matter of these two posts would be taken by the Administrative Council, on the recommendation of the Secretary-General, after he had consulted with the Coordination Committee.

He also drew attention to the expediency of asking the Administrative Council to examine whether arrangements might be made so that the Funds of the C.C.I.F. could earn interest. It had been decided that that would be desirable.

The Chairman asked whether there were any other comments on the Report by the Budget Committee. The Assembly, subject to the Secretary-General's declaration and the other points made in the discussion, unanimously approved the Report by the C.C.I.F. Budget Committee.

The Plenary Assembly then examined the " Report on the financial requirements of the C.C.I.F. until the XVIIIth Plenary Assembly ".

Mr. Valensi commented on the report and explained that the budget of the C.C.I.F. had already been settled by the Administrative Council ; that for the years 1956 and 1957, it was a matter of estimates that the Plenary Assembly instructed the Director of the C.C.I.F. to transmit to the Secretary-General, in order that the latter could take them into consideration in the preparation of budgets to be submitted to the Administrative Council.

In conformity with the Report of the Budget Committee of the C.C.I.F., the following substitution should be made ; under the heading 601—Allowances and Insurances—in the budget for the year 1956, the sum of 17.000 Sw. frs for the sum of 20.000 Swiss francs.

Taking account of this modification and conforming to the approval which had just been given by the Plenary Assembly to the Report of the Budget Committee, the Plenary Assembly unanimously approved the " Report on the financial requirements of the C.C.I.F. until the XVIIIth Plenary Assembly " and asked the Director of the C.C.I.F. to transmit that report to the Secretary-General to be used as he thought fit.

II. Recommendations relative to the amalgamation of the C.C.I.T. and the C.C.I.F.

The Plenary Assembly took note of the two draft recommendations established by the working group formed during the first meeting dealing with organisation. This Working group, with M. Gneme (Italy) as chairman had unanimously accepted that those two texts be submitted to the approval of the Plenary Assembly.

The Plenary Assembly approved the final wording below of Draft Recommendation No. 1, which corresponded to a decision taken during the first meeting devoted to questions dealing with organisation :

The International Telephone Consultative Committee,

as a result of

Resolution No. 2 of the Convention of Buenos Aires which invites the Plenary Assemblies of the C.C.I.T. and the C.C.I.F. to make a detailed study of the amalgamation of the two C.C.I.'s and to present their recommendations at the next International Telegraph and Telephone Administrative Conference,

and also, the provisions of the additional Protocol II appended to the Convention of Buenos Aires and, in particular, § 3 of this Protocol, in which, if the International Telegraph and Telephone Administrative Conference is postponed until after 1954, the Administrative Council is authorized to exercise, after consultation with the Members of the Union, the same powers as are conferred on the Telegraph and Telephone Administrative Conference by § 1 and 2 of this Protocol ;

considering

that the new techniques of telegraphy and telephony approach one another more and more closely ;

that international telegraph and telephone services make increasing use of the same routes ;

that the relations of the I.T.U. with various other international organisations present similar problems to the C.C.I.T. and to the C.C.I.F. in respect of which unity of views would be desirable as far as this is possible ;

that the qualifications of the technical officials at present separated in the specialised secretariats of the C.C.I.T. and the C.C.I.F. would be better employed if these technical officials were grouped in the same office under the control of a single authority.

issues, with a majority of 21 votes to 13, with one abstention, the recommendation

1. That the amalgamation of the C.C.I.T. and the C.C.I.F. according to the provisions of the additional Protocol II appended to the Convention of Buenos Aires is in the interests of the Union ;

2. That the Secretary General of the I.T.U. should be asked to communicate this Recommendation to the Administrative Council for examination during the next meeting.

* * *

The Plenary Assembly unanimously approved the following Recommendation concerning the manner in which amalgamation of the C.C.I.F. and the C.C.I.T. should take place. The Assembly noted that supplementary expenses were implied in the Recommendation of convening a special meeting of the chief Chairmen and Vice-Chairmen to re-examine the structure of the Study Groups if the amalgamation of the C.C.I.F. and C.C.I.T. be approved.

THE INTERNATIONAL TELEPHONE CONSULTATIVE COMMITTEE,

considering

that, if the amalgamation of the C.C.I.T. and the C.C.I.F. is decided upon by the International Telegraph and Telephone Administrative Conference, additional provisions should be established to the General Regulations (appended to the Convention) in order to define clearly the methods of operation for a unified C.C.I.F.

that the time of attendance of each official taking part in the Plenary Assembly of such a joint C.C.I. should be reduced to the strict minimum necessary for the treatment of those questions of interest to that official,

makes the recommendation

that the additional rules specifying the methods of operation of the joint C.C.I. could stipulate that its Plenary Assembly could take place in three phases :

— one phase devoted to purely telegraphy questions,
— one phase devoted to purely telephony questions,
— one phase devoted to questions concerning both telegraphy and telephony,

considering, furthermore, that,

the working group A of the VIIth Plenary Assembly of the C.C.I.T. has examined whether there is a more or less direct connection between the questions submitted to the Study Groups of the C.C.I.T. and the C.C.I.F., but that then making the relative proposals contained in the pages 190 to 193 of the documents of Arnhem 1953, it was not possible to take into consideration the new duties for the Study Groups of the C.C.I.F. laid down by the XVIIth Plenary Assembly of the C.C.I.F.,

that the number of Study groups of a joint C.C.I. should be reduced to a minimum,

unanimously makes the recommendation

that it would be useful to proceed to a new and detained examination of the proposals of the Working group A of the VIIth Plenary Assembly of the C.C.I.T., and the duties laid down by the XVIIth Plenary Assembly of the C.C.I.F. for its study groups,

and that this task can be confided to a Meeting of chief Chairmen and of the Vice-Chairmen of the various actual Study Groups of the C.C.I.T. and the C.C.I.F. at a meeting convened by the Administrative Council ;

considering finally,

that considerable burdens may be imposed by the coordinated establishment and the rational operation of a world network of international routes of modern types, serving at one and the same time for telegraphy and telephony,

makes the recommendation

that the specialised secretariat of a joint C.C.I. should include an adequate number of specially qualified officials,

that proposals on this subject should be made to the Administrative Council by the Secretary-General of the I.T.U. after consultation with the Coordination Committee.

III. General plan of the Works to be published after the XVIIth Plenary Assembly of the C.C.I.F.

The Plenary Assembly took note of the document, Minutes of the meeting charged with the establishment of the general plan of the works to be published after the XVIIth Plenary Assembly of the C.C.I.F. (Geneva, 4 October 1954), which is reproduced on pages 84 to 90 of the present document.

The Plenary Assembly approved of the arrangements contemplated for the replacement of the *Yellow Book* by a *Green Book* of the C.C.I.F., constituting a redrafting of all the C.C.I.F. texts brought up to date after the XVIIth Plenary Assembly.

The Plenary Assembly charged the Secretariat of the C.C.I.F. to take the necessary measures so that the completion of the " Directives " appearing in the second part of the " General Trunk Interconnection Programme " be carried out at the same time as the revision of the corresponding passages in the Volumes of the *Green Book*.

The Assembly decided that a consecutive numbering should be introduced in the duplicated documents of the C.C.I.F. (in addition to the numbering proper to each Study Group) in order to be able to locate immediately documents during discussion.

The Assembly proceeded to a wide exchange of views on the subject of the advantages of the adoption of a standard size for the duplicated C.C.I.F. documents which would allow convenient classification in files.

Mr. VALENSI pointed out that the size now used permitted an economy of the order of 10 to 15 % in the number of stencils used.

The FRENCH delegate stressed the difficulties of classification with the size now used, difficulties which had led the Administration of the Netherlands to present the suggestion of modifying the present size of paper.

The Assembly decided to ask the Coordination Committee of the International Telecommunications Union to establish, after enquiry, the best ways of publishing duplicated documents, expressing the desire that these ways be the same for the three C.C.I.'s and which would be satisfactory to the greatest possible number of countries.

The ITALIAN Delegate spoke on behalf of the Assembly to thank Mr. MIRZA for having so well directed the work of the Assembly throughout these meetings dealing with organisation and to have conducted the study of such delicate problems without difficulty.

The meeting was closed at 12.30 hours.

ANNEX

Memorandum by the Secretary-General of the Union on the Report by the C.C.I F. Budget Committee

In so far as he is responsible for submitting the annual budget of the Union to the Administrative Council, and, generally speaking, for the management of the staff as a whole and of the finances for all the permanent organs, the Secretary-General of the Union, having perused the report by the C.C.I.F. Budget Committee (XVIIth P.A. — Document 6), feels obliged to draw the attention of the C.C.I.F. Plenary Assembly to the following points :

1. The following is the normal procedure whereby the ordinary budget of the Union is drawn up :

(a) The Secretary-General centralizes the estimates of expenditure submitted by the heads of all the permanent organs. These estimates give particulars of estimated staff numbers and of all expenditure in connection therewith, in all necessary detail.

(b) The Secretary-General then drawn up a first draft budget on the basis of these figures.

(c) The Coordination Committee (made up of high officials from all the permanent organs) discusses this first draft budget.

(d) The Secretary-General then approves a draft budget for submission to the Administrative Council for examination and final approval.

As regards the draft ordinary budget for 1956, we are still in phase *a)*. Phase *b)* has not yet begun.

2. In this connection. attention should be drawn to Additional Protocol IV of the Buenos Aires Conference, in which an upper limit is set on the ordinary expenditure of the Union for the period 1954 to 1958. § 8 lays down that : " in adopting decisions which might have financial effects, the administrative conferences and Plenary Assemblies of Consultative Committees shall make an exact estimate of supplementary expenses which might result therefrom ".

3. It is obviously necessary to maintain a certain balance in the expenditure of the various organs, and especially in the classification of posts.

This is of course only feasible by means of joint studies carried out in the Coordination Committee with a view to the decisions which in the last resort can only be taken by the Administrative Council. Incidentally, the Council has recently given special attention to these problems.

4. Hence the Plenary Assembly of each C.C.I. does not have to draw up a real draft budget, but rather to make estimates of the financial requirements of the C.C.I. concerned. These estimates will be submitted to the Secretary-General with a view to the preparation in consultation with the Directors of the C.C.I.'s and the Chairman of the I.F.R.B., of a draft budget for the whole of the Union, to be submitted to the Council for consideration.

This being so, the Secretary-General feels that the C.C.I.F. Plenary Assembly, while submitting estimates as accurate as possible of C.C.I.F. requirements for the next three years, should abstain from expressing any views on administrative matters which have to be settled uniformly between all organs—questions to which the Administrative Council itself attaches the greatest importance.

The Secretary-General hastens to add that, on the whole, the C.C.I.F.'s estimates of expenditure for 1955 to 1957 seem very reasonable, and that there is no reason to suppose that the Council will have difficulty in meeting C.C.I.F. requirements. Besides, the Plenary Assembly may rest assured that the Secetary-General will do everything to ensure that the requirements of the C.C.I.F. Secretariat are met, within the limits of the credits available.

Marco Aurelio ANDRADA
Secretary-General

MINUTES
OF THE SECOND MEETING OF HEADS OF DELEGATIONS
(Geneva, Monday, October the 11th, 1954)

approved by the Plenary Assembly

The second Meeting of Heads of Delegations at the C.C.I.F. XVIIth Plenary Assembly was held in Geneva (Maison des Congrès), on Monday, October the 11th, 1954, from 1500 to 1730 hours, with Mr. WETTSTEIN (Switzerland) in the Chair.

After having considered the proposals made by the meeting of Heads of Delegations, the XVIIth Plenary Assembly approved the " Membership of Study Groups and sub-committees for 1955, 1956 and 1957 ", which is given on pages 563 to 573.

When this list was being drawn up, the following comments were made on the membership of certain study groups :

4th Study Group.

This study group should comprise engineers responsible for the organization networks, whereas the acoustic specialists should rather belong to the Sub-Committee for experiments on telephone transmission quality.

Committee for the General Trunk Interconnection Programme.

The countries which have expressed a wish to take part in the work of this committee are listed in the above-mentioned text. The Director of the C.C.I.F. would send a circular to all member-countries of the I.T.U. belonging to the region covered by the General Trunk Interconnection Programme (Europe, Mediterranean Basin, Middle East, and Southern Asia), to inquire whether they wish to participate, if they do not already appear in this list. He would draw their attention to the fact that if they did so participate, they would be required to share in defraying C.C.I.F. extraordinary expenditure as a whole, up to and including the XVIIth Plenary Assembly.

Sub-Committee for Rapid Operating Methods.

The Plenary Assembly expressed the wish that Administrations should for preference delegate to this Sub-Committee their representatives in the 6th, 8th or 9th Study Groups or, for such Administrations as might not be represented in those Study Groups, experts with the same qualifications.

* * *

Further, having examined the proposals made by the meeting of Heads of Delegations, the XVIIth Plenary Assembly approved the nomination of the Chairmen and Vice-Chairmen whose names appear in the membership of the Study Groups and Sub-Committees.

The meeting of the Heads of Delegations then considered the question of dates for the meetings of study groups, committees, subcommittees or working groups. Bearing in mind the proposals made by the meeting of Heads of Delegations, the XVIIth Plenary Assembly approved the Annex attached, entitled : " Meetings of Study Groups (or working groups thereof), 1955/1957 ".

When the Annex was being drawn up, the following comments were made :

1. *Editing of the C.C.I.F. printed volumes.*

For signalling and switching, it would not be possible to complete either the *Green Book* or the Directives for the General Trunk Interconnection Plan, until the working group of the 8th Study Group had completed its work.

As regards transmission, the Secretariat would perform the preliminary work of editing and classification, taking as a basis the instructions issued by the Committee which studied the general plan for C.C.I.F. printed works. The working group of the 3rd and 4th Study Groups, which is to meet in February 1955, would modernize certain transmission recommendations in Volumes III and IV that appeared out-of-date.

2. *Routing Plan for European Semi-Automatic International Traffic.*

It was pointed out that a study of this subject (provisional and necessarily incomplete) appeared on page 21 (5th paragraph to the foot of the page) and on pages 23 to 28 of the document " C.C.I.F. — 1952/1954 — 6th and 7th Study Groups — Document No. 29 ". In the list of transit centres in this document a correction should be made (page 21), " MILANO " replacing " ROMA ".

The Sub-Committee for Rapid Operating Methods will in 1956 hold a meeting with a view to drawing up a " Draft plan for the routing of European International semi-automatic traffic ". It will then be possible to see how further study of this matter (which should in any case be completed before 1960) would develop.

ANNEX

Meetings of Study Groups (or working groups) 1955-1957

1955

11-15 January 1955 (Geneva)

Sub-Committee on Rapid Operating Methods
— To define a signal code for semi-automatic working.
— To designate the members of the working groups :
 1. For " Semi-Automatic Service " ; Operators' Instructions.
 2. For the Instructions for the Maintenance of Semi-Automatic Circuits.
— To record the agreements already reached between Administrations as regards the semi-automatic working of international circuits.

17-22 January 1955 (Geneva)

Working Group of the 8th Study Group
— Specifications for international signalling and switching equipment.

26th January-5th February 1955 (Geneva)

Working Groups of the 3rd and 4th Study Groups on revision of transmission texts.

March-April 1955 (one week) (London)	*Working Group of the 8th Study Group* — To finish the final specifications for international signalling and switching equipment. — Study of specifications for maintenance equipment associated with international signalling and switching equipment.
First fortnight of June (Geneva, about 10 days)	*Working Group of the 9th Study Group* — Consideration of the results achieved by experiments on variations in equivalent. — Drafting of the draft General Line Maintenance Instructions, on the basis of the first draft drawn up by the C.C.I.F. Secretariat and of document " C.C.I.F. — 1952/1954 — Document No. 93 ".
June-July 1955 (Stockholm) (about 10 days)	*Working Group of the 8th Study Group* — To finish the Specifications for maintenance equipment associated with international signalling and switching equipment.
September 1955 (Geneva)	*Committee for the revision of international tariffs* — Study of the cost price of television transmissions (using the replies collected by correspondence to a 3rd Study Group question). — Study of the cost price of international signalling and switching equipment ; proportionate allocations for an international exchange and for a transit centre. — Study of the cost price for communications established by means of radio relay links.
October 1955 (Paris)	*Meeting of the 9th Study Group* — Establishment of the periodic maintenance plan, 1956. — Approval of the draft " General Line Maintenance Instructions ". *Working Group of the Sub-Committee on Rapid Operating Methods* — Preparation of draft " Maintenance Instructions for Semi-Automatic Circuits ".
1955 (date and place not decided) (in France)	*Committee for the revision of the Directives for protection against disturbances* — 1st meeting, possibly to take advantage of a validation by the C.M.I. of experimental work.
1955 (?)	*Meeting of a joint Committee of the C.C.I.'s for the establishment of a joint glossary of definitions* — Date of the meeting to be fixed by the Directors of the three C.C.I.'s

1956

March 1956 (Geneva)	*Meetings of the 3rd, 4th and 5th Study Groups*
March-April 1956 (Geneva)	*Meetings of the 6th, 7th and 8th Study Groups* — *Meetings of the Sub-Committee for Rapid Operating* Methods with the object of establishing the routing plan for international semi-automatic telephone traffic in Europe (preliminary study).
Autumn 1956 (Geneva)	*Meeting of the 9th Study Group* — Establishment of the periodical maintenance plan, 1957.

Autumn 1956 (Geneva)	*Meetings of the 1st and 2nd Study Groups*
1956 (?) (date to be fixed)	*Committee for the revision of the Directives for protection against disturbances* (2nd meeting)

The date of the meeting of the Committee for the revision of the International Telephone Regulations will be fixed by the Director of the C.C.I.F. in agreement with the Secretary-General of the I.T.U., as soon as the opening date of the Telephone and Telegraph Administrative Conference is known.

MINUTES
OF TWO MEETINGS FOR OPERATING AND TARIFFS

(Geneva, 6 October 1954, morning and 7 October 1954, afternoon)

The first meeting of the XVIIth Plenary Assembly of the C.C.I.F. for operating and tariffs was held at Geneva on 6th October 1954, from 10 a.m. to 12.30 p.m. and the second meeting on 7th October 1954, from 3 p.m. to 7.30 p.m. under the chairmanship of Mr. HARVEY (United Kingdom).

The documents listed below served as a basis for the discussion.

" C.C.I.F. — 1952/1954 — 6th and 7th S.G. — Document No. 23 — Report of the meeting of the Committee for the revision of international telephone tariffs, Geneva, 17 March 1953."

" C.C.I.F. — 1952/1954 — 6th and 7th S.G. — Document No. 24 — Report of the meeting of the 6th and 7th Study Groups of the C.C.I.F. at Geneva, 12/21 March 1953."

" C.C.I.F. — 1952/1954 — 6th and 7th S.G. — Document No. 29 — Report of the meeting of the 6th and 7th Study Groups of the C.C.I.F. at Geneva, from 16 to 25 September 1954."

The Plenary Assembly first examined the draft replies to questions Nos 1 to 20 the study of which has been undertaken by the 6th and 7th Study Groups. These replies are given in the Report of the meeting of the 6th and 7th Study Groups at Geneva in March 1953 (Document " C.C.I.F. — 1952/1954 — 6th and 7th S.G. — Document No. 24 ") and in September 1954 (Document " C.C.I.F. — 1952/1954 — 6th and 7th S.F. — Document No. 29 ").

The Plenary Assembly approved the draft replies with comments and changes as follows :

Document No. 24

Questions Nos. 5 and 11.

The information given in the appendix to the reply to these questions will be printed in the Volume of the *Green Book* of the C.C.I.F. relating to recommendations concerning operating and tariffs, so as to keep track of this information in the works of the C.C.I.F.

Document No. 29

Question No. 7.

The Plenary Assembly decided to add the following to the wording of the new question :

" Is it necessary to revise Recommendation No. 49 of the C.C.I.F. as regards the tariff applicable to broadcast transmissions using a normal type circuit ? It so, what do you propose ?

the following note :

Note. — It would be useful for these proposals to include information concerning :

(a) the capital invested in circuits for broadcast transmissions of normal type ;

(b) the annual charges for these circuits, taking account of operating costs, and maintenance, and maintenance and general costs.

and an appendix :

Appendix

A previous study of net costs had enabled the following information to be obtained :

(This appendix will give a summary of the information which was sent to the Secretariat of the C.C.I.F. for the study of question No. 7 in 1952/1954).

Question No. 8.

The Plenary Assembly considers that in view of the changes introduced by this reply in the " Instruction for the staff concerned with supervising and charging for broadcast transmissions in Europe ", it will be necessary to reprint this booklet.

Further it considers that the definition of " circuit de conversation (control circuit) " should be included in the List of definitions when it is revised.

Question No. 12.

The Plenary Assembly decided to modify the notes which follow the new wording to question No. 12 so that all information relative to the net cost of equipment (for television circuits on coaxial pairs as well as for circuits in broad band radio relay systems) should be sent direct to the Secretariat of the C.C.I.F.

The amended text of question No. 12 is therefore as follows :

Question No. 12 (7th Study Group, in cooperation with the 3rd and 5th Study Groups of the C.C.I.F.).

In accepting that television will develop rapidly during the next few years and that Administrations will have to place circuits at the disposal of Broadcasting Organisations for this new service, is it not desirable to fix the charges for these television transmissions by considering at the same time.

(a) the case of a television circuit on a coaxial pair,

(b) the case of a television circuit on broad band radio relay links.

Note 1. — With a view to providing the necessary technical information to the 7th Study Group in order to fix the charges to be applied to occasional television transmissions or the renting of circuits for television transmissions, the 3rd and 5th S.G. of the C.C.I.F. should first reply to the two following questions :

A. *Coaxial pairs.* — *(a)* What, at least approximately, is the ratio between the net cost of a telephone conversation exchanged from end to end on a telephone circuit in a coaxial system, and the net cost of a television transmission in one direction only over a coaxial system *without modification of the cable and the repeaters* ?

(b) In view of the fact that for good quality television transmissions, it is necessary to have terminal equipment different from that for telephony and, moreover, to modify the repeaters in order to obtain a supplementary phase compensation, what supplement is envisaged to the abovementioned ratio in order to take account of these modifications ?

B. *Broad-band radio relay system.* — *(c)* What, at least approximately, is the ratio between the net cost of a telephone conversation exchanged from end to end over a carrier current telephone system on a broad-band relay system, and the net cost of a television transmission, in one direction only, over a broad-band radio relay system without modification of the relay stations ?

(d) In view of the fact that for good-quality television transmissions, it is necessary to have terminal equipment different from that for telephony and, moreover, to modify the relay stations in broad-band radio relay systems, what supplement should be envisaged to the above-mentioned ratio in order to take account of these modifications ?

Note 2. — The questions posed will be studied for three television standards envisaged in Europe (405, 625 and 819 lines) on the basis of the replies of the C.C.I.R. to its study programme No. 32 (corresponding to C.C.I.F. — 3rd Study Group — Question No. 16).

Note 3. — When the above-mentioned information requested of the C.C.I.F. 3rd and 5th S.G.s becomes available, the Committee for the revision of International Tariffs will establish a detailed questionnaire in order to study the net cost of television transmissions.

Question No. 15.

The Plenary Assembly had a considerable discussion on the new wording proposed for Recommendation No. 23.

Following this discussion, the Plenary Assembly considered that it would be useful (having regard to the official powers of the International Telecommunication Union, in accordance with the existing agreement between the United Nations Organisation and the International Telecommunication Union) that a right should be officially affirmed for the international plan, for the benefit of Administrations and recognized Private Operating Companies, when international lines are set up and operated by a public service other than an Administration or private telephone operating organisation.

Finally, the Plenary Assembly approved Recommendation No. 23 with the following changes of wording (in the body of the Recommendation and as regards point 6) :

THE INTERNATIONAL TELEPHONE CONSULTATIVE COMMITTEE,

considering,

. . . .

issues the recommendation

that the following principles should be applied to the use of private international telephone connections for a public service (set up and operated by that public service):

1. . . . .

. . . .

6. To compensate to a certain degree for the loss of revenue resulting to the Administrations and private telephone operating organisations) from the privilege thus accorded to the users of such private international telephone connections, the Administrations and/or private operating Companies concerned will charge an annuity of 12 gold francs per kilometer of circuit used on their own territory, the payment of this annuity falling upon the proprietors of the circuits used. Each Administration will itself determine the length of the circuits to be taken into consideration, taking account of the point where the circuit crosses the frontier and the point or points from which the circuit(s) can be used.

Question No. 17.

The Plenary Assembly made certain changes to the draft Recommendation No. 63 *bis*.

As well as certain modifications of a purely editorial nature it is necessary in this draft Recommendation :

1. To replace the two " considerations " by the following text :

considering

— that Tables A and B mentioned in Recommendation No. 63 were established primarily for the calculation of the number of circuits used in manual service,

— that for reasons of uniformity and convenience it is preferable, for calculating the number of circuits necessary to carry a given traffic in semi-automatic operation, to refer to a formula which is widely used and for which there exists tables and curves which are easy to obtain.

2. To complete the last line of this Recommendation by adding the following sentence :

The values which are recommended for use for the " loss probability " should therefore be considered rather as serving to determine the value of the parameter *p* indicating the column of the numerical table or the curve which should be used.

3. To replace by the following text, the text relating to the first 2 cases envisaged :

1st case. — Direct routes used only for terminal traffic without the possibility of automatic alternative routing. The table or the graph corresponding to a value of the parameter *p* (loss probability) equal to 5% should be used.

Nevertheless, in the case where operators have direct access to international circuits or have access to them by means of automatic selectors which search continously for a certain period, one can admit ... etc.

2nd case. — Routes involving obligatory passage through a transit centre without the possibility of automatic alternative routing. The table or the graph corresponding to a value of the parameter *p* (loss probability) equal to 3% for each group of circuits should be used.

The Plenary Assembly approved Recommendation No. 63 *bis*, with these amendments.

Ir will be necessary to arrange for the texts proposed for the " Operating Directives for the General Interconnection Programme " to be brought into agreement with Recommendation No. 63 *bis* as modified.

Question No. 19.

After the study it will be necessary to modify the definition of normal route as shown on page 120 of Volume I *ter* of the *Yellow Book.* The definition of the normal route given in Recommendation No. 1 of the C.C.I.F. giving international telephone operating definitions will then become as follows :

Normal route. — In manual operation, the route which should be chosen in the first instance for touring telephone traffic for a particular international relation.

In semi-automatic operation, for economical reasons, there could be several normal routes (the switching equipment being arranged to take account of these different normal routes). There could be, for example, a first choice normal route, a second choice normal route, a last choice normal route. It is convenient to call " overflow route " all normal routes other than the first choice route.

The following note will be introduced after this definition of normal route :

Note. — The attention of the International Telegraph and Telephone Administrative Conference should be drawn to this text.

The Plenary Assembly examined the arrangements which will be necessary for the establishment of a " normal routing plan for telephone traffic (for semi-automatic operation) in Europe ". This plan will indicate the first choice normal route and possibly normal routes other than the first choice route, called " overflow routes ", which will be determined by agreement between the administrations concerned.

To establish this routing plan it might be necessary to have a special meeting at which all Administrations and Private Operating Companies in Europe should be represented. When selecting its Delegation each Administration or Private Operating Company should include in it Members of the 3rd, 6th, 7th and 8th Study Groups or officers with similar qualifications.

After intervention by the Delegates of BELGIUM, FRANCE, UNITED KINGDOM and SWITZERLAND the Plenary Assembly decided that before such a meeting was held, it would be necessary for a Committee to determine the criteria according to which the routing plan should be established, and in particular, what would be the value of overflow routes in Europe having regard to the replies which will have been obtained to the new question posed on the subject of the net cost of semi-automatic equipment ; and of the share (quote part) which should accrue to an international terminal exchange and an international transit exchange.

" The Plenary Assembly, at its second meeting, devoted to organizational questions, decided to entrust this provisional task to the Sub-Committee on Rapid Operating Methods. This Sub-Committee, in the course of its preliminary studies, might take into consideration the information given in the document " C.C.I.F. — 1952/1954 — 6th and 7th Study Groups — Document No. 29 " (pages 21 to 28), information given as provisional data only (in particular, it should be noted that ROMA shown in this document as a transit centre is to be replaced by MILANO).

It may be that the Sub-Committee on Rapid Operating Methods will be able to perform the entire work of drawing up a plan for semi-automatic routing.

Recommendation No. 21 bis.

The Plenary Assembly approved Recommendation No. 21 *bis* regarding the simultaneous use (for telegraphy and telephony) of rented telephone circuits. This Recommendation is in agreement with Recommendation H/13 of the C.C.I.T. It will be necessary when this Recommendation is inserted in the list of operating Recommendations, to make a reference to this C.C.I.T. Recommendation.

The adoption of this Recommendation puts an end to the study of question No. 9 of the 1st Study Group.

Questions whose study should be undertaken or continued in 1955/1957

The Plenary Assembly considers that it will be necessary to leave for study question No. 15 regarding the utilisation by third parties of rented circuits. Recommendation No. 23 only concerns the case of connections set up and operated by a public service and does not cover the general case of the utilisation of rented circuits by third parties.

New questions B, F, and K should be studied in cooperation with Study Group No. XI of the C.C.I.T.

In order to make allowance for the new Recommendation 21 *bis*, Question K, on page 62 of the document " C.C.I.F. — 1952/1954 — 6th and 7th Study Groups — Document No. 29 " should be amended to read :

Question K (7th Study Group in cooperation with the 3rd Study Group and with C.C.I.T. Study Group XI) (Category) A 2 [urgent].

In order to meet the particular needs of certain users having a large telephone, telegraph or phototelegraph traffic, is it to be recommended that it should be agreed to lease telephone circuits permitting, at the will of the user, a telephone conversation, a phototelegraph transmission, or the use of a telegraph channel ?

What should be the conditions for lease of such a circuit, which could only be of good quality, since transmissions are always successive ?

Question O should be studied in cooperation with the 8th Study Group and should be considered as urgent.

In the wording of Question I, it will be necessary to delete all reference to the transmission of telegraph messages or to phototelegraphy, which are proper to the C.C.I.T. and the 1st paragraph of the wording of that question should be as follows :

Is it desirable (to meet the particular needs of certain users interested only in either the reception or the emission of telephone messages or broadcast programme) that Administrations and Private Operating Companies should foresee in parallel with the existence of broadcast (or telephone) circuits, a lease of receivers or transmitters (possibly connected by telephone circuits to the premises of those interested) to effect either reception only or simply transmission ?

The attention of the C.C.I.T. is drawn to the expedience of making a similar study (within the C.C.I.T.) for the transmission of telegraph messages or of phototelegraphs.

A considerable discussion followed concerning the desirability of introducing a new question relating to a reduction of international telephone tariffs for press conversations.

The NETHERLANDS Delegate mentioned that a questionnaire had been sent by the I.T.U. to all Administrations regarding a report made by UNESCO on the general problem of the facilities offered to the press. It would therefore be preferable not to introduce a question on this subject in the C.C.I.F. until the results of the study undertaken by the I.T.U. were known.

The U.S.S.R. Delegate and the CZECHOSLOVAKIAN Delegate would have wished that this question could have been put to study in the C.C.I.F. straight away so that an exchange of views on the matter could have taken place before the next " International Telegraph and Telephone Administrative Conference " and permitting, during that Conference, a rapid solution to the problems which could arise.

After various interventions by the Delegates of FRANCE, ITALY, the UNITED KINGDOM and SWITZERLAND and by Mr. Terras, Chairman of the 7th Study Group, and having regard to the fact that most Administrations thought that the best course would be to leave the examination of this problem to the Administrative Council of the I.T.U., the U.S.S.R. Delegate did not insist on the inclusion of the question which he had proposed on this subject in the list of questions to be studied by the C.C.I.F.

* * *

After a break, a considerable discussion took place on the " C.C.I.F. Committee for the General Interconnection Programme ", as defined in Resolution 292 of the I.T.U. Administrative Council (Ninth Session, Geneva, May, 1954). Mr. Valensi explained that the Committee in question, although its discussions were governed by the General Regulations and although all expenses in connection with its documents were borne by the C.C.I.F., was not really a " study group " in the sense of the Convention and General Regulations ; it was a meeting participated in not only by the qualified reprsentatives of administrations and of independent telephone operating companies, but also by specialists designated by name by the Plenary Assemblies of the 3 C.C.I.s of the I.T.U. because of their particular competence in the matter of international main telecommunication routes. The purpose of the meeting was simply to record the multilateral agreements reached between the administrations and telephone operating organizations of sovereign countries as regards the setting up or disposition of the main telecommunication routes interconnecting their respective countries.

Following this discussion and with the agreement of Mr. Gastebois, Chairman of the " C.C.I.F. Committee for the General Interconnection Programme ", of the Director of the C.C.I.R., of the Director of the C.C.I.F. and of Mr. Besseyre, representing the Interim Director of the C.C.I.T.—also with the agreement of Mr. Gneme, " Doyen " of the I.T.U., and of Mr. Harvey, Vice-Chairman of the XVIIth Plenary Assembly of the C.C.I.F., it was decided to make the following changes in the wording to the draft text set up by the " C.C.I.F. Committee for the General Interconnection Programme " during its meeting in Geneva from 1st to 15 September 1954 :

1. The Book to be printed will be entitled : General Interconnection *Plan* 1954/1958 " and this name will be introduced in all cases instead of the term " General Interconnection Programme. *

2. The second paragraph of the introduction to this work will be reworded as follows :

This general plan of interconnection is a document set up by a Committee comprising, in addition to qualified Delegates from Administrations and recognized private operating Organisations of Europe, of the Mediterranean Basin, of the Middle East, and of Southern Asia, specialists of the three International Consultative Committees of the International Telecommunication Union ; it is intended to assist these administrations and recognized private operating Organisations when they conclude between themselves *in their full sovereignty*, agreements with a view to organising or to improving international services between their respective countries.

3. Appendix 3 entitled : " List of telegraph circuits necessary during 1954/1958 in Europe, with certain information concerning the Mediterranean Basin, the Middle East and Southern Asia ", will not appear in the printed book, but will constitute a document kept up to date at regular intervals by the Specialized Secretariat of the C.C.I.T.

4. Appendix 7 entitled " Table of the number of telephone circuits or circuits for V.F. telegraph system) considered necessary for the operation (including traffic reserve) of the various international services of Europe and of the Mediterranean Basin during the period 1954/1958 (excluding circuits for frontier services) " will not appear in the printed work ; it will consist of a mimeographed document which, instead of being shown in the form of a table, will have one page for each country, and this document will be kept up to date at regular intervals, by the Specialized Secretariat of the C.C.I.F.

5. Page 4 of the " draft text " for the printed work, under " Connection Turkey-Iran ", in the 3rd paragraph, should read :

the telephone Administrations of Turkey and Iran should preferably use this method of construction over the whole route between D. Beyazit and Macou.

The CHAIRMAN, on behalf of all the Delegates thanked M. Gastebois, Chairman of the Committee for the General Plan of Interconnection, as well as the Members of that Committee, who had carried out a major and extremely useful work during the remarkably short time, having regard to the importance and the number of the questions concerned.

Mr. LANGERBERGER on behalf of all the Delegates and Representatives congratulated Mr. Harvey for the competence and the courtesy with which he had presided over these two meetings reserved for questions of operating and tariffs.

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* Nevertheless, it was recognised, in a later meeting, that the C.C.I.F. Plenary Assembly cannot modify the title " C.C.I.F. Committee for the General Interconnection *Programme* " which appears in Resolution No. 292 of the I.T.U. Administrative Council (see Minutes of the 2nd and 3rd meetings concerned with organisational question.)

MINUTES
OF MEETINGS DEALING WITH TRANSMISSION
(Geneva, 6th October and 8th October 1954)

The first transmission meeting of the XVIIth Plenary Assembly of the C.C.I.F. was held at Geneva (Maison des Congrès) on 6th October 1954 from 1500 hours to 1830 hours and the second meeting on 8th October from 1500 hours to 1400 hours with Mr. G. Pedersen (Denmark) in the chair.

The Meeting first took as a basis of discussion document " C.C.I.F. — 1952/1954 — 4th Study Group — Document No. 33 — Minutes of the meeting of the 4th Study Group of the C.C.I.F. at Geneva, from 1st to 8th October 1953 ". The replies to questions Nos. 1, 2, 3, 11 and 15 given in this document were approved by the Plenary Assembly with the following observations :

Question No. 1. — The new wording of this question, suggested by the 4th Study Group is approved.

Question No. 2. — The reply of the 4th Study Group should appear in the printed works of the C.C.I.F.

Question No. 3. — The reply to this question, with the modifications proposed by the 1st Study Group, will be incorporated in the printed works of the C.C.I.F.

Question No. 11. — This question remains for study with the same wording.

Question No. 15. — The bibliography given in the reply to this question will be inserted in the documentary part of the printed works of the C.C.I.F. and the study of this question is concluded.

* * *

The meeting then took as a basis of discussion document " C.C.I.F. — 1952-1954 — 4th Study Group — Document No. 59 — Minutes of the meeting of the 4th Study Group at Geneva, 16th to 20th September 1954 ".

The replies to questions Nos. 7, 8, 14 and to the new question C in this document were approved without comment.

The following observations were made with regard to the replies to certain questions.

Questions Nos. 4 and 5.

In accordance with the reply given later by the 3rd Study Group, the Laboratories of the C.C.I.F. should make articulation tests using the recordings of noise on radio relay systems already given to them, and also the recordings of carrier telephone systems (on coaxial pairs and on balanced pairs) which Administrations have been asked to supply. It is not necessary for tests to be made using either the recordings of induced noise from transport and power distribution lines, or those for noises due to exchange switching apparatus.

Question No. 6.

It is emphasised that the measurements of relative reference equivalent which are to be made in the C.C.I.F. Laboratories have as their only object the determination of a method for measuring a numerical value, as near as possible to the reference equivalent, by means of comparisons with A.R.A.E.N. using as a basis the volume of the received sound. This would seem to be necessary if S.F.E.R.T. should cease to be of use in the future.

Full details of the tests to be made by the C.C.I.F. Laboratories will be given in the programme of tests to be made in these Laboratories which will appear in the printed works of the C.C.I.F.

Questions Nos 9, 10, 10 bis *and A.*

There was a prolonged discussion on that part of the draft recommendation prepared by the 4th Study Group on the question of methods of specifying the quality of transmission, to be used in the international telephone service, and the permissible limits for reference equivalent and the A.E.N. of the national sending and receiving systems.

It was finally decided that this text should not at present be regarded as a recommendation, but only as a rule which Administrations and Private Operating Companies are requested to try out for a period of one year after which they should inform the Secretariat of the C.C.I.F. of the results obtained. The Secretariat of the C.C.I.F. should then send, by post, this information to all members of the I.T.U. and if there have been no major difficulties in applying it in practice the text should become a recommendation.

The changes to be made to the reply of the 4th Study Group to give effect to this decision are given in the Annex attached.

Questions Nos. 12 and 13.

The reply of the 4th Study Group in will be included in the printed works of the C.C.I.F. with the following modifications :

Replace the last phrase at the bottom of *page 21*, by :

" It is pointed out that with this artificial ear, certain precautions must be taken when applying telephone receivers with an earpiece having a small diameter and being relatively shallow.

Replace the first two lines on *page 22* by :

" The exact dimensions of the artificial ear used in the C.C.I.F. Laboratories are defined in the ..."

Page 23. — The title of this diagram should be :

" Provisional reference artificial ear used by the C.C.I.F."

Question No. 16.

In the absence of precise information regarding the new location for the C.C.I.F. Laboratories within the projected I.T.U. building, this question must remain for study.

Question No. 17.

The bibliography given in the reply to this question will be included in the documentary part of the printed works of the C.C.I.F.

The revised list of questions which the 4th Study Group proposes to start studying or to continue to study in 1954/1957 (" C.C.I.F. — 1952/1954 — 4th Study Group — Document No. 59, pages 41 to 55 ") is approved with the modifications given above in relation to the replies to certain questions.

The programme of work of the C.C.I.F. Laboratories during the years 1954/1955/1956 (" C.C.I.F. — 1952/1954 — 4th Study Group — Document No. 59, pages 56 to 67 ") is approved.

* * *

The Plenary Assembly then studied the replies to the transmission questions which appear in document " C.C.I.F. — 1952/1954 — 3rd Study Group — Document No. 46 : Minutes of the Meeting of the 3rd Study Group at Geneva, from 12th to 31st October 1953 " together with document 46 *bis* and with the modifications to these replies appearing in document " C.C.I.F. — 1952/1954 — 3rd Study Group — Document No. 94 — Minutes of the Meeting of the 3rd Study Group in Geneva from 21st September to 1st October 1954 ".

These replies were approved with the following reservations :

Question No. 3.

It is suggested by the Study Group that maintenance of circuits in the semi-automatic network will be studied after the Plenary Assembly by a working party set up for this purpose. This point should be further considered during the meeting for signalling and switching.

Question No. 5 bis.

The meeting approved the setting up of a working party entrusted with the revision, in the printed works of the C.C.I.F., of certain old numerical values or wording which has several possible interpretations. This working party, which was given a delegation of power by the Plenary Assembly, will include delegations of the following Administrations : France, Italy, Federal German Republic, United Kingdom, Switzerland.

In the unlikely event of this working party being unable to settle without controversy certain of the points mentioned in the attached Annex 2, it will be their responsibility to formulate new questions and the Secretariat of the C.C.I.F. will forward these questions to Administrations ; if twelve Administrations agree in putting these questions to study, this will be done by applying the procedure described at the end of Article 7, § 2 of the International Telecommunications Convention of Buenos Aires, 1952. If, after the XVIIth Plenary Assembly of the C.C.I.F., the attention of the Secretariat is drawn to the need for making certain modifications to texts approved by the Plenary Assembly, the Secretariat will study them and, if of an editing character they will be accepted without further study. If the Secretariat considers that they are of a fundamental nature, they will be passed on to the working group which will meet after the Plenary Assembly and the comments of the working party will be communicated, in so far as is necessary, to Administrations which take part in the work of the C.C.I.F.

It was also agreed that the working party should examine also certain texts which appear in the *Yellow Book* of the C.C.I.F., Volume IV (pages 196 to 248, 252, 258 and 293 to 300) but which are in fact within the field covered by the 3rd Study Group.

Question No. 9.

Since, in line with the draft recommendation of Study Group XI of the C.C.I.T., the meeting of the Plenary Assembly of the C.C.I.F. devoted to operating and tariff questions has decided that it is not necessary to permit simultaneous telephone and telegraph transmission on international private wires, it is not necessary for the 3rd Study Group to continue to study the technical characteristics of such connections.

Question No. 16.

It is necessary to make quite clear in the printed works of the C.C.I.F. that all recommendations adopted as a result of the reply to this question and also to questions Nos. 16 *bis* and 16 *ter* are provisional.

Question No. 19.

It was decided to delete all reference to the length of circuit in the wording of this question.

Question No. 22.

The study of this question is completed.

Question No. 23.

The new question to be put to study is Category A 2. The study of questions Nos. 23 *bis* and 23 *ter* is completed.

Question No. 24 bis.

The study of this question is completed.

Question No. 31.

The second part of the reply to this question, made in October 1953, should be appended to its text.

Question No. 32.

The meeting did not examine in detail the document " C.C.I.F. — 1952/1954 — 3rd Study Group — Document No. 93 " which was the account of the Meeting of the Permanent Maintenance Sub-Committee at Geneva in September 1953, because the Chairman of the Sub-Committee stated that all matters relating to the Sub-Committees proposals regarding questions Nos. 4, 8 and 32 of the 3rd Study Group, had been covered in document No. 94.

The setting up of the working party the analyse the results of tests of variations of equivalent with time (question No. 4), to study the revision of Maintenance Instructions for circuits in the semi-automatic network (Question No. 32) and to draft Maintenance Instructions for circuits in the semi-automatic network (Question No. 3 of the 3rd Study Group and Question No. 10 of the 8th Study Group) should be reconsidered during the meeting dealing with signalling and switching and a decision should be made finally during the closing meeting of the Plenary Assembly.

On the other hand it should be made clear in annex 2 to the reply to this question (which reproduces the suggestions made by the Permanent Maintenance Sub-Committee on the subject of maintenance of carrier telephone systems), that the frequencies shown for reference measurement on a line regulated section on balanced pairs correspond to only one of the alternative schemes adopted for pilots of carrier telephone systems on balanced pairs.

Question No. 37

The new question (relating to interconnection of coaxial cable and radio relay systems for transmission of alternative or simultaneous telephony and television) given in the answer to this question is to be studied by the 5th Study Group in cooperation with the 3rd Study Group of the C.C.I.F. and with the C.C.I.R. Also the Meeting decided to put to study the following new question :—

New question (5th Study Group in cooperation with the 3rd Study Group and with the C.C.I.R.) (Category A 2) [urgent].

What conditions should be fixed, for international transmissions, for the interconnection of a coaxial cable system carrying a television transmission and a radio relay system carrying the same transmission :

(a) in the case of interconnection at video frequency ?

(b) in the case where the modulated signal transmitted over the coaxial pair is applied without alteration to the radio relay system if this is possible ?

Questions E, F, G, H, I

The replies made to these questions in October 1953 should be added to their wording.

Question E ter.

It will be necessary, in a later meeting of the Plenary Assembly, to consider whether a delegation of power should be given to a working party entrusted with responsibility for dealing with this question and if this working party should also deal with the new question which appears in the reply to question E *ter*.

The list of questions to be studied in 1954/1957 is that which appears on pages 260 to 358 of document " C.C.I.F. — 1952/1954 — 3rd Study Group — Document No. 46 " with the alterations, additions and deletions given in document " C.C.I.F. — 1952/1954 — 3rd Study Group — Document No. 94 " and in these minutes.

* * *

The Meeting then took as a basis of discussion, documents " C.C.I.F. — 1952/1954 — 5th Study Group — Document No. 4 " minutes of the meeting of the 5th Study Group at Geneva in October 1953 " and " C.C.I.F. — 1952/1954 — 5th Study Group — Document No. 8 — Minutes of the meeting of the 5th Study Group at Geneva from 30th September to 1st October 1954 ".

The Meeting approved the replies to the questions of the 5th Study Group. The study of question No. 1 should be continued with its new wording and the study of question No. 2 is completed. The questions dealing with radio relay systems had already been examined when the questions of the 3rd Study Group were considered.

* * *

At the end of the second meeting, the *Chairman* thanked Messrs Franklin, Swedenborg and Marzin and all the other members of the 3rd, 4th and 5th Study Groups for the good work they had done and the results of which the Plenary Assembly had been able to approve with very few amendments.

Mr. EHNLE (Holland) thanked the Chairman for the able and courteous manner with which he had directed the debates during the two meetings devoted to transmission.

ANNEX

Alterations to be made to document C.C.I.F. — 1952/1954 — 4th Study Group — Document No. 59

Page 8: Modify as follows the beginning of the reply to questions No. 9, 10, 10 *bis* and A :

" The XVIIth Plenary Assembly of the C.C.I.F. adopts as a provisional rule the attached text which replaces pages 2 and 3 of the Draft Directives of transmission for the General Interconnection Plan 1954/1958 and the corresponding passages of the *Yellow Book.* The study of questions No. 6, 9, 10, 10 *bis* and of new question A is completed.

The XVIIth Plenary Assembly of the C.C.I.F. put to study the following new question of a documentary nature :

" *New question.* — (4th Study Group in cooperation with the 3rd Study Group) (Category B) [urgent]. (Continuation of question No. 8 studied in 1952/1954.)

Administrations are requested to send to the Secretariat of the C.C.I.F. before 1st October 1955, the results of the experience they have acquired in applying to their national transmitting and receiving systems the rule given below ".

In addition, the following new question is put to study :

" *New question.* — (4th Study Group in cooperation with the 3rd Study Group) (Category B) [urgent].

What limits are applied by your Administration, to the junction and trunk networks of your country in order to ensure satisfactory quality for inland calls, it being understood that the recommendation of the C.C.I.F. relating to reference equivalent and the rule relating to transmission performance rating are satisfied for international calls.

Note. — The object of the C.C.I.F. recommendation is to ensure satisfactory quality on international calls in which there are differing national systems and where the recommended limits are reached, it being understood that in each country the network has been designed so as to ensure satisfactory quality for inland calls. This question has been set so as to provide Administrations which are about to develop their national telephone service, with information on the best method of laying out their network ".

Page 9: Delete at the top of the page the heading " Draft Recommendation ".

Page 10: Delete Remark 3. In the table read : Reference equivalent of the connection between two operators (with the subscribers lines connected) : 3.3 nepers or *28.7* decibels.

Page 12: 1st paragraph, read :

" *Transmission performance rating (indice de qualité de transmission).*

It is the value (in decibels or in nepers) of the additional loss necessary to be added to or substracted from the *Reference System* for the determination of *Articulation Reference Equivalent (S.R.A.E.N.)* to obtain equal transmission performance when the apparatus under test is either used to replace part of the complete reference system or is added to one of its parts as appropriate ".

Pages 14-15: replace § *(d)* by :

" (d) *Limits for transmission performance rating between two subscribers, the transmission performance rating of the national sending system and the transmission performance rating of the national receiving system.*"

Administrations and Private operating companies are requested to try out the following rule and to inform the Secretariat of the C.C.I.F. *before the 1st October 1955* if they have had any difficulty in applying it to their national network.

The Secretariat of the C.C.I.F. will communicate the results of this investigation to all countries which are Members and Associate Members of the I.T.U. and will ask them if, having regard to the results of this investigation, this rule can be made into a firm recommendation.

Rule: It is very desirable that, for 90% of international calls, the nominal total transmission performance rating should not exceed 49 decibels (5.65 nepers). Provisionally this limit may be subdivided in the following manner :

For 90% of international calls :

— the nominal transmission performance rating of the national sending system should not exceed 24 decibels (2.77 nepers),

— the nominal transmission performance rating of the national receiving system should not exceed 18 decibels (2.04 nepers).

It is assumed in the above that the transmission performance rating of the international circuit does not exceed 0.8 nepers or 7 decibels. This transmission performance rating is equal to the nominal equivalent of the circuit at 800 c/s (as defined in sections 1.1.1. above and 1.3.1. below), correction being made if necessary for impairment (see section 1.1 *ter* below). This limit does not take account of the variations in the equivalent of the international circuit, with respect to its nominal value, as a function of time.

Note 1. — The limits (24 decibels and 18 decibels) for the national systems, at the sending and receiving ends, do not include the probable variations, as a function of time, of the equivalent of the trunk circuits which enter into the composition of the national system.

Note 2. — These limits apply to A.E.N. values deduced from values determined, for a local system, at the C.C.I.F. Laboratory as indicated in annex 2 below, with, in particular, a room noise at the receiving end of 60 decibels for the commercial systems and an electrical background noise (of a psophometric e.m.f. of 2 millivolts) injected at the input to the receiving system of the A.R.A.E.N."

MINUTES
OF THE MEETING TO CONSIDER
THE CHOICE OF A SIGNALLING SYSTEM
AND QUESTIONS OF SIGNALLING AND SWITCHING

(Geneva, 7th of October, morning)

The meeting set apart for the choice of a signalling system and for questions of signalling and switching was held in Geneva 7th of October 1954 from 9.30 to 12.05 under the chairmanship of Mr. Rouviere (France).

The documents which formed the basis of the discussion were the following :

" Minutes of the Joint Meeting of the 6th and 8th Study Groups of the C.C.I.F. (Geneva, 25th September - 2nd October 1954) (meeting set apart for the choice of a signalling system), and

" C.C.I.F. — 1952/1954 — 8th C.E. — Document No. 22 ".

The Plenary Assembly examined :

1. The three recommendations made in the Minutes of the Joint Meeting of the 6th and 8th Study Groups and of the Permanent Sub-Committee for Maintenance (Geneva, 1st-15th of September 1954) ;
2. The arrangements to be made for completing the texts of the C.C.I.F. as regards semi-automatic operation ;
3. The replies to the questions studied, and the proposals for the study of new questions, made by the 8th Study Group.

* * *

I. Choice of a signalling system and recommendations regarding semi-automatic operation

Recommendation No. 1 relating to the choice of a signalling system was read.

The CHAIRMAN mentioned that the 8th Study Group during its meeting in October 1954 had recommended that a supplementary paragraph should be inserted into this Draft Recommendation to mention the possibility of using dial impulses for the transmission of numerical signals.

On the proposal of the FRENCH DELEGATE supported by the DELEGATE OF THE UNITED KINGDOM, and after a comment by the SWISS DELEGATE the following amendments to the Draft Recommendation were accepted by the Plenary Assembly :

(a) In the first part (of an introductory nature) of that Recommendation to replace the 2nd paragraph by :

that the field trials which were conducted with public traffic in 1953 and 1954 in order to permit a choice between the two signalling systems proposed for standardisation (the one frequency system and the two frequency system) showed that in the opinion of the operating services both systems were satisfactory, and did not afford clear evidence of the superiority of one system over the other,

and to replace the text itself of the recommendation by :

issues the recommendation

that the Administrations and Private Operating Companies use for semi-automatic international telephone operation one of the two later defined standard systems in the following conditions.

(b) At the end of the part " terminal traffic " after the second recommendation, insert as a note the text proposed by the 8th Study Group ; consequently, one should read :

Note. — By agreement between Administrations, the transmission of numerical signals can be by means of dial pulses, without recourse to the use of the special signal codes used for numerical information in each of the two standard systems.

(c) In the part relating to transit traffic, change the wording of the 4th paragraph (which is a statement of fact) and delete Note 1 (Note 2 becoming Note 1). Consequently one should read :

" .....will be applied,

and having regard to the fact

that the majority of countries which prefer the 1 V.F. system, in 1954, attach only small importance to transit routings, whilst the majority of countries which consider that during the above mentioned period transit operation will be of importance for the distribution of their traffic and which desire to see a rapid development of transit operation, are in favour of the 2 V.F. system.

recommends :

that Administrations and/or Private Operating Companies will normally use the 2 V.F. system for transit operation, except when special agreement is reached between three or more countries to use the 1 V.F. system for transit working between them.

Note 1. — In accordance with this recommendation the transit equipment and the circuits used for transit in semi-automatic operation... " (the rest unchanged).

Recommendation No. 1 with these amendments was unanimously approved.

Mr. CHOVET, French Delegate, proposed that a telegram should be sent to Captain LEGG to inform him of the happy result of the work as regards an international signalling system and to send him in his retirement best wishes and thanks for having prepared the way for that happy conclusion.

In succession, The CHAIRMAN, Mr. VALENSI, Director of the C.C.I.F. and the leader of the UNITED KINGDOM DELEGATION underlined the fine spirit of understanding which had lead to this excellent solution of a problem for which it had appeared so difficult to reach general agreement on a decision ; the problem (the choice of an international signalling system) had been the object of work without precedent in the history of the C.C.I.F. and the work has been carried out with a remarkable team spirit.

Recommendation No. 2 regarding the facilities to be provided at an incoming centre in international semi-automatic operation and Draft Recommendation No. 3 emphasizing the interest of international semi-automatic operation were unanimously approved.

II. Preparation of C.C.I.F. texts regarding semi-automatic operation

The Plenary Assembly examined the proposals which had been made by the " Joint Meeting of the 6th and 8th Study Groups and the Permanent Sub-Committee for the Maintenance " for the preparation of the final texts regarding semi-automatic operation to be produced in C.C.I.F. publications. These texts are :.

— the equipment specifications,

— a maintenance instruction for automatic circuits,

— the " semi-automatic service " part of the Instructions for operators in the European International Telephone Service.

The Plenary Assembly devolved powers to the Sub-Committee on Rapid Operating Methods for the final preparation of :

(a) the signal code to be used for semi-automatic operation,

(b) the " semi-automatic service " part of the Instructions for Operators,

(c) the Maintenance Instructions for automatic circuits.

As regards these last two points, the Sub-Committee will have to approve texts drawn up by two working groups :

— the first group to draft the section on " semi-automatic " service of the Instruction for Operators ;

— the second working group will include several representatives of the Permanent Sub-committee on Maintenance (maintenance of circuits), of individuals responsible for the maintenance of international switching equipment, and of one or two representatives of the operating services.

The Plenary Assembly further devolved powers to a working group made up of members of the 8th Study Group, for the drafting of specifications for international signalling and switching equipment and for the associated maintenance equipment.

The Plenary Assembly examined the terms of reference to be given to the working group called upon to draft specifications for equipment.

After an intervention by the Delegate of CHILE, the Plenary Assembly decided to complete these terms of reference (see page 6 of the minutes of the meeting held by the 8th Study Group) by the following point 5, comprising a note which refers to the new text adopted for the Signalling Instructions (see point 3 below of the minutes of this meeting) ".

5. If possible to prepare C.C.I.F. texts regarding signalling in manual service and the specification for the signalling equipment, having regard to the following note.

Note. — Whenever an administration has to purchase new signalling equipment for international circuits, which are at that time to be operated under manual condition, it could be of advantage, to ensure a greater technical uniformity in the installations, to use, after agreement with the other interested administrations, signalling equipment of the type used for semi-automatic working. Such receivers would not have to be replaced when, subsequently, semi-automatic operation was introduced on the circuits. In such a case, it is recommended that the signal receivers (1 or 2 frequency) should be as fully as possible in accordance with the specifications drawn up, for signal receivers in semi-automatic service.

The Plenary Assembly approves, with the addition of this point 5, the terms of reference to be given to the Working Party of the 8th Study Group for preparing the final specifications.

The Plenary Assembly considers that this Working Party should include, in addition to a representative particularly skilled in automatic equipment matters from each of the following countries : Belgium, France, Netherlands, United Kingdom, Sweden and Switzerland, the Chairman (or the Vice-Chairman) of the 3rd Study Group of the C.C.I.F.

III. Replies of the 8th Study Group and proposals of new questions for the 8th Study Group

The Plenary Assembly approved the replies proposed by the 8th Study Group with the minor changes in wording mentioned in the following annex.

The Plenary Assembly decides further, that there will be a need for the 8th Study Group to undertake or to continue the study of the questions shown in the list of " Proposals for new questions submitted by the 8th Study Group ".

The new question E, relative to the technical arrangements for charging, should be studied by the 8th Study Group alone, exclusively from the technical point of view. Hence its wording should be amended to read as follows (last two paragraphs and the addition of a note) :

(a) to obtain a technique as simple and as uniform as possible for the recording of the charges to be made to subscribers for international calls (in particular where it is envisaged that the charges will be recorded on the subscriber's meters, or by an analogous method), is it desirable, from the technical point of view, to abandon the present method of charging used in international manual operation, and, if so, what changes should be proposed ?

(b) What technical possibilities could reasonably be introduced into the automatic equipments to permit a distribution of charges between the countries concerned ?

Note. — In studying this question, account should be taken of the information collected about methods which might be envisaged for providing the accounting services with the data required for apportionment of charges.

The Plenary Assembly approved the amendments made in the Signalling Instructions (manual operation) the revised text of which had been submitted to it (pages 7 and 8 of the minutes of the meeting held by the 8th Study Group).

Mr. Valensi, on behalf of all the Delegates, thanked Mr. Rouviere for the competence and courtesy with which he had presided over this meeting.

The meeting rose at 12.05 p.m.

MINUTES
OF THE PROTECTION MEETING

(Geneva, 8 October 1954)

The Protection meeting of the XVIIth Plenary Assembly took place at Geneva (Maison des Congrès) on 8 October 1954 from 9.30 am to 1 p.n. under the Chairmanship of Mr. Afanassiev (U.S.S.R.).

The Plenary Assembly first examined the document " C.C.I.F. — 1952/1954 — 1st C.E. — Document No. 46 ".

It is pointed out that the numbers appearing on pages 7 to 20 of this document, for modified or new Recommendations, are provisional. The Assembly approved these Recommendations, as well as the deletion of Recommendations indicated on page 7, with only the following remarks :

Modification to Recommendation No. 4. — Substitute the following text to the 1st sub-division of paragraph *(e)* :

(e) *Characteristic of robustness*

The maximum durations should be determined during which the protectors support without deterioration (melting of the electrodes, bursting or splitting of the envelope,...) the passage of constant currents, the values of these currents being greater than 0.1 A and may reach several amperes.

The rest of the modifications to the present text of the *Yellow Book*, Volume VI, page 151, was approved without changes.

Modification of Recommendation No. 9. — To correct a material error on page 10, 3rd paragraph, read :

... that, moreover, the increase required of the admissible limit can only be accepted when it is recognized possible to guarantee an adequate safety to staff and telecommunication equipment, perhaps with the aid of appropriate supplementary apparatus.

Modifications of the Directives concerning the calculation of the mutual inductance of two lines with earth return (New Recommendation) — Complete the formular on page 17 as follows :

1st formula : Place the bar of the fraction between 100 and $d_b—d_a$.

2nd formula : The brackets should include $\left(1+\frac{k^2}{d^2}\right)$

Modifications to the Directives concerning the evaluation of danger risks due to electrical induction (new Recommendation). — It is pointed out that in proposing to delete in the text of the Directives indications concerning the risk of acoustic shock, account has been taken of the new Recommendation proposed under the title " Protection devices against acoustic shocks ". Further, the new method proposed to evaluate the risks of danger due to electric induction gives more guarantee than the method at present appearing in the Directives, even from the point of view of the risk of acoustic shock.

The Assembly approves of the insertion, in the documentary part of the works to be published by the C.C.I.F., of the note appearing on pages 21 to 34 of this document.

The Assembly approves the procedure for the revision of the Directives as proposed by the 1st C.E. ; it is not yet possible to fix the date of the 1st meeting of the Committee for the revision of the Directives.

Questions, the study of which should be undertaken or continued in 1955/1957

The Assembly approves the list of questions the study of which is to be undertaken or continued by the 1st Study Group in 1955/1957, with the following modifications :

Question No. 4 should be Category A 1.

The wording of *question No. 8* should be completed in the following manner :

Question No. 8. — (Category A 1) [non urgent] (continuation of question No. 8 studied in 1952/1954).

Arrangements and measurements to be made in cases of parellelism of telephone lines and d.c. traction or d.c. power lines, especially in the case of abrupt variations of the traction current and in the case of short circuits.

Note 1. — For the study of this question particular consideration will be given to the document " C.C.I.F. — 1952/1954 — 1st C.E. — Document No. 25 " established by the U.I.C.

Note 2. — The study of this question will be carried out by the 1st Study Group of the C.C.I.F. in co-operation with the 4th Study Group of the 1st Section of the C.M.I.

The wording of *question No. 13* should be completed in the following manner, in order to take account also of the unbalance of telegraphy installations.

Question No. 13. — (1st S.G. of the C.C.I.F. in co-operation with C.E. III and C.E. VII of the C.C.I.T.) (Category A 1) [urgent] (continuation of question No. 13 studied in 1952/1954).

(a) How can the different types of unbalance which can be defined for a telephone installation be distinguished, according to the nature of the installation (subscriber's installation or telephone exchange installation), or according to whether one considers the effect of the unbalance on the magnitude of the noise observable in a receiver inside the installation or connected at its output terminals, when the entry to the installation is connected to a line which is subject to a longitudinal e.m.f., or whether one considers the effect of the unbalance on the transmission of an outside line connected at the input to the installation ?

(b) In what manner can limits be defined for the different types of unbalance ?

1. Of subscribers' installations,
2. Of telephone exchange installations.

What should these limits be ?

Note 1. — In the study of this question, the following considerations will be taken into account :

As regards the effect of unbalance with respect to earth of telephone exchanges on the magnitude of the noises when the incoming line is the seat of a longitudinal e.m.f., it appears that the unbalance should be characterised by a factor which is determined by measurement using a device fulfilling the following conditions :

(1) The unbalance factor should be defined in such a manner that it expresses in the simplest way the relation between the psophometric voltage at the output terminals of the installation and the e.m.f. causing the noise.

(2) The circuit of the measuring device should be so chosen, that the values of the unbalance factor obtained by the measurement can be compared with values determined by calculation from the impedances of the components of the installation under consideration.

(3) It should be possible to make the measurement quickly and in a simple manner, by means of the device which includes only measuring apparatus of a standard type.

(4) The value of the unbalance factor relating to an exchange should be determined without taking account of the possible unbalance of the line ; in the apparatus the latter should be represented by two equal impedances, representing the conductors of a symmetrical circuit with respect to earth.

(5) The method of determining the unbalance factor should lead to giving in the value *zero* in the case of perfect balance and should remain less than 1 (or 100%), however great may be the unbalance.

It will be necessary to collect information relating to unbalance to earth of the feeding bridges of existing telephone exchanges, to find out on what basis limits could be chosen for the unbalance of different installations ; to determine which basic circuits of measuring devices for unbalance factor can be recommended taking into account the conditions indicated above.

In the case of installations serving circuits appropriate to simultaneous telephony and telegraphy, or parts of the telegraph equipment including an earth connection, are directly connected to the line wires, account should be taken of the presence of this equipment to determine the unbalance, from the telephony point of view, of the complete installation.

Note 2. — For the study of this question, the following documents, in particular, will be taken into consideration :

" C.C.I.F. 1952/1954 — 1st S.G. — Document No. 17 "
" C.C.I.F. 1953/1954 — 1st S.G. — Document No. 31 "
" C.C.I.F. 1952/1954 — 1st S.G. — Document No. 39 "
" C.C.I.F. 1952/1954 — 1st S.G. — Document No. 43 "

Note 3. — The study of this question will be carried out by the 1st S.G. of the C.C.I.F. in co-operation with the 7th S.G. of the 1st Section of the C.M.I.

It is desirable to replace the wording of question No. 19 by the following more explicit text, with which the English text should be made to agree :

Question No. 19. — (1st S.G. in co-operation with the 8th S.G.) (Category A 1) [urgent] (new question).

Protection of signalling, on long distance telephone circuit operated automatically or semi-automatically, against the harmful effects of industrial electricity lines.

Note. — The bases for the study of this question will result from the conclusions of the work of the 8th Study Group in connection with the necessary limitation of circuit noise guaranteeing the functioning of signal receivers.

Question No. 20 proposed by the 1st S.G. is deleted, the number thus liberated is attributed to the following new question :

Question No. 20. — (Category A 1) [urgent] (new question).

Is there need to take special steps to eliminate the risks of noise in cable telephone circuits when the sheaths of these cables must be connected to power cables, gas or water mains, pipe-lines, electrified railway tracks, to obtain an electrical protection scheme against corrosion ?

Note. — The study of this question will be pursued by the 1st S.G. of the C.C.I.F. in co-operation with the 2nd S.G. of the C.C.I.F. and with the Study Groups No. 12 of the 1st Section and No. 26 of the 2nd Section of the C.M.I.

The CHAIRMAN thanked Mr. Collet, Chairman of the 1st S.G. and the Members of this Committee, for the care with which they have prepared the documentation submitted to the Plenary Assembly.

* * *

The Assembly then examined the document " C.C.I.F. — 1952/1954 — 2nd S.G. — Document No. 26 " in respect of which Mr. HALSTRØM Chairman of the 2nd S.G. indicated the essential points.

The Assembly approves the two draft Recommendations which are presented to it concerning modifications to be made to the two works :

" Recommendations for the protection of underground cables against corrosion " (Paris, 1949), and

" Recommendations for the protection of underground cables against the action of stray currents due to electric traction installations " (Florence 1951), with the insertion after the point 1 of the first Recommendation :

1. § 1.1.1., page 5, sub-division 1, 2nd line, delete the words " chemical or ",

the following remark :

When proceeding with a new edition of the Recommendations, a careful revision should be made of the terminology and the definitions of § 1.1.2.

It will then be necessary to use the terminology finally adopted throughout.

The Assembly takes note of the texts of documentary interest which should complete or replace the corresponding texts of Volume II of the *Yellow Book* — Protection. It approves the list of questions the study of which should be undertaken or continued by the 2nd S.G. in 1955/1957, in dividing question No. 3 into two questions No. 3 and No. 3 *bis* for which the wordings will be as follows :

Question No. 3. — (Category A 1) [urgent] (continuation of question No. 3 studied in 1952/1954).

Modifications and additions that may possibly be made to the text of " Recommendations concerning the protection of underground cables against corrosion " (Paris, 1949).

Note. — It would be useful to collect information on the modifications to be effected to take account of the ever increasing use of electrical protection schemes,

and

Question No. 3 bis. — (Category B) [non urgent] (continuation of the question No. 3 *bis* studied in 1952/1954).

(a) Information concerning cases of the corrosion of the sheaths of underground cables noticed even though these sheaths were acting as cathodes.

(b) Nature of electrolytic corrosion noticed in the case of alternating stray currents or of direct and alternating stray currents in superposition. Possibility of corrosion by direct current resulting from the effect of rectification of alternating currents during their passage from the cable into the nearby soil.

Note 1. — (1) For the study of this question, particular consideration will be given to the indications concerning the corrosion diagram for lead and contained in the document " C.C.I.F. — 1952/1954 — 2nd S.G. — Document No. 18 " to which should be added the similar publication made, in English, in the Journal of the Electrochemical Society (98 (1951) 57).

This diagram is only valid in the cases where the surroundings contain carbon dioxide (CO_2).

It would be useful to complete the study by the establishment of diagrams of the corrosion of lead in other surroundings (e.g. in the presence of acetic, phenol, etc...).

(2) With the object of better defining the causes of corrosion, it would be desirable to collect more extensive information on the character of the attacks as expounded at the present time in the " Recommendations for the protection of underground cables against corrosion " (Paris, 1949), § 2.2.3.3.1., sub-division 38, page 10.

(3) Regarding the part *(a)* of the question, the document " C.C.I.F. — 1952/1954 — 2nd S.G. — Document No. 9 " points out a case of corrosion that could be included under this heading. As is also shown by the above-mentioned corrosion diagram, this case of corrosion can probably be explained by the alcalinity of the surroundings (high pH value) and by an insufficient electro-negative potential.

It would be proper to examine from this point of view if, and in what conditions the passage of an electric current can render cement (or asbestos cement) aggressive with respect to lead or lead alloys, in particular, in the case of cables laid in conduits of cement or asbestos-cement and forming part of an electrical protection system.

(4) Regarding part *(c)* of this question, the document " C.C.I.F. — 1952/1954 — 2nd S.G. — Document No. 7 " cities instances where it is thought that alternating currents have played a part in the corrosion phenomena.

Note 2. — The study of this question will be pursued by the 2nd S.G. of the C.C.I.F., in cooperation with Study Committees Nos. 21, 25 and 26 of the 2nd Section of the C.M.I.

Owing to the introduction of the new question No. 20 of the 1st S.G. relative to the risks of noise in telephone circuits, which would arise from the putting into practice of electrical protection, the reference to these risks of noise should be deleted in the Note 1 to question No. 12.

The Chairman thanked Mr. HALSTRØM, Chairman of the 2nd S.G. and the Members of this Committee, for the very clear and careful manner in which this document has been presented.

Mr. HARVEY, speaking on behalf of all the Delegates and Representatives, thanked Mr. AFANASSIEV for the courtesy and competence with which he had presided over this meeting.

MINUTES
OF THE MEETING DEVOTED TO VOCABULARY AND SYMBOLS
(Geneva, 11 October 1954)

The meeting devoted to the vocabulary and to symbols took place on Monday 11 October 1954, under the chairmanship of Mr. ALBANESE (Italy).

The document serving as a basis for discussion were as follows :

" C.C.I.F. — 1952/1954 — Symbols — Document No. 11 — Minutes of the Letter and Graphical Symbols Committee ", Geneva, 27-29 September 1954).

" C.C.I.F. — 1952/1954 — Vocabulary — Document No. 4 — Minutes of the Vocabulary Committee ", Geneva 30th September - 2nd October 1954.

I. Letter and Graphical Symbols

The Plenary Assembly proceeded to a wide exchange of views on the subject of the expediency of modifying the Recommendation No. 1 of Page 40 of Volume IV, of the *Yellow Book* concerning the letter symbols to be employed for the neper and the decibel.

The majority of the delegations were in favour of the maintenance of the notation " db " used in their country for denoting the decibel. The notation " dB " which was proposed by the International Standards Organisation (I.S.O.) at the International Electrotechnical Committee (C.E.I.) has not yet been approved by this organisation which had the authority to make a decision.

The Plenary Assembly decided unanimously to issue the recommendation below in connection with the 1st part and with a majority of 16 votes to 7 for the 2nd part.

THE INTERNATIONAL TELEPHONE CONSULTATIVE COMMITTEE

Taking note of the proposal of the I.S.O. according to which it would be expedient to avoid any confusion with the symbol " Newton " to change the symbol for the neper by adopting Np instead of N, recommends, unanimously,

That for relations between telephony technicians, it is preferable that the symbol N be maintained for the neper, with the possibility of using Np in the cases where the symbol N would give rise to misunderstanding,

considering, furthermore,

That the I.S.O. proposed the universal adoption of the symbol dB for the decibel,

That several telephone administrations have adopted the symbol db long ago and that they do not desire to change this symbol to adopt bB,

recommends, with a majority of 16 votes to 7,

That for relations between telephony technicians it is desirable to continue to use the symbol db which corresponds to that most generally used.

The Plenary Assembly approves the draft Recommendation which was presented to it on the subject of the revision of the list of graphical symbols appearing in Volume IV of the *Yellow Book*, but thought that this list could not be considered as a final list and that this recommendation should read :

There is reason to replace *provisionally* the list of symbols which appears in the *Yellow Book* by ...

The Plenary Assembly considers that there is no reason to issue a recommendation on the subject of the presentation to the International Electrotechnical Committee (C.E.I.) of the text of an " Introduction to the list of Graphical Symbols for weak current installations ", and that it would be sufficient to mention this text in an appendix to the wording of the question No. 3 the study of which is to be pursued.

The Assembly approved the list of questions the study of which is to be undertaken or pursued by the Symbols Committee in 1955/1957, in altering the wording of question No. 7 which should read :

A. Is there reason to introduce modifications or additions to the list of symbols, especially in connection with devices for controlled selection and for free hunting selectors appearing in the list of graphical symbols?

B. If so, what are these modifications?

II. Vocabulary

The Plenary Assembly approved the draft recommendation which was presented to it on the question of the definition of the expressions " telecommunications " and " radio waves ".

The Assembly approved the principle of a mixed Committee of the three C.C.I.s during the year 1955, for the establishment of a joint List of Definitions. Contrary to the proposal made by the Vocabulary Committee, they considered that it would not be useful to introduce into the List of Definitions of the C.C.I.F. a definition for the term " telecommunication " (electromagnetic).

The Assembly decided to set for study the question No. 1 concerning definitions to relays proposed by the Vocabulary Committee.

Mr. Collet speaking on behalf the members of the Assembly thanked Mr. Albanese for the competence and courtesy with which he had directed the discussions.

MINUTES
OF THE FINAL MEETING
OF THE C.C.I.F. XVIIth PLENARY ASSEMBLY

(Geneva, 12 October 1954)

The final meeting of the C.C.I.F. XVIIth Plenary Assembly was held in the Maison des Congrès, Geneva, on 12 October 1954, from ten o'clock to noon, with Mr. WETTSTEIN (Switzerland) in the chair.

As soon as the meeting opened, Mr. SHOJI (Japan) made the following statement :

" Mr. Chairman, Ladies and Gentlemen,

As representative of the Japanese Delegation to this Plenary Assembly I wish to say that we are pleased to be able to participate in this meeting. It is of further significance to us on this occasion as it falls on the 75th anniversary of my country's adhesion to the International Telegraph Union, and to-morrow morning we are going to celebrate the historical event in Tokyo.

" In the name of the Japanese Administration I would like to thank the Chairman and Mr. Valensi and all who are assembled here and also all the staff of the secretariat who have worked to make this meeting possible.

" Japanese telecommunication owes much for its early development to the kind collaboration of many countries and especially of the Union. We are indebted and thankful for the collaboration which continue even to-day.

" On this occasion, I must tell Mr. Valensi that my colleagues in Japan are unanimous in their high esteem of his personality and wish him good health and prosperity.

" In conclusion, let me extend to all of you who are gathered here, good health and prosperity ".

Mr. VALENSI said that the following telegram had been received from the Syrian Administration :

Regret to inform you that last-minute difficulties have prevented departure our representative for XVIIth Plenary Assembly stop We apologize and send all our best wishes for the success of the Assembly's activities.

In reply to the telegram despatched on behalf of the XVIIth Plenary Assembly, the following telegram had been received from Captain Legg :

Captain Legg is deeply grateful to Mr. Chovet and XVIIth Plenary Assembly C.C.I.F. for their kind message of greetings on the occasion of the acceptance of recommendation regarding signalling systems for international semi-automatic working stop He sends in return his warmest thanks and cordial wishes for continued success of C.C.I.F.

* * *

The Plenary Assembly thereupon approved the minutes of previous meeting held by it, with the amendments which have been included in the foregoing text. As regards some of these documents, the following comments were made :

Minutes of the meeting devoted to the choice of a signalling system and to signalling and switching questions

Mr. VALENSI read out a letter from Mr. Lambiotte which completed the information given in the minutes and of which the most important passage was as follows :

" To facilitate the work of the Sub-Committee on Rapid Operating Methods at its next meeting, it would be well if the various administrations were asked to give their views, not later than 15 December next, on the two questions with which the sub-committee will have to deal, namely :

" 1. Changes in the list of operating signals, if any ;

" 2. Preparation of a final list of international codes (Study Group 6 Question 16). This list, which for the time being might be left incomplete, should make it possible to order equipment for transit operation.

" Moreover, with an eye to the discussions of the working group which will be called upon, by the Sub-committee on Rapid Operating Methods, to revise the instructions for maintenance of the international semi-automatic network, administrations should also be asked to submit any comments they might care to make on these maintenance instructions.

" This question being less urgent, 15 January might be set as the final date for receipt of replies ".

The Director of the C.C.I.F. would ask administrations to supply such information in due course.

List of Delegates attending the XVIIth Plenary Assembly

This document had been corrected in accordance with the information supplied to the Secretariat. [The final list appears at the beginning of the present book.]

The draft text for Minutes of the second meeting of Heads of Delegations was approved subject to certain amendments, embodied in the final version of the minutes.

It was agreed that the meetings to be held by the 6th, 7th and 8th Study Groups and by the Sub-Committee on Rapid Operating Methods (Geneva, March-April, 1956) should be organized by agreement with the Chairmen of those Study Groups, in order to avoid overlapping between the meetings of the 6th and 8th Study Groups on the one hand, and those of the Sub-Committee on Rapid Operating Methods on the other, since a good many people belonged both to those two Study Groups and to the Sub-Committee. It would also have to be borne in mind that the 8th Study Group was concerned in certain transmission questions to be dealt with by the 3rd Study Group in March, 1956. In the dates decided on for the meetings to be held in 1956, allowance was made for the meeting of the C.C.I.R. Plenary Assembly. Should the Administrative Telegraph and Telephone Conference take place in 1956, some changes would perhaps be required in the programme of C.C.I.F. Study Group meetings.

It was decided that in principle the " Joint C.C.I. Committee for the Glossary of Essential Telecommunication Terms " should meet in 1955, since work on partial glossaries of definitions was already completed, or far advanced, in the three C.C.I.s. The exact date of the meeting would be decided on by agreement between the Directors of the three C.C.I.s. Only after the meeting, in accordance with the procedure laid down by the I.T.U. Administrative Council, would the Glossary serve as a basis for the International Telecommunication Vocabulary.

Furthermore, no provision was made for any meeting of the " Committee for revision of Recommendations against Corrosion ", since engineering progress was so rapid in that field that it would be impossible to draw up, before the C.C.I.F. XVIIth Plenary Assembly, a text which would remain valid over any length of time.

* * *

Mr. CLARA (Spain) said how sorry the Assembly was to say goodbye to Miss Félix who had worked for the C.C.I.F. from its beginnings. She had always displayed the greatest good humour despite the heavy demands made on her by the meetings.

After a few personal memories, he finished by saying :

" Today, Miss Félix, I bring you the warmest good wishes of your grateful friends, on whom, I am confident, you will be able to count, come what may.

" On behalf of all, I would ask you to accept, with these flowers, with this little album of signatures, a clock which, in chiming the hours, will I hope remind you of the friends who are grateful for your devoted work and wish you every happiness for the future ".

(Loud applause.)

Miss FELIX expressed her thanks in the following terms :

" Mr. Chairman, Delegates,

" I am most deeply touched by Mr. Clara's very kind words, spoken on behalf of you all.

" I am surprised to receive this magnificent product of Swiss handicraft to chime the hours of a retirement which you have been so good as to hope will be carefree and serene.

" I am very moved at the thought of soon leaving the C.C.I.F., created and animated by our Director, Mr. Valensi. In assuring him of my gratitude, I should like to submit my respectful good wishes.

" I ask you to accept, Mr. Chairman and Gentlemen, my warmest thanks and my best wishes for your good health and the success of your work ".

Mr. VALENSI fully associated himself with what Mr. Clara had said on behalf on the delegates.

The CHAIRMAN, thereupon gave the following speech :

" Ladies and Delegates,

" We have now arrived at the end of the XVIIth Plenary Assembly of the C.C.I.F. You will agree with me that our meeting has fully achieved its ends. It has substantial achievements to its credit, for which I thank you all.

" We have studied questions of considerable moment and taken decisions fraught with consequences for international telephony. We can say, without any false modesty, that the C.C.I.F. has once more taken a great step forward towards the improvement and extension of international telephony.

" Before we break up, may I, on your behalf, perform a most agreable duty. First of all, I would thank most warmly the Vice-Chairmen who have directed our meetings with such outstanding competence. We would also thank the C.C.I.F. Secretariat, of which the members have spared neither their time nor their energy, and especially its Director, Mr. Valensi, whom we are pleased to be able to keep another two years, and Miss Félix, to whom the C.C.I.F. owes so much. We shall be sorry to see her go. On behalf of all, may I wish our secretary-accountant the long and happy retirement she has so richly deserved. May her present good health continue unimpaired for many years to come.

" We would likewise thank our devoted engineers, Messrs. Lalou and Chapuis, the staff of the typing service and of the document reproduction section, and our operator, Mr. Henry, who, happily for us and for him, has not had too much trouble with the somewhat capricious desk for which he is responsible. We would thank the interpreters for the successful way in which they have interpreted and translated our technical jargon.

" We must not overlook the C.C.I.F. Laboratory and its teams. Under the expert management of Mr. Castagné, it has done much important, if tedious work. For all it has done for the sake of international telephony, it deserves praise and congratulation.

" Telecommunication constitutes one of the pillars of international relations, and is certainly one of the most important and effective links between peoples. May the work we have done together here so conscientiously and in such harmony bear fruit by contributing to a lasting peace.

" Before I declare the Assembly officially closed, would anybody else like to speak ? "

Mr. VALENSI said that he had been deeply touched by the action taken by the Assembly in prolonging his term of office two years. After so many years devoted to the C.C.I.F. he was still ready to play his part in the constructive work the C.C.I.F. was doing. C.C.I.F. meetings had always been remarkable for the atmosphere of harmony in which they were held.

Mr. SHRIVASTAVA (India) recalled that for the first time his Administration was taking an active part in the work of the C.C.I.F. In India, telecommunications were steadily developing and he much appreciated the cooperative spirit shown by the Assembly. The Swiss Administration was to be thanked for its generous hospitality.

Mr. GNEME (Italy) senior I.T.U. delegate said :

" Allow me, as senior I.T.U. delegate, to associate myself wholeheartedly with the expressions of appreciation, so richly deserved, addressed to the Chairman of the Assembly, the Vice-Chairmen, the Director and his staff, and Miss Félix, for all they have done to make it possible for us to get through so much important work in record time.

" May I, in particular, thank Mr. Wettstein, our Chairman, who has directed our discussions with such exemplary skill. May I ask him to add my voice to those which have expressed their lively appreciation to the Swiss Administration for its courtesy and for all the facilities granted us during our stay in this beautiful city of Geneva, still more beautiful in the splendid weather we have been enjoying.

" I have on occasion been a source of irritation to my old friend (no reference to age, of course) Mr. Valensi. However, I think he bears me no ill-feeling, and that he will recognize that as a proof of the recognition of his outstanding qualities, so much appreciated by the Administrative Council, as an organizer and director of the first order, and as an exceptional woker with a thorough knowledge of his subject-matter. These qualities enable him to reply clearly, completely and immediately to the questions and suggestions made by delegates during the discussions (occasionally so lively) of the Plenary Assembly.

" In conclusion, may I say how pleased I am to have had this first experience of attending a C.C.I.F. Plenary Assembly, which has enabled me to acquire a clear insight into the organization and working methods of the C.C.I.F., over and above that which I already possess of the other C.C.I.s, in the work of which I have been privileged to take part from the beginning ".

The Chairman declared the XVIIth Plenary Assembly closed.

ANNEX

List of documents to the XVIIth Plenary Assembly of the C.C.I.F.

(Geneva, October 1954)

C.C.I.F. — XVIIth P.A. — Document No. 1

Possible amalgamation of the International Telephone Consultative Committee and the International Telegraphic Consultative Committee.

C.C.I.F. — XVIIth P.A. — Document No. 2

Minutes of the 1st Meeting of the Heads of Delegations (Geneva, 4 October 1954).

C.C.I.F. — XVIIth P.A. — Document No. 3

Minutes of the first meeting devoted to questions of organisation (Geneva, 5th October 1954, afternoon).

C.C.I.F. — XVIIth P.A. — Document No. 4

Report of the meeting of the Committee charged with the establishment of the general plan of the printed works to be published after the XVIIth Plenary Assembly of the C.C.I.F. (Geneva, 4 October 1954).

C.C.I.F. — XVIIth P.A. — Document No. 5

Minutes of the meeting to consider the choice of a signalling system and questions of signalling and switching (Geneva, 7th of October, morning).

C.C.I.F. — XVIIth P.A. — Document No. 6
Report of the budget committee of the C.C.I.F. (Geneva, October 1954).

C.C.I.F. — XVIIth P.A. — Document No. 7
Minutes of the opening session of the XVIIth Plenary Assembly of the C.C.I.F. (Geneva, 5 October 1954).

C.C.I.F. — XVIIth P.A. — Document No. 8
Minutes of two meetings for operating and tariffs (Geneva, 6 October 1954, morning and 7 October 1954, afternoon).

C.C.I.F. — XVIIth P.A. — Document No. 9
List of the Delegates to the XVIIth Plenary Assembly.

C.C.I.F. — XVIIth P.A. — Document No. 10
Minutes of the protection meeting (Geneva, 8 October 1954).

C.C.I.F. — XVIIth P.A. — Document No. 11
Minutes of the 2nd and 3rd sessions devoted to questions of organisation (Geneva, 10 October 1954).

C.C.I.F. — XVIIth P.A. — Document No. 12
Minutes of the transmission meetings (Geneva, 6th and 8th October 1954).

C.C.I.F. — XVIIth P.A. — Document No. 13
Minutes of the 4th meeting devoted to questions dealing with organisation (Geneva, 11 October 1954, morning).

C.C.I.F. — XVIIth P.A. — Document No. 14
Minutes of the meeting devoted to Vocabulary and Symbols (Geneva, 11 October 1954).

C.C.I.F. — XVIIth P.A. — Document No. 15
Minutes of the second meeting of Heads of Delegations (Geneva, 11 October 1954).

REPORT OF THE BUDGET COMMITTEE OF THE C.C.I.F.

(Geneva, October 1954)

The Budget Committee of the C.C.I.F. held two meetings under the Chairmanship of Mr. Raus (Luxembourg) at the Maison des Congrès, 6 October 1954, at 15 hours, and 8 October 1954, at 15 hours.

The list of delegates present at these meetings is attached.

The Budget Committee examined three questions :

1. Expenses of the XVIIth Plenary Assembly of the C.C.I.F. itself,
2. Extraordinary expenses to be foreseen for the C.C.I.F. until the XVIIIth Plenary Assembly,
3. Division of the extraordinary expenses of the C.C.I.F. from 1951 until 1954.

1. Expenses of the XVIIth C.C.I.F. Plenary Assembly itself

The Budget Committee after a thorough examination of the " Report of the financial requirements of the C.C.I.F. until the XVIIIth Plenary Assembly—Table of extraordinary expenses of the C.C.I.F. during the period from 1 September to 12 October 1954—(provisional estimate) ", and taking into account that the extent of the work necessitated by the whole of meetings of the Study Groups and the XVIIth Plenary Assembly, from the 1 September to the 12 October 1954, had been underestimated in the report mentioned, proposes to the XVIIth Plenary Assembly to substitute for the numbers on the page 5 of the said report the following figures :

Article 1. Staff expenditure

1. *Administrative services*

(b) Provision for overtime for the extra staff and certain members of the I.T.U. staff . . . . (instead of 1,000 Sw. frs.)	9,000 Sw. frs.
3 secretarial allowances due to the foreign functionaries fulfilling the duties of secretaries to the 1st, 2nd, 6th and 7th Study Groups of the Committee for the revision of Directives and for the Symbols Committee *(new number)*	2,800 Sw. frs.

3. *Printing services*

(b) Provision for overtime for staff of the printing services . . . . (instead of 1,000 Sw. frs.)	3,000 Sw. frs.

Pages 6 and 7 of the said Report remain unchanged : however the entry " Unexpected ", is reduced to 5,179.68 (instead of 10,179.68 Sw. frs).

The total of the extraordinary expenses of the C.C.I.F. during the period from 1 September to 12 October 1954 (provisional estimate) will reach therefore the sum of 106,779.68 Sw. frs.

2. Ordinary expenses of the C.C.I.F. to be foreseen until the XVIIth Plenary Assembly

The Budget Committee after having thoroughly examined the drafts of the detailed C.C.I.F. budgets for the years 1956 and 1957 (the summaries of which constitute annexes 3 and 4 to the " Report on the financial needs of the C.C.I.F. until the XVIIIth Plenary Assembly ") considers that the only modification to be made to the draft C.C.I.F. budget for the year 1956 in the said report consists in the substitution under the entry 601 : " Allowances and Insurances ", of the number 17,000 for the number 20,000 Sw. frs. The total of the expenses envisaged for 1956 is therefore 520,260 Sw. frs.

The Budget Committee made no remarks concerning the draft budget of the C.C.I.F. for 1957.

It is for the XVIIth Plenary Assembly of the C.C.I.F., in conformity with the paragraph 6 of chapter 17 of the General Regulations appended to the International Telecommunication Convention of Buenos Aires, 1952, to approve this report on the financial requirements of the C.C.I.F., which after approval by the Plenary Assembly should be transmitted to the Secretary-General of the I.T.U. for his further use.

3. Division of the extraordinary expenses of the C.C.I.F. from 1951 to 1954

The Budget Committee asked the Secretary General to establish a " List of the sharers in the extraordinary expenditure of the C.C.I.F. for the period 1951 to 1954, i.e. from the XVIth Plenary Assembly at Florence, 1951, until the XVIIth Plenary Assembly, Geneva 1954 ".

This list is appended.

The Budget Committee draws the attention of the Plenary Assembly to the necessity of establishing the list of Countries who will share in the expenditure occasioned by the use of the Russian language in oral translation during the meetings of the C.C.I.F. (Geneva, September/October, 1954). These expenses are not included in the estimates of the Report on the financial requirements of the C.C.I.F.

The Budget Committee requests the XVIIth Plenary Assembly to study the expediency of asking the Administrative Council to re-examine whether arrangements could not be made, so that the funds of the C.C.I.F. earn interest if they are not to be immediately used in entirety.

The Director of the C.C.I.F. speaking on behalf of the Members of the Budget Committee very sincerely thanked Mr. Raus for the competence and courtesy with which he had presided over the deliberations of the Committee.

The meeting was closed at 16.50 hours.

BUDGET COMMITTEE
(6 and 8 October 1954)

Chairman : Mr. RAUS (Luxembourg)

Afghanistan	Mr. AZIM GRAN
Spain	Mr. CLARA CORELLANO — Mr. DEL RIEGO
France	Mr. TERRAS
India	Mr. GADADHAR
Italy	Mr. SACCO
German Federal Republic	Mr. WENZLAU
United Kingdom of Great Britain and Northern Ireland	Mr. B.T. PHILPOTT
Switzerland	Mr. A. LANGENBERGER
I.T.U. Secretariat	Mr. H. TOWNSHEND, aided by Mr. PRÉLAZ
Interpreter	Mr. HUGON
C.C.I.F. Secretariat	Mr. G. VALENSI, Director of the C.C.I.F. Miss FÉLIX, Secretary

ANNEX

List of sharers in the extraordinary expenses of the C.C.I.F. for the period 1951 to 1954, i.e. after the XVIth Plenary Assembly at Firenze 1951 to the XVIIth Plenary Assembly, Geneva, 1954

(a) *Members:*

Afghanistan	1 unit(s)
Saudi Arabia (Kingdom of)	1 "
Argentina (Republic)	25 "
Australia (Commonwealth)	20 "

Austria	½ unit(s)	
Belgium	8 ”	
Burma	3 ”	
Bulgaria (People's Republic)	1 ”	
Ceylon	1 ”	
China	15 ”	
Colombia (Republic of)	3 ”	
Denmark	5 ”	
Egypt	5 ”	
Spain	3 ”	
Finland	3 ”	
France	30 ”	
Greece	3 ”	
Hungary (People's Republic)	1 ”	
India (Republic of)	20 ”	
Iran	1 ”	
Ireland	3 ”	
Iceland	½ ”	
Israel (State of)	1 ”	
Italy	20 ”	
Japan	25 ”	
Lebanon	½ ”	
Luxembourg	½ ”	
Norway	5 ”	
Pakistan	15 ”	
The Netherlands, Surinam, Dutch East Indies, New Guinea	10 ”	
Poland (People's Republic)	10 ”	
Portugal	8 ”	
French Protectorates of Morocco and Tunisia	2 ”	
Portuguese Overseas Provinces	8 ”	
Federal German Republic	20 ”	
Federal People's Republic of Yugoslavia	1 ”	
Roumania (People's Republic)	1 ”	
United Kingdom of Great Britain and Northern Ireland	30 ”	
Sweden	10 ”	
Switzerland (Confederation)	10 ”	
Syria (Republic)	1 ”	
Czechoslovakia	8 ”	
Turkey	5 ”	
Union of South Africa and the Territory of South-West Africa	13 ”	
Union of Soviet Socialist Republics	30 ”	
Uruguay (Oriental Republic)	3 ”	
Spanish Zone of the Protectorate of Morocco and Spanish Possessions	1 ”	391 units

b) *Recognised Private Operating Agencies:*

Canada : British Columbia Telephone Cy.	10 units	
Telephone Association of Canada	10 ”	
Chile : Chile Telephone Company	3 ”	
Cuba : Cuban Telephone Company	5 ”	
Spain : Compañia Telefónica Nacional de España	2 ”	
United States of America : American Telephone and Telegraph Co.	30 ”	
France : Society Radio-Orient	½ ”	
Japan : Nippon Telegraph and Telephone Public Corp.	1 ”	
Kokusai Denshin Denwa Co.	½ ”	
Mexico : Teléfonos de Mexico	5 ”	67 units

(c) *Scientific or Industrial Organisations:*

Allgemeine Elektrizitäts-Gesellschaft	1 unit(s)	
Felten & Guilleaume, Fernmeldeanlagen	1 ,,	
Felten & Guilleaume, Carlswerk	1 ,,	
Siemens & Halske A.G.	3 ,,	6 units

(d) *International Organisations:*

United Nations Organization	*	
International Telegraph Consultative Committee	*	
International Radio Consultative Committee	*	
European Broadcasting Union (E.B.U)	*	
International Broadcasting Organization (I.B.O.)	*	
World Meteorological Organization (W.M.O.)	*	
International Civil Aviation Organization (I.C.A.O.)	*	
International Conference of Large Electrical Networks (C.I.G.R.E.)	*	
International Union of Producers and Distributors of Electric Power (U.N.I.P.E.D.E.)	*	
International Union of Railways (I.U.R.)	*	
International Union of Gas Industries (I.U.G.)	*	
International Electrotechnical Committee (I.E.C.)	*	
International Union of City Transport (I.U.C.T.)	*	
International Air Transport Association (I.A.T.A.)	*	
Total number of units		464

MINUTES OF THE MEETING OF THE COMMITTEE CHARGED WITH THE ESTABLISHMENT OF THE GENERAL PLAN OF THE PRINTED WORKS TO BE PUBLISHED AFTER THE XVIIth PLENARY ASSEMBLY OF THE C.C.I.F.

(Geneva, 4 October 1954)

A Committee charged with the establishment of the general plan of the printed works to be published after the XVIIIth Plenary Assembly of the C.C.I.F· met at Geneva on 4 October 1954, under the chairmanship of Mr. Lambiotte (Belgium). A list of those participating in this meeting is given below, mention being made of the Study Groups represented by these members :

1st and 2nd Study Groups

Messrs. Albanese (Italy)
Collet (France
Halstrøm (Denmark)
Michailov (U.S.S.R.)

3rd and 5th Study Groups

Messrs. Ciai (Italy)
Düll (German Federal Republic)
Litton (Ireland)
Meschino (Italy)
Phillips (United Kingdom)
McPherson (Australia)

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* Organisation exonerated from any contribution to expenditure, in application of Resolution No. 222 (modified) of the Administrative Council.

4th Study Group:
Mr. HALSTRØM (Denmark) * — Mr. POCOCK (Cuban Telephone Company)

6th and 7th Study Groups:
Mr. PETCHE (United Kingdom) — Mr. TERRAS (France)

8th Study Group:
Messrs. BARRON (United Kingdom), CHOVET (France) — Mr. WRIGHT (Chile Telephone Company)

Symbols and Vocabulary Committee:
Mr. ALBANESE (Italy) * — Mr. COLLET (France) *

Replacement of the Yellow Book

This Committee had a wide exchange of views on the best way to ensure that the texts of the printed works issued after the XVIIth C.C.I.F. Plenary Assembly are quite up to date ;

The Committee considers that it would first be useful completely to re-edit all the C.C.I.F. texts after the XVIIth Plenary Assembly ; this would be indicated by a change in the colour of the binding of C.C.I.F. publications. The *Yellow Book* should be replaced for example by a *Green Book.*

It considers that after this textual redrafting, each Volume of the *Green Book* should be the responsibility of only one Study Group (or if absolutely necessary of two Groups having associated fields of study) and that there should be no overlapping between subject matter relevant to several Study Groups, as is at present the case for Volumes IV and VI of the *Yellow Book.*

The Committee does not feel that there is reason to treat Operating and Tariff Recommendations differently from the other Recommendations of a technical character and it seems to the Committee that it would be preferable to form these Recommendations into a special book which would be used exclusively by the 6th and 7th Study Group.

After redrafting the C.C.I.F. works, the *Green Book* published after the XVIIth Plenary Assembly (Geneva 1954) should comprise :

Volume I: Minutes of the XVIIth Plenary Assembly
(common to all Study Groups)

Volume II: Recommendation relating to protection
(Study Groups concerned : 1st and 2nd S.G.'s)

Volume III: Recommendation relating to transmission and Maintenance Instructions
(Study Groups concerned : 3rd, 5th and 9th S.G.'s)

Volume IV: Transmission quality, Subscriber's apparatus
(Study Group concerned : 4th S.G.)

Volume V: International signalling and switching equipment. Arrangement of international terminal exchanges.
(Study Group concerned : 8th S.G.)

Volume VI: Operating and tariff Recommendations
(Study Groups concerned : 6th and 7th S.G.'s).

Each volume should include an individual alphabetical index.

* Already mentioned in this list.

The Committee considered whether there was a need for a general index at the end of Volume I. Owing to the different dates of publication of the various volumes of the *Green Book*, it would not be possible to present such a general index in Volume I. Further the utility of a general index is much less after a Plenary Assembly during which a complete revision of the C.C.I.F. texts is undertaken. A general index is of special interest for Plenary Assemblies which make only partial rearrangements of the texts and which do not completely revise the series of volumes of a C.C.I.F. Book.

The Committee endeavoured to have a revision of the C.C.I.F. texts covering the whole of the passages appearing in the *Yellow Book* without leaving any in obscurity. If certain passages are now, in fact, the subject of constant attention of some Study Groups, other passages do not now seem to be of great interest. This is the case for items which were once the subject of C.C.I.F. Recommendations or descriptions of apparatus for general information only. These passages, which are drawn from the *White Book* edited during the Xth Plenary Assembly (Budapest, 1934) and the XIth Plenary Assembly (Copenhagen, 1936) appear :

— in the 3rd part of Volume V of the *Yellow Book*,
— at the end of the 4th part of Volume IV of the *Yellow Book*.

The Committee considered it necessary for these passages to be revised and for a decision to be taken concerning them ; as a first step the competent Study Group should be determined.

Volume IV of the Yellow Book. — An annex to this report indicates, for the various parts of Volume IV which concern the 4th Study Group, the points which should be examined in order to have a complete revision, and not merely a revision covering the pages already replaced by that part of Volume IV of the *Yellow Book* concerning transmission quality.

Pages 196 to 248, 252 to 253, 293 to 300 are within the province of the 3rd S.G., although the subjects in question have not specifically been examined by the 3rd S.G. for the last three years. It is for the working group formed within the 3rd S.G. to re-examine these passages and to see whether certain parts should be incorporated in Volume III of the new Green Book.

Volume V of the Yellow Book (pages 49 to 70). — The Committee proposes that the Director of the C.C.I.F. asks, by means of a circular to all Administrations and Private Operating Agencies of the C.C.I.F. what parts of these passages, relating to subscribers installations, to trunk lines and telephone exchanges, should be kept and, where appropriate, to what Study Group and in what Volume of the *Green Book* these passages should be placed.

The Committee asks that in the event of the deletion from the *Yellow Book* of Recommendation or description of an informative character, a note should mention this fact in the *Green Book* and indicate the pages and the Volume of the *Yellow Book* where these passages appear.

* * *

Special note concerning the various volumes of the " Green Book "

Volume I. — This Volume will contain : the list of delegates, the minutes of the meetings of the Plenary Assembly, the texts relative to the organisation of the C.C.I.F., the list of questions the study of which is to be undertaken or continued in 1955/1957, the composition of the Study-Groups and Sub-Committees in 1955/1957.

1. The Committee proposes to arrange for the C.C.I.F. texts concerning letter and graphical symbols, including the complete list of the symbols that the C.C.I.F. proposes for use of the International Electrotechnical Committee, to appear in Volume I.

2. An exchange of views took place within the Committee concerning which Volume of the *Green Book* in which it would be desirable to arrange for the appearance of the passages relating to definitions, which at present appear in Volume IV of the *Yellow Book* (1st part). The Committee noted that when Volume IV of the *Yellow Book* was published, the List of Definitions which was issued after the XVIth Plenary Assembly (Florence 1951) was not available. The Committee considers that there is no longer any need to print the definitions contained in this List in the *Green Book.* An exception will be made in the case of definitions concerning operation and which comprise Recommendation No. 1 for Operation which will be published in Volume VI of the *Green Book*, and also for the new definitions which are not placed in the List of Definitions.

3. Since the List of Definitions is only of a provisional nature pending the publication of similar Lists by the C.C.I.T. and the C.C.I.R. and until a fusion of the Lists published by the three C.C.I.s has been made, it is desirable that there should be a C.C.I.F. Recommendation in Volume I of the *Green Book* to use the List of Definitions published by the C.C.I.F., until a fresh decision has been made.

4. The Committee considered whether it would be useful to arrange for the appearance at the end of Volume I of a list of all the documents published by the C.C.I.F. since the last Plenary Assembly. The titles of these documents are unfortunately too short to form a summary of the contents of documents and, moreover, after a Plenary Assembly, there are no arrangements for obtaining the documents that have been presented to this Assembly, especially if such a request is made after a lapse of several years. The Committee considers that such a list of documents should not be published.

5. The Committee expressed a wish for the minutes of the meetings of the Plenary Assembly which are published in Volume I, to include only the decisions and recommendations made by the Assembly and omit the minor details concerning the correction of documents which are not themselves published in the Report of the Plenary Assembly. These corrections will form the subject of annexes to the minutes which will not be published in the *Green Book.*

Expected date of publication. — The text of Volume I can be established immediately after the Plenary Assembly and the publication of this Volume can be expected at the beginning of 1955.

Volume II. — This volume will comprise : Recommendations for Protection against disturbances, Recommendations for Protection against corrosion and the corresponding documentation.

The Committee recommends a separate printing of the texts of Recommendations proposing modifications to the two C.C.I.F. publications :

— Recommendations concerning the protection of underground cables against corrosion (Paris, 1949) ;
— Recommendations for the protection of underground cables against the action of stray currents due to electric traction installations (Florence 1951).

This separate edition should include a complete index to these two latter publications and to the Recommendations for protection against corrosion, in Volume II of the *Green Book.* This separate edition will be supplied as far as possible to subscribers to the two above-mentioned publications.

Expected date of publication. — The text of Volume II can be established at the end of the Plenary Assembly and the publication of this volume can be expected at the commencement of 1955.

Volume III of the Green Book. — This Volume will include all the recommendations relative to lines transmission, maintenance instructions and the texts appearing in Volume IV of the *Yellow Book* inclusion of which is considered to be desirable in the Volume of the *Green Book* concerning the 3rd and 5th Study Groups.

Expected date of publication. — The 3rd Study Group has envisaged a working group be charged with the revision of Volume III *bis* of the *Yellow Book.* This working Group should also consider the passages from the Volume IV of the *Yellow Book* concerning the 3rd Study Group.

The Plenary Assembly should indicate whether there should be a delegation of authority to this working group, or to the 3rd Study Group, to approve the final text of Volume III of the *Green Book.*

The permanent Sub-Committee for maintenance should also proceed to a complete revision of the Maintenance Instructions (lines). This revision will bear in particular on the reply to the question No. 32 of the 3rd Study Group, which lays down the essential principles for the maintenance of carrier systems. The Plenary Assembly must again indicate whether it agrees to a delegation of authority for the final establishment of the Maintenance Instructions.

Volume III of the *Green Book* containing the Maintenance Instructions will probably not be published until the autumn of 1955.

Volume IV of the Green Book. — This Volume will contain recommendations relating to the quality of transmission and recommendations concerning other subjects within the competence of the 4th Study Group. It will be necessary for a working group to undertake in particular the revision of the passages from Volume IV of the *Yellow Book.*

Expected date of publication. — The position is substantially the same as that for Volume III of the *Green Book.*

Volume V of the Green Book. — This volume will include the recommendations concerning international equipment for signalling and switching and relating to the arrangement of international terminal exchanges.

Expected date of publication. — The 8th Study Group has asked the Plenary Assembly for a delegation of authority to a working group charged with the preparation of specifications of international signalling and switching equipment. This working group must produce a complete specification for signalling and switching equipment and associated maintenance apparatus by the middle of 1955. In these circumstances Volume V of the *Green Book* can only be published towards the end of 1955.

Volume VI of the Green Book. — This Volume will comprise operating and tariff Recommendations.

Expected date of publication. — The text of Volume VI can be established towards the end of the Plenary Assembly and publication can be expected at the beginning of 1955.

Others C.C.I.F. publications

The Committee took note of the proposal made to the Plenary Assembly by the 1st S.G. that it should undertake the revision and preparation of the new publication " Directives concerning the protection of telecommunication lines against the deleterious effects of industrial power lines ". It sees no objection to this proposal.

The Committee has not concerned itself with the revision of the book " General Interconnection Plan ". It considers that the texts appearing in this work under the title Directives : Directives for operating, signalling and transmission could however, merit examination at the same time as the corresponding texts of the volume of the *Green Book.* The Committee considers that it would be desirable to define exactly the scope of these Directives, as it is to be feared that certain passages may only be duplicating those in the *Green Book*, if there were a full reproduction of large portions of the book.

Various points relating to the publication of roneotype C.C.I.F. documents

It has been suggested :

(a) that documents bear, in addition to the numbering proper to each Study Group, a consecutive numbering which allows the document to be located quickly during discussion,

(b) that C.C.I.F. documents be printed on a standard size of paper to enable convenient classification in files, if the resulting costs are not too great,

(c) that the C.C.I.F. publication entitled " List of international telephone communication routes used in Europe in 1954 (normal, auxiliary and emergency routes). Manual Working " be improved from the point of view of its editing and form, taking as a model the publication edited by the Secretariat of the I.T.U. entitled " Table B of the extra-European system (unit telegraph charges set up for use in the establishment of extra-European tariffs, in execution

of Article 28 of the International Telegraph Regulations, Paris 1949). — Revisions of Paris, 1949, and Geneva 1952.

The Committee did not consider itself in a position to pronounce on these points.

ANNEX

Passages in Volume IV of the " Yellow Book " which should be revised by the 4th Study Group

Pages 63 to 117 of Volume IV of the *Yellow Book* are now replaced by the pages 59 to 115 of Volume VI of the *Yellow Book*.

Pages 118 to 186 should be retained with the modifications introduced by the 4th Study Group.

Pages 187 to 193 contain a description of the old type psophometer. This description is now replaced by that of the new psophometer defined by the XVIth Plenary Assembly at Florence 1951. As the two types of measuring apparatus are still in service, however, it would appear desirable to retain in the new C.C.I.F. *Green Book* the specification of the old psophometer and it would be desirable that the two passages relating to the old and new psophometers appear in opposition to one another, the two tables giving the psophometric weightings being placed side by side.

Pages 193 to 195 of Volume IV dealing with the sound level meter should remain in Volume IV of the *Green Book* as well as pages 248 to 251 concerning measurements carried out on subscriber's telephone apparatus (with any modifications that may be considered useful).

Pages 254 to 292 relating to voice-ear testing should be re-examined in order to take account of the new texts which the 4th S.G. has proposed on these points.

ORGANISATION OF THE C.C.I.F.

A. EXTRACTS FROM THE INTERNATIONAL TELECOMMUNICATION CONVENTION OF BUENOS AIRES, 1952, AND THE GENERAL REGULATIONS ANNEXED THERETO

Article 1 of the Convention

Composition of the Union

1. The International Telecommunication Union shall comprise Members and Associate Members.

2. A Member of the Union shall be :

(a) any country or group of territories listed in Annex 1 upon signature and ratification of, or accession to, this Convention, by it or on its behalf ;

(b) any country not listed in Annex 1 which becomes a Member of the United Nations and which accedes to this Convention in accordance with Article 16 ;

(c) any sovereign country not listed in Annex 1 and not a Member of the United Nations which applies for Membership in the Union and which, after having secured approval of such application by two-thirds of the Members of the Union, accedes to this Convention in accordance with Article 16.

3. (1) All Members shall be entitled to participate in conferences of the Union and shall be eligible for election to any of its organs.

(2) Each Member shall have one vote at any conference of the Union and at any meeting of a permanent organ of the Union of which it is a Member.

4. An Associate Member of the Union shall be :

(a) any country, territory or group of territories listed in Annex 2 upon signature and ratification of, or accession to, this Convention, by or on its behalf ;

(b) any country which has not become a Member of the Union in accordance with § 2 of this Article, by acceding to this Convention in accordance with Article 16, after its application for Associate Membership has received approval by a majority of the Members of the Union ;

(c) any territory or group of territories, not fully responsible for the conduct of its international relations, on behalf of which a Member of the Union has signed and ratified or acceded to this Convention in accordance with Article 16 or 17, provided that its application for Associate Membership is sponsored by such Member, after the application has received approval by a majority of the Members of the Union ;

(d) any trust territory on behalf of which the United Nations has acceded to this Convention in accordance with Article 18, and the application of which for Associate Membership has been sponsored by the United Nations.

5. If any territory or group of territories, forming part of a group of territories constituting a Member of the Union, becomes or has become an Associate Member of the Union in accordance with sub-paragraphs *(a)* and *(c)* of § 4 above, its rights and obligations under this Convention shall be those of an Associate Member only.

6. Associate Members shall have the same rights and obligations as Members of the Union, except that they shall not have the right to vote in any conference or other organ of the Union. They shall not be eligible for election to any organ of the Union of which the Members are elected by a plenipotentiary or administrative conference.

7. For purposes of § 2 *(c)*, 4 *(b)* and 4 *(c)* above, if an application for Membership or Associate Membership is made, by diplomatic channel and through the intermediary of the country of the seat of the Union, during the interval between two plenipotentiary conferences, the Secretary-General shall consult the Members of the Union ; a Member shall be deemed to have abstained if it has not replied within four months after its opinion has been requested.

Article 4 of the Convention

Structure of the Union

The organization of the Union shall be as follows :

1. The Plenipotentiary Conference which is the supreme organ of the Union ;
2. Administrative Conferences ;
3. The permanent organs of the Union which are :
   (a) the Administrative Council,
   (b) the General Secretariat,
   (c) the International Frequency Registration Board (I.F.R.B.)
   (d) the International Telegraph Consultative Committee (C.C.I.T.)
   (e) the International Telephone Consultative Committee (C.C.I.F.)
   (f) the International Radio Consultative Committee (C.C.I.R.)

Article 7 of the Convention

International Consultative Committees

1. (1) The duties of the International Telegraph Consultative Committee (C.C.I.T.) shall be to study technical, operating, and tariff questions relating to telegraphy and facsimile and to issue recommendations on them.

(2) The duties of the International Telephone Consultative Committee (C.C.I.F.) shall be to study technical, operating and tariff questions relating to telephony and to issue recommendations on them.

(3) The duties of the International Radio Consultative Committee (C.C.I.R.) shall be to study technical radio questions and operating questions, the solution of which depends principally on considerations of a technical radio character and to issue recommendations on them.

2. The questions studied by each International Consultative Committee, on which it shall issue recommendations, are those submitted to it by the plenipotentiary conference, by an administrative conference, by the Administrative Council, by another Consultative Committee or by the International Frequency Registration Board. A Consultative Committee shall likewise issue its recommendations on questions, the study of which has been decided upon by its Plenary Assembly or requested by at least twelve Members or Associate Members in the interval between two meetings of the Plenary Assembly concerned.

3. The International Consultative Committees shall have as Members :

(a) of right, the administrations of all Members and Associate Members of the Union ;

(b) any recognized private operating agency which, with the approval of the Member or Associate Member which has recognized it, expresses a desire to participate in the work of these Committees.

4. Each Consultative Committee shall work through the medium of :

(a) the Plenary Assembly, meeting normally every three years ;

(b) study groups, which shall be set up by the Plenary Assembly to deal with questions to be studied ;

(c) a Director, who shall be appointed by the Plenary Assembly for an indefinite period, but with the reciprocal right of terminating the appointment ; the Director of the Radio Consultative Committee shall be assisted by a Vice-Director specializing in broadcasting, appointed under the same conditions ;

(d) a specialized secretariat, which assists the Director ;

(e) laboratories or technical installations set up by the Union.

5. The Directors of the Consultative Committees and the Vice-Director of the International Radio Consultative Committee shall all be nationals of different countries.

6. (1) Consultative Committees shall observe the applicable Rules of Procedure of Conferences contained in the General Regulations annexed to this Convention.

(2) The Plenary Assembly of a Consultative Committee may adopt such additional provisions as may facilitate the work of the Committee if they do not conflict with the Rules of Procedure of Conferences.

7. The working arrangements of the Consultative Committees are defined in Part II of the General Regulations annexed to this Convention.

Article 12 of the Convention

Regulations

1. Subject to the provisions of Article 11, the General Regulations contained in Annex 5 to this Convention shall have the same force and duration as the Convention.

2. (1) The provisions of the Convention are completed by the following sets of Administrative Regulations which shall be binding on all Members and Associate Members :

Telegraph Regulations,
Telephone Regulations,
Radio Regulations,
Additional Radio Regulations.

(2) Members and Associate Members shall inform the Secretary-General of their approval of any revision of these Regulations by administrative conferences. The Secretary-General shall inform Members and Associate Members promptly regarding receipt of such notifications of approval.

3. In case of inconsistency between a provision of the Convention and a provision of the Regulations, the Convention shall prevail.

Article 13 of the Convention

Finances of the Union

1. The expenses of the Union shall be classified as ordinary expenses and extraordinary expenses.

2. The ordinary expenses of the Union shall be kept within the limits prescribed by the plenipotentiary conference. They shall include, in particular, the expenses pertaining to the meetings of the Administrative Council, the salaries of the staff and other expenses of the General Secretariat, of the International Frequency Registration Board, of the International Consultative Committees, and of the laboratories and technical installations created by the Union. These ordinary expenses shall be borne by all Members and Associate Members.

3. (1) The extraordinary expenses shall include all expenses pertaining to plenipotentiary conferences, administrative conferences and meetings of the International Consultative Committees. They shall be borne by the Members and Associate Members which have agreed to participate in these conferences and meetings or which have actually participated.

(2) Recognized private operating agencies shall contribute to the expenses of the administrative conferences in which they participate or in which they have asked to participate.

(3) International organizations shall contribute to the expenses of plenipotentiary and administrative conferences to which they are admitted.

(4) Recognized private operating agencies shall contribute to the expenses of meetings of the Consultative Committees of which they are members. Similarly, international organizations and scientific or industrial organizations shall contribute to the expenses of meetings of the Consultative Committees to which they are admitted to participate.

(5) Nevertheless the Administrative Council may exempt international organizations from any participation in extraordinary expenses, on condition of reciprocity.

(6) Expenses incurred by laboratories and technical installations of the Union, in measurements, testing, or special research for individual Members or Associate Members, groups of Members or Associate Members, or regional organizations or others, shall be borne by those Members or Associate Members, groups, organizations or others.

4. The scale of contributions to the expenses of the Union shall be as follows :

30-units class	8-units class
25-units class	5-units class
20-units class	4 units class
18-units class	3-units class
15-units class	2-units class
13-units class	1-unit class
10-units class	½-unit class

5. Members and Associate Members, recognized private operating agencies, international organizations and scientific or industrial organizations shall be free to choose the class in which they will share in defraying the expenses of the Union.

6. (1) Each Member and Associate Member shall inform the Secretary-General, before the Convention enters into force, of the class it has chosen.

(2) This decision shall be notified to Members and Associate Members by the Secretary-General.

(3) Members and Associate Members may at any time choose a class higher than the one already adopted by them.

(4) Any application submitted after the date of entry into force of the Convention and entailing a reduction in the number of contributory units of a Member or Associate Member shall be referred to the following plenipotentiary conference and shall take effect from a date to be determined by that conference.

7. The sale price of documents sold to administrations, recognized private operating agencies or individuals shall be fixed by the Secretary-General, in collaboration with the Administrative Council, bearing in mind the fact that the cost of publication must be covered by the sale of the documents.

8. Members and Associate Members shall pay in advance their annual contributory shares calculated on the basis of the estimated expenditure of the Union for the following financial year.

9. The amounts due shall bear interest from the beginning of each financial year of the Union with regard to ordinary expenses and from thirty days after the date on which accounts for extraordinary expenses are sent to Members and Associate Members. This interest shall be at the rate of 3% (three per cent.) per annum during the first six months and at the rate of 6% (six per cent.) per annum from the beginning of the seventh month.

Article 14 of the Convention

Languages

1. (1) The official languages of the Union shall be Chinese, English, French, Russian and Spanish.

(2) The working languages of the Union shall be English, French and Spanish.

(3) In case of dispute, the French text shall be authentic.

2. (1) The final documents of the plenipotentiary and administrative conference, as well as their final acts, protocols and resolutions shall be drawn up in the official languages of the Union in versions equivalent in form and content.

(2) All other documents of these conferences shall be issued in the working languages of the Union.

3. (1) The official service documents of the Union as prescribed by the Administrative Regulations shall be published in the five official languages.

(2) All other documents for general distribution prepared by the Secretary-General in the course of his duties shall be drawn up in the three working languages.

4. Any of the documents referred to in § 2 and 3 above may be published in languages other than those there specified, provided that the Members or Associate Members requesting such publication undertake to defray the whole of the cost of translation and publication involved.

5. At conferences of the Union and whenever it is necessary at meetings of its permanent organs, the debates shall be conducted with the aid of an efficient system of reciprocal interpretation between the three working languages.

6. (1) At conferences of the Union and at meetings of its permanent organs, languages other than the three working languages may be used :

(a) if an application is made to the Secretary-General or to the Head of the permanent organ concerned to provide for the use of an aditional language or languages, oral or written, provided that the additional cost so incurred shall be borne by those Members or Associate Members which have made or supported the application ;

(b) if any delegation itself makes arrangements at its own expense for oral translation from its own language into any one of the three working languages.

(2) In the case provided for in § 6 (1) *(a)* above, the Secretary-General or the Head of the permanent organ concerned shall comply to the extent practicable with the application, having first obtained from the Members or Associate Members concerned an undertaking that the cost incurred will be duly repaid by them to the Union ;

(3) In the case provided for in § 6 (1) *(b)* above, the delegation concerned may, furthermore, if it wishes, arrange at its own expense for oral interpretation into its own language from one of the three working languages.

PART II OF THE GENERAL REGULATIONS ANNEXED TO THE CONVENTION

INTERNATIONAL CONSULTATIVE COMMITTEES

Chapter 10

General Provisions

1. The provisions of Part II of the General Regulations supplement Article 7 of the Convention defining the duties and structure of the International Consultative Committees.

2. The Consultative Committees shall also observe the applicable Rules of Procedure of Conferences contained in Part I of the General Regulations.

Chapter 11

Conditions for participation

1. (1) The International Consultative Committees shall have as Members :

(a) of right, the administrations of all Members and Associate Members of the Union,

(b) any recognized private operating agency which, with the approval of the Member or Associate Member which has recognized it, subject to the procedure prescribed below, expresses a desire to participate in the work of the Committees.

(2) The first request from a recognized private operating agency to take part in the work of a Consultative Committee shall be addressed to the Secretary-General who shall inform all the Members and Associate Members and the Director of the Consultative Committee concerned. A request from a recognized private operating agency must be approved by the Member or Associate Member recognizing it.

2. (1) International organizations which coordinate their work with the International Telecommunication Union and which have related activities may be admitted to participate in the work of the Consultative Committees in an advisory capacity.

(2) The first request from an international organization to take part in the work of a Consultative Committee shall be addressed to the Secretary-General who shall inform by telegram all the Members and Associate Members and invite Members to say whether the request should be granted ; the request shall be granted if the majority of the replies of the Members received within a period of one month are favourable. The Secretary-General shall inform all the Members and Associate Members and the Director of the Consultative Committee concerned of the result of the consultation.

(3) The conditions under which any administration, recognized private operating agency or international organization may withdraw from participation in the work of a Consultative Committee are laid down in Chapter 20, § 5 of these Regulations.

3. (1) Scientific or industrial organizations, which are engaged in the study of telecommunication problems or in the design or manufacture of equipment intended for telecommunication services, may be admitted to participate in an advisory capacity in meetings of the study groups of the Consultative Committees, provided that their participation has received the approval of the administrations of the countries concerned.

(2) The first request from a scientific or industrial organization for admission to meetings of study groups of a Consultative Committee shall be addressed to the Director of the Consultative Committee ; such a request must be approved by the administration of the country concerned.

Chapter 12

Duties of the Plenary Assembly

The Plenary Assembly shall :

(a) consider the reports of study groups and approve, modify or reject the draft recommendations contained in these reports ;

(b) decide new questions to be studied in conformity with the provisions of Article 7 § 2 of the Convention ; and if need be, establish a study programme ;

(c) so far as necessary, maintain existing study groups and set up new study groups ;

(d) allocate to study groups the questions to be studied ;

(e) consider and approve the report by the Director on the activities of the Committee since the last meeting of the Plenary Assembly ;

(f) approve a report on the financial needs of the Committee until the next Plenary Assembly, for submission by the Director to the Administrative Council ;

(g) consider any other matters deemed necessary within the provisions of Article 7 of the Convention and Part II of the General Regulations.

Chapter 13

Meetings of the Plenary Assembly

1. The Plenary Assembly shall normally meet every three years.

2. The date of the meeting of the Plenary Assembly may be changed with the approval of the majority of the Members of the Union which participated in the previous meeting of the Plenary Assembly, or which, not having so participated, have informed the Secretary-General of their wish to take an active part in the work of the Consultative Committee concerned.

3. (1) So far as possible meetings of the Plenary Assembly shall be held at the seat of the Union.

(2) However, each meeting of the Plenary Assembly may fix another place for the following meeting. This place may subsequently be changed by application of the procedure described in § 2 above.

4. At each of these meetings, the Plenary Assembly shall be presided over by the Head of the delegation of the country in which the meeting is held or, in the case of a meeting held at the seat of the Union by a person elected by the Plenary Assembly itself ; the Chairman shall be assisted by Vice-Chairmen elected by the Plenary Assembly.

5. The secretariat of the Plenary Assembly of a Consultative Committee shall be composed of the specialized secretariat of that Committee, with the help, if necessary, of the personnel of the administration of the inviting government and of the General Secretariat.

Chapter 14

Languages and Method of Voting in Plenary Assemblies

1. The languages used in the Plenary Assemblies and in the official documents of the Consultative Committees shall be as provided in Article 14 of the Convention.

2. The countries which are authorized to vote at sessions of Plenary Assemblies of the Consultative Committees are those to which reference is made in Article 1, § 3 (2) and Article 15, § 2 of the Convention. However, when a country is not represented by an administration, the representatives of the recognized private operating agencies of that country shall, as a whole, and regardless of their number, be entitled to a single vote.

Chapter 15

Composition of Study Groups

1. The Plenary Assembly shall set up the necessary study groups to deal with questions to be studied. The administrations, recognized private operating agencies and international organizations admitted in accordance with § 2 of Chapter 11 which wish to take part in the work of the study groups shall give in their names either at the meeting of the Plenary Assembly or, at a later date, to the Director of the Consultative Committee concerned.

2. In addition, and subject to the provisions of § 3 of Chapter 11 of these Regulations, experts of scientific or industrial organizations may be admitted to take part in an advisory capacity in any meeting of any study group.

3. The Plenary Assembly shall appoint the Chairman and Vice-Chairman of each study group. If, in the interval between two meetings of the Plenary Assembly, a Group Chairman is unable to carry out his duties, the Vice-Chairman shall take his place, and the study group concerned shall elect, from among its members, a new Vice-Chairman.

Chapter 16

Treatment of Business of Study Groups

1. Study groups shall normally conduct their work by correspondence.

2. (1) However, the Plenary Assembly may give directives concerning the convening of any meetings of the study groups that may appear necessary to deal with large groups of questions.

(2) Moreover, if, after a Plenary Assembly, a Group Chairman considers it necessary for his study group to hold a meeting not provided for by the Plenary Assembly to discuss orally questions which could not be solved by correspondence, he may, with the approval of his administration and after consultation with the Director concerned and the members of his study group, suggest a meeting at a convenient place bearing in mind the need to keep expenses to a minimum.

3. However, in order to avoid unnecessary journeys and prolonged absences, the Director of a Consultative Committee, in agreement with the Group Chairmen of the various study groups concerned, shall draw up the general plan of meetings of groups of study groups which are to meet in the same place during the same period.

4. The Director shall send the final reports of the study groups to the participating administrations, to the recognized private operating agencies of the Consultative Committee and, as occasion may demand, to such international organizations as have participated. These shall be sent as soon as possible and, in any event, in time for them to be received at least one month before the date of the next meeting of the Plenary Assembly. Questions which have not formed the subject of a report furnished in this way shall not appear on the agenda for the meeting of the Plenary Assembly.

Chapter 17

Duties of the Director. Specialized Secretariat

1. (1) The Director of a Consultative Committee shall coordinate the work of the Consultative Committee, including its Plenary Assembly and study groups, and shall be responsible for the organization of the work of the Consultative Committee.

(2) He shall be responsible for the documents of the Committee.

(3) The Director shall be assisted by a secretariat composed of a specialized staff to work under his direction and to aid him in the organization of the work of the Committee.

(4) The Director of the International Radio Consultative Committee shall also be assisted by a Vice-Director in accordance with Article 7 of the Convention.

2. The Director shall choose the technical and administrative members of the secretariat within the framework of the budget as approved by the plenipotentiary conference or the Administrative Council. The appointment of the technical and administrative personnel is made by the Secretary-General in agreement with the Director.

3. The Director shall participate as of right, but in an advisory capacity, in meetings of the Plenary Assembly and of the study groups. He shall make all necessary preparations for meetings of the Plenary Assembly and of the study groups.

4. The Vice-Director of the International Radio Consultative Committee shall participate as of right in an advisory capacity in meetings of the Plenary Assembly and of the study groups when questions in which he is concerned are on the agenda.

5. The Director shall submit to the Plenary Assembly a report on the activities of the Consultative Committee since the last meeting of the Plenary Assembly. After approval, this report shall be sent to the Secretary-General for submission to the Administrative Council.

6. The Director shall submit for the approval of the Plenary Assembly a report on the financial needs of the Consultative Committee up to the next meeting of the Plenary Assembly ; this report, after approval by the Plenary Assembly, shall be sent to the Secretary-General for appropriate action.

Chapter 18

Preparation of Proposals for Administrative Conferences

One year before the appropriate administrative conference, representatives of the interested study groups of each Consultative Committee shall correspond with or meet with representatives of the General Secretariat in order to extract from the recommendations issued by it since the preceding administrative conference proposals for modification of the relative set of Regulations.

Chapter 19

Relations of Consultative Committees between themselves and with other International Organizations

1. (1) Plenary Assemblies of Consultative Committees may set up joint study groups to study and make recommendations on questions of common interest.

(2) The Directors of Consultative Committees may, in collaboration with the Group Chairmen, organize joint meetings of study groups of different Consultative Committees, to study and prepare draft recommendations on questions of common interest. Such draft recommendations shall be submitted to the next meeting of the Plenary Assembly of each Consultative Committee concerned.

2. The Plenary Assembly or the Director of a Consultative Committee may invite a representative of the Committee to attend, in an advisory capacity, meetings of other Consultative Committees or of other international organizations to which that Consultative Committee has been invited.

3. The Secretary-General of the Union, or one of the two Assistant Secretaries-General, the representatives of the International Frequency Registration Board, and the Directors of the other Consultative Committees of the Union or their representatives may attend meetings of the Consultative Committees in an advisory capacity.

Chapter 20

Finances of Consultative Committees

1. The salaries of the Directors of the Consultative Committees, including the salary of the Vice-Director of the International Radio Consultative Committee, and the ordinary expenses of the specialized secretariats shall be included in the ordinary expenses of the Union in accordance with the provisions of Article 13 of the Convention.

2. The totality of the extraordinary expenses of each Consultative Committee, which shall include the extraordinary expenses of the Directors, the Vice-Director of the International Radio Consultative Committee and of the whole of the secretariat employed at any meetings of the study groups or of the Plenary Assembly, and the cost of all working documents of the study groups and the Plenary Assembly shall be borne in the manner prescribed in Article 13, § 3 and 6, of the Convention by:

(a) the administrations which have advised the Secretary-General that they wish to take an active part in the work of the Consultative Committee even if they have not attended the meeting of the Plenary Assembly ;

(b) the administrations which, while not having advised the Secretary-General that they wished to take part in the work of the Consultative Committee have nevertheless attended the meeting of the Plenary Assembly or a meeting of a study group ;

(c) the recognized private operating agencies which have, in accordance with Chapter 11 § 1 (2), made a request to take part in the work of the Consultative Committee even if they have not attended the meeting of the Plenary Assembly ;

(d) those international organizations which have, in accordance with Chapter 11 § 2 (2), been admitted to take part in the work of the Consultative Committee and which have not been excused payment in accordance with Article 13 § 3 (5) of the Convention ;

(e) the scientific or industrial organizations which have, in accordance with Chapter 11 § 3, attended meetings of study groups of the Consultative Committee.

3. The recognized private operating agencies, international organizations and scientific or industrial organization, referred to in subparagraphs *(c)*, *(d)* and *(e)* of § 2 above shall declare the class, from among those mentioned in § 4 of Article 13 of the Convention, according to which they will contribute to the extraordinary expenses of the Consultative Committee.

4. The expenses of study groups shall be included in the extraordinary expenses of the next meeting of the Plenary Assembly. However, where meetings of study groups take place more than one year before the date of the next meeting of the Plenary Assembly, the Secretary-General shall render to the administrations, agencies and organizations concerned, interim accounts in respect of the extraordinary expenditure incurred.

5. The administrations, recognized private operation agencies, international organizations and scientific or industrial organizations referred to in § 2 above shall be under an obligation to contribute to the extraordinary expenses as from the date of the close of the preceding meeting of the Plenary Assembly. This obligation shall remain in force until terminated. A notice of termination shall take effect as from the close of the meeting of the Plenary Assembly following the date of reception of such notice, but shall not affect the right to receive all documents pertaining to that meeting of the Plenary Assembly.

6. Each administration, recognized private operating agency, international organization and scientific or industrial organization shall defray the personal expenses of its own participants.

7. However, the personal expenses of the representative of a Consultative Committee incurred as a result of his participation in a meeting in the circumstances envisaged in § 2 of Chapter 19 shall be borne by the Committee which he represents.

B. RECOMMENDATIONS OF THE INTERNATIONAL TELEPHONE CONSULTATIVE COMMITTEE COMPLETING THE PROVISIONS OF THE INTERNATIONAL TELECOMMUNICATION CONVENTION OF BUENOS AIRES, 1952, AND THE SECOND PART OF THE GENERAL REGULATIONS ANNEXED TO THE SAID CONVENTION

Additional Internal Regulation for the C.C.I.F.

The XVIIth Plenary Assembly of the INTERNATIONAL TELEPHONE CONSULTATIVE COMMITTEE,

In view of Article 7, § 6 (2) of the International Telecommunication Convention, Buenos Aires, 1952,

decides

that the provisions of the General Regulations annexed to the Convention of Buenos Aires, 1952, concerning the organization of the C.C.I.F., should be completed as follows :

(a) *Plenary Assembly (P.A.)*

1. If the Plenary Assembly meets at the Seat of the Union, the precise date for this meeting will be fixed by the Director of the Committee in agreement with the Secretary-General of the Union, having regard to the progress of the work of the Study Groups (S.G.). If the Plenary Assembly does not meet at the Seat of the Union, the exact date of the meeting will be fixed by the inviting Government in agreement with the Director of the Committee.

The Director of the Committee will send to all Members and Associate Members of the Union (as well as to International Organizations whose activities are connected with those of the C.C.I.F.) an invitation to participate in the meeting of the Plenary Assembly. If a country which is a Member or Associate Member has already officially notified that a recognized Private Operating Company of its country should participate in the work of the C.C.I.F., the invitation will also be addressed to this Private Operating Company. Otherwise, it rests with the Member or Associate Member to communicate this invitation to the Private Operating Companies of its country.

The Director of the Committee will include with this invitation a draft programme of Committee meetings preparatory to the Plenary Assembly and of sessions of the Plenary Assembly. If the Plenary Assembly does not meet at the Seat of the Union, the Director of the Committee will send the above-mentioned invitation in the name of the inviting Government. The invitation will indicate that participation in the Meeting of the P.A. entails participation in the extraordinary expenses of the C.C.I.F.

Members or Associate Members of the Union which desire to participate in this meeting are required to advise the Director of the Committee, by letter or telegram, at least a month before the meeting, of the names of the Delegates of Administrations and the Representatives of recognized Private Operating Companies who will attend the meetings of the preparatory Committees and at meetings of the Plenary Assembly (and especially of the name of the Head of the Delegation) as well as the names of Experts of the Scientific and Industrial Organizations who will attend only meetings of the preparatory Committees.

The Director of the C.C.I.F. will invite the Directors and Vice-Director of the other two C.C.I.'s of the Union to participate in the Plenary Assembly in a consultative capacity.

2. Recommendations submitted to a vote in the course of a Plenary Assembly are considered as adopted if they obtain a majority of votes ; the minutes of meetings of the Plenary Assembly will indicate the results of the vote without mentioning the delegations which have voted for or against, unless a delegation expressly asks that its vote should be mentioned.

The corresponding recommendations will also mention these results in the form :

" The C.C.I.F. unanimously issues the Recommendation ..." or " the C.C.I.F. issues by a majority (of ... votes against ... votes with ... abstentions) the Recommendation ..."

It is not admissible for a Delegation to vote on behalf of an administration which has not sent a Delegation.

3. If a Plenary Assembly is held at the Seat of the Union, the Heads of Delegations will meet before the opening session in order to designate the persons who

will be proposed as Chairman and Vice-Chairmen of the said meeting for election by the Plenary Assembly (Chapter 13, Article 4 of the General Regulations annexed to the Buenos Aires Convention, 1952).

During their first meeting, the Heads of Delegations will examine the " Report on the activities of the Committee since the last Plenary Assembly " and make a proposal to the Plenary Assembly for the constitution of the " Budget Committee " charged with the examination of the " Report on the financial needs of the Committee until the next Plenary Assembly ", and the expenses incurred by the current Plenary Assembly.

Before the closing session of the Plenary Assembly, the Heads of Delegations will meet in order to prepare, for the Plenary Assembly, proposals concerning the constitution of Study Groups and the designation of Group Chairmen (who should preside over each of these Study Groups) as well as the Vice-Chairmen (who will replace Group Chairmen prevented from carrying out their duties in the interval between two meetings of the Plenary Assembly).

4. In the closing session of the Plenary Assembly, the Director will give a résumé of the work including in particular the Recommendations approved by the Plenary Assembly and the list of questions, the study of which should be undertaken or pursued by the various Study Groups. During this closing session, the Plenary Assembly will establish lists of the Administrations or Private Operating Companies which will participate in the work of the various S.G.'s ; the Plenary Assembly will take a decision on the proposals of the Meeting of the Heads of Delegations concerning the designation of Group Chairmen and Group Vice-Chairmen.

5. New questions put to study by a Plenary Assembly are divided by this Assembly into three categories :

Category A 1 — Questions for which there should be agreement capable of world-wide application.

Category A 2 — Questions for which there should be agreement for application in Europe only.

Category B — Questions solely of a documentary character and for which agreement is not necessary.

In addition, the Plenary Assembly will indicate whether each question is " urgent " or " non urgent ".

(b) *Director*

1. The Director of the C.C.I.F. (who, in virtue of Article 7, § 4 *(c)* of the International Telecommunication Convention of Buenos Aires, 1952, is nominated by the Plenary Assembly for an indefinite period, with reciprocal rights of termination) should be chosen having regard to his special qualifications in matters dealt with by the Committee. No national of the countries from which nationals are Directors and Vice-Director of another C.C.I. can be elected as Director of the C.C.I.F.

2. The Director is authorized to deal directly with the Group Chairmen of Study Groups and the Chairmen of Sub-Committees set up by the Plenary Assembly.

3. In order that the Director may keep up to date on technical progress, Administrations and Private Operating Companies (as far as circumstances permit) authorize him to visit their installations and to obtain all necessary information ; the expenses incurred in this connection are chargeable to the C.C.I.F.

4. The Director will take all necessary preparatory measures for meetings of the Plenary Assembly, Study Groups and Sub-Committees, the work of which he should coordinate (Chapter 17, Article 1 of the General Regulations annexed to the International Telecommunications Convention of Buenos Aires, 1952).

5. After the closure of a Plenary Assembly, the Director will send (to all the Administrations and Private Operating Companies which have expressed a desire to participate in the work of the C.C.I.F. and to International Organizations which will cooperate in the work of the C.C.I.F.) lists of questions, the study of which should be undertaken or continued by each Study Group or Sub-Committee ; he will ask them to furnish their observations, the results of their findings, and the draft replies which they propose to make on the various questions.

6. At least a month before each meeting of a Study Group or Sub-Committee, the Director will send (to all the Members of this Study Group or Sub-Committee) the complete " Preliminary Documentation " obtained from all Administrations and Private Telephone Operating Companies and from all the International Organizations consulted.

After each meeting of a Study Group or a Sub-Committee the Director will establish, under the direction of the Group Chairman of this Study Group or of the Chairman of this Sub-Committee, the report giving an account of the work completed during the meeting and containing the " Draft Recommendations " for submission for the approval of the next Plenary Assembly.

The Director will send this report (as well as the above-mentioned corresponding " Preliminary Documentation ") to all Administrations and Private Operating Companies which have expressed a wish to participate in the work of the C.C.I.F.

7. In his " Report on the financial needs of the Committee until the next Plenary Assembly ", the Director will communicate to the Plenary Assembly (for information), a résumé of the accounts for the years which have elapsed since the preceding Plenary Assembly, and " Estimated ordinary expenses of the C.C.I.T. " to cover the financial requirements of the Committee until the next Plenary Assembly.

These " Estimated ordinary expenses of the C.C.I.F. " are first submitted to a preliminary examination by the " Budget Committee " ; the Chairman of this Committee will prepare a report on this subject for the Plenary Assembly documentation. After approval, these " Estimated ordinary expenses of the C.C.I.F. " are sent (by the Director of the C.C.I.F.) to the Secretary-General of the Union, for the information of the Administrative Council of the Union.

After the meeting of the Plenary Assembly, the Director will send to the Secretary-General of the Union (for the information of the Administrative Council of the Union) the list of meetings of Study Groups envisaged up to the time of the next Plenary Assembly and an estimate of the probable costs of the said Study

Group meetings. The Director will submit for a preliminary examination by the "Budget Committee" and also for the approval of the Plenary Assembly, the account for the extraordinary expenditure incurred for the current Plenary Assembly.

(c) *Study Groups (S.G.'s)*

1. In principle, there are three categories of Study Groups : Study Groups dealing with questions of protection, Study Groups dealing with questions of transmission, switching and signalling and those Study Groups handling operating and tariff questions.

In order to facilitate the work, the number of Administrations or Private Operating Companies who are members of a Study Group should be as restricted as possible.

2. In order to prepare a general plan of the meeting of Study Groups in the same category (Chapter 16, Article 3 of the General Regulations annexed to the International Telecommunication Convention of Buenos Aires, 1952), each Group Chairman will advise the Director in good time, of the number of meeting days necessary for the work of his Study Group and, if he intends to hold common meetings with one or several other Study Groups, the number of days necessary for this puspose.

3. Minutes are not taken for the various sessions of a Study Group or a Sub-Committee. The report, giving an account of the work completed during a Study Group meeting or a Sub-Committee meeting which has taken place in the interval between two successive meetings of the Plenary Assembly, should reach all Administrations and Recognized Private Operating Companies which have expressed a wish to participate in the work of the C.C.I.F., at least a month before the date of the following Plenary Assembly ; since questions which have not been made the subject of a report fulfilling these conditions, cannot be included in the agenda of the Plenary Assembly.

These Administrations or Private Operating Companies are authorized to communicate Study Group and Sub-Committee reports to all the Experts whom they consider it useful to consult, except when a Study Group (or a Sub-Committee) concerned has decided that its report should be treated as confidential.

4. All the Study Groups will meet simultaneously at the meeting place for the Plenary Assembly before its opening session in order to finalise the texts of the draft recommendations to be submitted for the approval of the Plenary Assembly.

The programme for the whole of the Study Group meetings (during the days preceeding the Plenary Assembly) will be sent in good time to the Administrations and to Recognized Private Operating Companies of countries who are Members or Associate Members of the Union in order to enable them to assist at these meetings.

While the Plenary Assembly is in session, the Study Groups will hold themselves at the disposition of the Plenary Assembly in order to carry into the texts of the "Draft Recommendations" the textual modifications proposed by this Assembly.

(d) *Technical collaboration between the C.C.I.F. and International Technical Organisations dealing with questions likely to interest International Telephony*

THE INTERNATIONAL TELEPHONE CONSULTATIVE COMMITTEE

unanimously recommends :

1. That it is desirable to set up technical collaboration between the C.C.I.F. and the following International Organisations which deal with questions likely to interest international telephony :

— International Railway Union (I.R.U.).
— International Electrotechnical Commission (I.E.C.).
— International Conference of large electrical networks (C.I.G.R.E.).
— International Union of Producers and Distributors of electric power (U.N.I.P.E.D.E.).
— Postal and Telecommunications Commission of the International Chamber of Commerce.
— International Union of Public Transport Undertakings (I.U.T.).
— International Union of Gas Industries (I.U.G.).
— Technical Commission of the International Broadcasting Organisation (I.B.O.).
— Technical Committee of the European Broadcasting Union (E.B.U.).
— International Standardisation Organisation (I.S.O.).

2. That it is desirable to send to all these Organisations the Minutes of the C.C.I.F. Study Groups likely to interest them.

Considering furthermore

Article 13, § 3 (5) of the International Telecommunication Convention, Buenos Aires, 1952, and Chapter 11, Article 2 (2) of the General Regulations annexed thereto, and Resolution No. 222 of the Resolutions of the Administrative Council of the Union of 1954

unanimously recommends

that the above Technical Organisations should be exempt from all contribution to the expenses of the C.C.I.F. Meetings which they attend, on the condition that they also allow the C.C.I.F. to attend, without charge, their Meetings.

C. RECOMMENDATION RELATIVE TO THE POSSIBLE AMALGAMATION OF THE C.C.I.T. AND THE C.C.I.F.

THE INTERNATIONAL TELEPHONE CONSULTATIVE COMMITTEE,

as a result of

Resolution No. 2 of the Convention of Buenos Aires which invites the Plenary Assemblies of the C.C.I.T. and the C.C.I.F. to make a detailed study of the amalgamation of the two C.C.I.'s and to present their recommendations at the next International Telegraph and Telephone Administrative Conference, and also, the provisions of the additional Protocol II appended to the Convention of Buenos Aires and, in particular, § 3 of this Protocol, in which, if the International Telegraph and Telephone Administrative Conference is postponed until after 1954, the Administrative Council is authorized to exercise, after consultation with the Members of the Union, the same powers as are conferred on the Telegraph and Telephone Administrative Conference by § 1 and 2 of this Protocol ;

considering

that the new techniques of telegraphy and telephony approach one another more and more closely ;

that international telegraph and telephone services make increasing use of the same routes ;

that the relations of the I.T.U. with various other international organisations present similar problems to the C.C.I.T. and to the C.C.I.F. in respect of which unity of views would be desirable as far as this is possible ;

that the qualifications of the Technical officials at present separated in the specialised secretariats of the C.C.I.T. and the C.C.I.F. would be better employed if these Technical officials were grouped in the same office under the control of a single authority.

issues, with a majority of 21 votes to 13, with one abstention, the recommendation

1. That the amalgamation of the C.C.I.T. and the C.C.I.F. according to the provisions of the additional Protocol II appended to the Convention of Buenos Aires is in the interests of the Union ;

2. That the Secretary General of the I.T.U. should be asked to communicate this Recommendation to the Administrative Council for examination during the next meeting.

THE INTERNATIONAL TELEPHONE CONSULTATIVE COMMITTEE,

considering

that, if the amalgamation of the C.C.I.T. and the C.C.I.F. is decided upon by the International Telegraph and Telephone Administrative Conference, additional provisions should be established to the General Regulations (appended to the Convention) in order to define clearly the methods of operation for a unified C.C.I.F.

that the time of attendance of each official taking part in the Plenary Assembly of such a joint C.C.I. should be reduced to the strict minimum necessary for the treatment of the only those questions of interest to that official,

makes the recommendation

that the additional rules specifying the methods of operation of the joint C.C.I. could stipulate that its Plenary Assembly could take place in three phases :

— one phase devoted to purely telegraphy questions,
— one phase devoted to purely telephony questions,
— one phase devoted to questions concerning both telegraphy and telephony,

considering, furthermore, that,

the working group A of the VIIth Plenary Assembly of the C.C.I.T. has examined whether there is a more or less direct connection between the questions submitted to the Study Groups of the C.C.I.T. and the C.C.I.F., but that then making the relative proposals contained in the pages 190 to 193 of the documents of Arnhem 1953, it was not possible to take into consideration the new duties for the Study Groups of the C.C.I.F. laid down by the XVIIth Plenary Assembly of the C.C.I.F.,

that the number of Study groups of a joint C.C.I. should be reduced to a minimum,

unanimously makes the recommendation

that it would be useful to proceed to a new and detained examination of the proposals of the Working group A of the VIIth Plenary Assembly of the C.C.I.T., and the duties laid down by the XVIIth Plenary Assembly of the C.C.I.F. for its study groups,

and that this task can be confided to a Meeting of chief Chairmen and of the Vice-Chairmen of the various present Study Groups of the C.C.I.T. and the C.C.I.F. at a meeting convened by the Administrative Council ;

considering finally,

that considerable burdens may be imposed by the coordinated establishment and the rational operation of a world network of international routes of modern types, serving at one and the same time for telegraphy and telephony,

makes the recommendation

that the specialised secretariat of a joint C.C.I. should include an adequate number of specially qualified officials,

that proposals on this subject should be made to the Administrative Council by the Secretary General of the I.T.U. after consultation with the Coordination Committee.

RECOMMENDATIONS RELATING TO LETTER SYMBOLS, GRAPHICAL SYMBOLS AND SYSTEMS OF UNITS

LETTER SYMBOLS

RECOMMENDATION No. 1

Letter symbols for the units of transmission

(New recommendation replacing the previous Recommendation No. 1, XVth Plenary Assembly, Paris 1949, Vol. 4 of the Yellow Book, *page 41)*

THE INTERNATIONAL TELEPHONE CONSULTATIVE COMMITTEE,

Taking note of the proposal of the I.S.O. (International Standardization Organization) that in order to avoid confusion with the symbol N for " newton " it would be desirable to replace the symbol N for " neper " by the symbol Np.

Agree unanimously the recommendation :

That for telecommunications purposes it is preferred for general use to continue with the symbol N for " neper " with the possibility of using the symbol Np for " neper " where the possibility of confusion arises.

Further,

That as many Telephone Administrations have for a long time the symbol db for " decibel " and that they do not wish to change to the symbol dB proposed by the I.S.O.

Agree by a majority of 16 to 7 :

That for telecommunication purposes, it is preferred to continue with the use of the symbol db for " decibel " as this symbol is the most commonly used.

RECOMMENDATION No. 2

Letter symbols for the unit of frequency

(Previous Recommendation No. 2, XVth Plenary Assembly, Paris 1949, Vol. IV of the Yellow Book, *page 41)*

THE INTERNATIONAL TELEPHONE CONSULTATIVE COMMITTEE

Considering

That it should have an interest in the standardization of the letter symbol for " frequency " for the systems using the " second " as the unit of time ;

That the International Electrotechnical Commission is the proper authority on this subject which it has already studied ;

That in a number of documents different letter symbols are used which have official recognition,

Agree unanimously the recommendation

That until a definite decision of the I.E.C. is everywhere in force, the following titles and letter symbols be used to the exclusion of all others :

hertz	Hz
cycles per second	c/s
periods per second	p/s

RECOMMENDATION No. 3

Letter symbols of joint interest in electrotechnology and telephony

(Previous Recommendation No. 3, XVth Plenary Assembly, Paris 1949. Vol. IV of the Yellow Book, *page 42)*

THE INTERNATIONAL TELEPHONE CONSULTATIVE COMMITTEE

Considering

That for easing the reading of documents concerning telephony, and in particular those prepared and published by the C.C.I.F. it would be useful to adopt, as far as possible, a uniform and coherent system of letter symbols,

That a list of letter symbols for the principal terms in electrotechnology has already been prepared by the C.E.I. which however does not meet all the needs of technique ;

That there are a number of distinct terms in telephony that it is important to consider, and that there is a restriction on the quantity of letters or characters that can be employed and that it is not possible to give a unique character to each term ;

That after all, the use (in a particular document) of a universally adopted symbol, although important, is less essential than the use of symbols which form a coherent whole,

Agree unanimously the recommendation :

That in documents published by the C.C.I.F. it should be the normal practice to use the letter symbols from the I.E.C. list (Document 27 — International letter symbols used in electricity — 3rd edition, 1953). An extract of this list giving the principal symbols needed for telephony is attached ;

That the following symbols which do not appear in the I.E.C. list are used but not necessarily as strictly as those in the I.E.C. list.

Name	Symbol	
	principal	reserve
Gain	k	
Equivalent	q	
Level	n	
Efficiency	r	
Clearness	η	
Repetition rate	R	
Psophometric Voltage	U_{ps}	U_{Ψ}
Psophometric Electromotive force	E_{ps}	E_{Ψ}
Signal to noise ratio	Δn_{ps}	Δn_{Ψ}
Cut-off frequency	f_o ou f_c	
Sensitivity Coefficient	σ	
Q coefficient. Coefficient of magnification	Q	

Considering also,

That definite proposals, on the subject of letter symbols concerning telecommunications, should not be made to the I.E.C. until after agreement by the three C.C.I.s of the U.I.T. ;

Agree unanimously the recommendation ;

That it would be desirable for the C.C.I.T. and the C.C.I.R. each to prepare proposals for the symbols which are of particular interest to them, and form a Mixed Study Group with the C.C.I.F. Symbols Study Group to prepare a single list, which, after agreement with the three International Consultative Committees, would be submitted to the International Electrotechnical Commission.

EXTRACT FROM TABLE 1 OF DOCUMENT 27
OF THE INTERNATIONAL ELECTROTECHNICAL COMMISSION (I.E.C.)

Item	Name	Symbol chief	Symbol reserve	Remarks
....	....			
	SPACE — TIME			
....	....			
....	(Length)			
20	wavelength	λ		
21	Propagation coefficient	γ	p	$\gamma = \alpha + j\beta$
22	phase coefficient	β	b	
23	attenuation coefficient	α	a	
26	Time	t		
27	time of one cycle	T		
28	time constant	τ	T	
29	Frequency	f	ν	
31	Angular frequency	ω		$\omega = 2\pi f$
32	Damping coefficient	δ		
33	Angular velocity	ω		
35	Linear velocity	v		
36	velocity of light in vacuo	c		
....	....			
	ELECTRIC			
56	Electromotive force	E		
57	potential difference	U	V	
58	potential	V		
59	Electric field strength (electric intensity)	E	K	The danger of confusing electric field strength with electromotive force, which is also denoted by E, will disappear in vector calculus where the symbol for electric field strength appears in bold-face type or other special form. In cases where E would cause ambiguity, the letter K is recommended.
60	Quantity of electricity, electric charge . .	Q		
61	Volume density of charge	ρ		
62	Surface density of charge	σ		
65	Capacitance	C		
66	Permittivity	ε, ϵ		In vacuo ε_0, ϵ_0
67	Current	I		
70	Conductance	G		
71	susceptance	B		
72	admittance	Y		$Y = G + jB$
73	Conductivity	γ	σ	
74	Resistance	R		
75	reactance	X		
76	impedance	Z		$Z = R + jX$
77	Resistivity	ρ		
78	Self-inductance	L		
79	mutual inductance	M	L_{mn}	

Item	Name	Symbol chief	Symbol reserve	Remarks
....	....			
	MAGNETIC			
87	Magnetomotive force	F	F_m, $\mathcal{F}$	
88	Magnetic field strength (magnetic intensity)	H		
89	magnetization	J		
90	Magnetic flux	Φ		
91	Magnetic flux density (magnetic induction)	B		
92	Permeance	Λ	P	
93	Permeability	μ		in vacuo μ_0
94	susceptibility	$\varkappa$, x		
95	Reluctance	R	R_m, $\mathcal{R}$	

RECOMMENDATION No. 4

Letter symbols for electronic valve characteristics

THE INTERNATIONAL TELEPHONE CONSULTATIVE COMMITTEE,

Recommends that :

Pending the meeting of the mixed C.C.I.F.-C.C.I.R. study group, charged with the revision of the list for submission to the I.E.C., the following list of letter symbols is approved.

LIST OF LETTER SYMBOLS FOR ELECTRONIC VALVES

No.	Name	Symbol normal	Symbol reserve
	ELECTRODE SYMBOLS		
1	Anode	a	
2	Grid	g	
3	Cathode	k	
4	Filament (emitting)	f	
5	Internal metallizing	m	
6	Internal shield	s	
	IMPEDANCES		
7	External impedance between x and y	Z_{XY}	
8	External impedance between x and earth	Z_X	Z_{XE}
9	Internal impedance between x and y	A_{xy}	
10	Internal impedance between x and cathode	Z_x	Z_{xk}

No.	Name	Symbol normal	Symbol reserve
	Examples		
11	Anode impedance	Z_A	
12	Internal impedance between *a* and *k*	R_a	
	Special symbols		
13	Equivalent grid noise resistance	R_n	
	INTERNAL CAPACITIES		
14	Capacity between *x* and all other electrodes	C_x	
15	Mutual capacitance between *x* and *y*	C_{xy}	
16	Partial capacitance between *x* and *y*	K_{xy}	
	Examples		
17	Capacitance between the anode and all other electrodes . .	C_a	
	Capacitance between the grid and the anode	$K_{g_1 a}$	
18	Special symbols :		
	Effective capacity of the grid circuit (function of C_{g_1},		
19	$K_{g_2 a}$ and of the gain)	C_{in}	
	VOLTAGES		
20	Voltage between *x* and *y*	U_{xy}	
21	Voltage between *x* and the cathode	U_x	U_{xk}
	Special symbols :		
22	Voltage of the filament terminals	U_f	
23	Voltage between the filament and cathode	U_{fk}	
24	Battery voltage	U_B	
	Example		
25	Voltage of the anode battery	U_{Ba}	
	CURRENTS		
26	Current in electrode *x*	i_x	
27	Current between *x* and *y*	i_{xy}	
	Special symbols :		
28	Heating current ; filament current	i_f	
	POWERS		
29	Output power between *x* and *y*	P_{XY}	
30	Output power between *x* and earth	P_X	
31	Dissipation in the valve between *x* and *y*	P_{xy}	
32	Dissipation in the valve between *x* and the cathode	P_x	
	Examples		
33	Output power	P_A	
34	Anode dissipation	P_a	
35	G_2 grid dissipation	P_{g_2}	
	Special symbols :		
36	Heating power	P_f	

No.	Name	Symbol normal	Symbol reserve
	AMPLIFICATION FACTOR		
37	$-\partial U_x / \partial U_y$ (i_x constant)	μ_{xy}	
38	Example : $\partial U_{g2} / \partial U_{g1}$	μ_{g2g1}	
	Special symbols :		
39	$-\partial U_a / \partial U_{g1}$ (i_a constant)	μ	
	SLOPE		
40	$\partial i_x / \partial U_y$ (U_x constant)	S_{xy}	
	Special symbols :		
41	$\partial i_a / \partial U_{g1}$ (U_a constant)	S	
42	Slope of a mixer valve	S_c	

Notes

Symbols 1-6. — These symbols may also be used to indicate the different electrodes, e.g. in drawings on diagrams.

If there are several electrodes of the same type, an additional cypher may be added, e.g. $g2$, Pg_2. For ordinary valves, electrodes of the same type are numbered in sequence, counting from the cathode ; and the number may be added to the symbol.

The corresponding capital letters are used as indexes as shown in the following symbols.

Symbols 7-12. — For resistances, etc. the impedance symbol is used.

x and y (X et Y) represent here and in what follows two arbitrary points in the system.

Symbols 20-28. — If there is need to distinguish between direct and alternating current, the index $_0$ is added for direct current and the index ω or w for alternating current.

LETTER SYMBOLS

RECOMMENDATION No. 5

Graphical Symbols

(Previous Recommendation No. 4 modified of the Yellow Book, *page 49)*

THE INTERNATIONAL TELEPHONE CONSULTATIVE COMMITTEE,

Considering

That on the whole, the list of graphical symbols for telecommunications compiled in June 1953 by a mixed C.C.I.F., C.C.I.T.-C.C.I.R. study group and approved by the I.E.C., is in general use and proving of value.

That usage has brought to light minor modifications that it would be desirable to make, either to make the nomenclature more precise, or to make the symbol clearer or easier to draw ;

That furthermore, the development of new techniques or new methods of exploitation necessitates the introduction of new symbols ;

That the modifications or additions required concern other C.C.I.'s of the I.T.U. ;

Recommends that :

With a view to the preparation of a combined list of modifications applying to telecommunications generally for submission to the I.E.C., it would be desirable to set up a joint study group of the C.C.I.'s of the I.T.U. ; this study group to be charged with the preparation of the combined list of modifications in final draft form.

The C.C.I.F. should be represented on this joint study group by members from the letter and graphical symbols study group,

Recommends, furthermore :

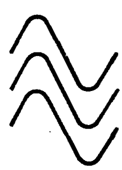
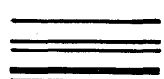
That whilst waiting the meeting of this joint study group, the following list of graphical symbols be provisionally approved ;

And that the symbols in this list be used in the preparation of diagrams to be circulated internationally and in particular for the C.C.I.F. publications.

GRAPHICAL SYMBOLS FOR TELECOMMUNICATIONS

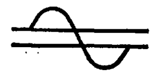
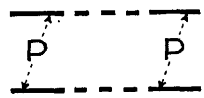
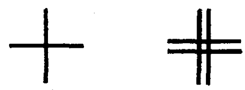
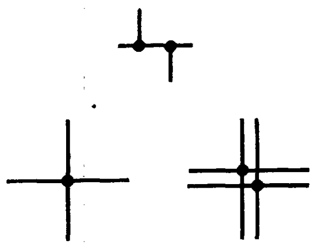
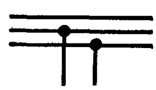
SECTION 1

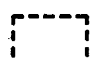
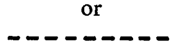
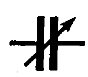
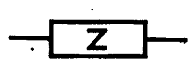
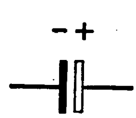
SYMBOLS COMMON TO TELECOMMUNICATIONS

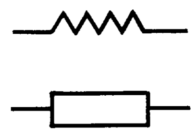
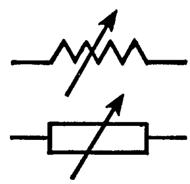
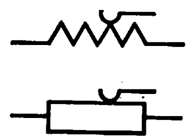
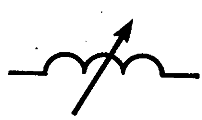
No. *	Description	Symbols	Remarks
	A. For use in circuit diagrams		
1 (A-1)	Direct current		In the case where the symbol ▬ is not suitable, ═ should be shown.
2 (A-2)	Alternating current, general symbol ; alternating current of power frequency		
3	Alternating current, audio frequency		The frequency or frequancy band in cycles per second may be added to symbols 2, 3 and 4. Il there are n frequencies present simultaneously, xn may be added to the symbol.
4	Alternating current, superaudio frequency (above the range of ordinary telephony)		
11 (A-201)	Conductor, general symbol		The thickness of the line indicates the strength of the circuit.

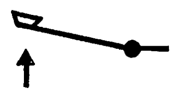
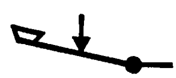
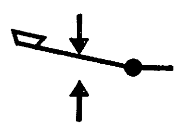
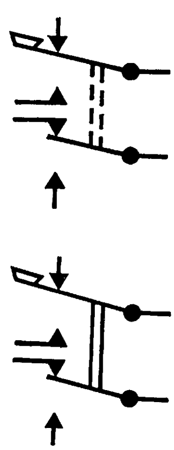
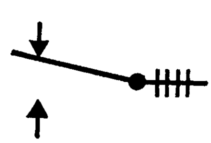
* The numbers in this column are the I.E.C. reference numbers and must be preceded by an E.

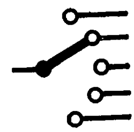
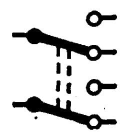
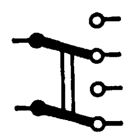
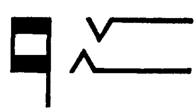
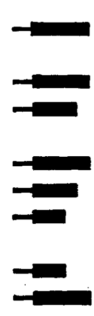
The symbols preceded by the letter N are the new symbols proposed by the C.C.I.F. (Paris 1949). The number following the letter is that of the old symbol and indicates the sequence in which the new symbol must be placed. The number following the hyphen corresponds to the class of the new symbol.

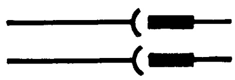
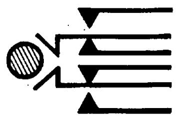
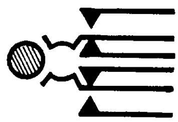
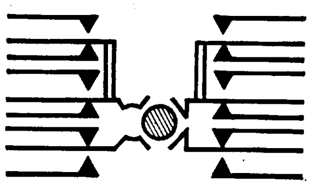
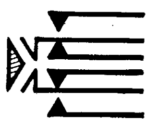
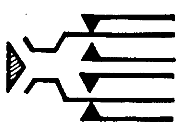
No.	Description	Symbols	Remarks
N-11-1	Twisted pair (2 variations)		
			This variant is used when the two conductors are separated on the diagram.
12	Boundary line		
13 (A-210)	Crossing of conductors without connection		
14 (A-220)	Crossing of conductors with connection		
15 (A-227)	Tapping points		
16	Common connection to grouped apparatus		
16a	Multiple point		If a number is shown by the arrow, it indicates the number of multipled circuits
17 (A-230)	Earth		

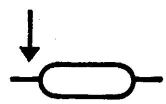
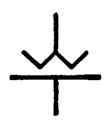
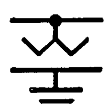
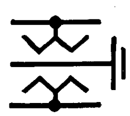
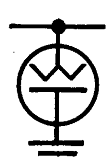
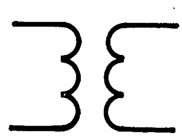
No.	Description	Symbols	Remarks
N-17-1	Frame or chassis		The shading may be partially or completely omitted if there is no risk of confusion.
31 (A-240)	Variability, general symbol		
32 (A-245)	Sliding contact		
N-32-1	Preset adjustement, e.g. Trimmer		
33	Insulation		To be used only in order to avoid ambiguity.
34	Screen	 or 	
41 (A-250)	Capacitor (condenser) or capacitance, general symbol		
41-1	Variable condenser or capacitance, example		
41-2	Variable differential condenser or capacitance		
42	Impedance, general symbol		
43	Polarized electrolytic condenser or capacitance		The + and − signs are used only where necessary.

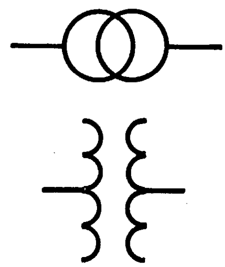
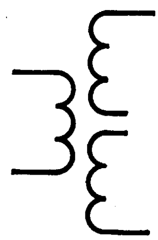
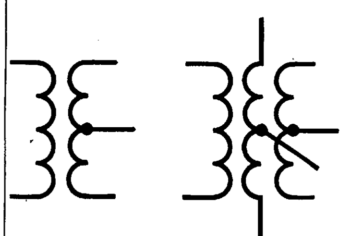
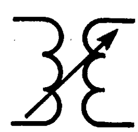
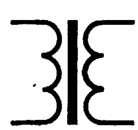
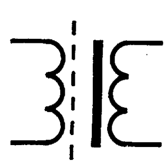
No.	Description	Symbols	Remarks
44	Resistor or resistance, where there is no need for specifying that it is non-inductive (2 variations)		
44-1	Variable resistor		
44-2 (A-262)	Variable resistor with sliding contact		
45 (A-270)	Resistor, where it is desired to specify that neither its inductance, nor its capacity are *appreciable* under working conditions		
45-1 (A-272)	Non-inductive variable resistor with sliding contact (e.g. potentiometer)		
46	Ballast resistor		
47 (A-280)	Inductor or inductance, general symbol		
47-1 (A-281)	Variable inductor		
47-2 (A-282)	Variable inductor, with sliding contact		
48	Inductance with iron core		

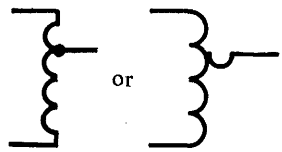
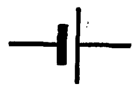
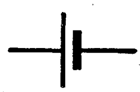
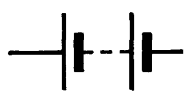
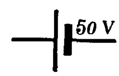
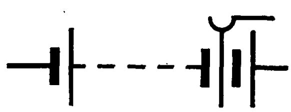
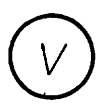
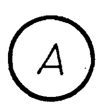
No.	Description	Symbols	Remarks
52 (A-302)	Connection point (permanent)	●	
53 (A-304)	Connection point (temporary)	○	
54	Contact		The triangle may be replaced by a single line if this will not lead to confusion.
55	Press-button, make		
56	Press-button, break		
57	Press-button, change-over		
58	Switch, 2 poles (2 variations)		
59	Switch with multiple springs		The number of strokes indicates the number of springs in the multiple.

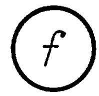
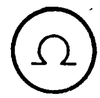
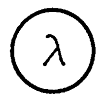
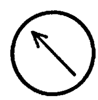
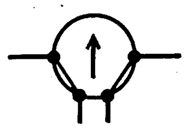
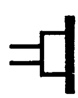
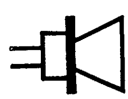
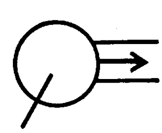
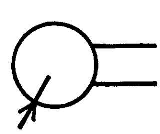
No.	Description	Symbols	Remarks
60	Single-pole switch with two positions		
61	Single-pole multi-way switch		
62	Double-pole two-way switch (2 variations)	 	
71	Jack, simplified symbol, or sleeve		
72	Spring of jack		
73	Jack with springs		
74	Plugs		

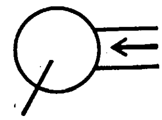
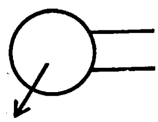
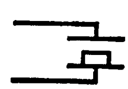
No.	Description	Symbols	Remarks
75	Multi-point plug		
76	Plug and socket		
81	Key, non-locking (e.g. ringing key)		
82	Key, locking (e.g. speak key)		
83	Key, 3 positions		In symbols 81, 82, 83, N-83-1, N-83-2 the shading may be omitted.
N-83-1	Plunger key, non-locking		
N-83-2	Plunger key, locking		

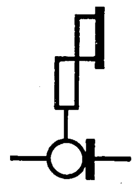
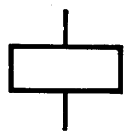
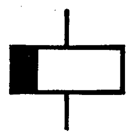
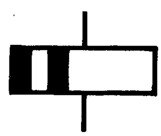
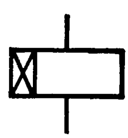
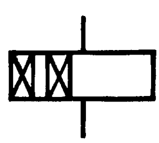
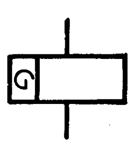
No.	Description	Symbols	Remarks
101 (A-370)	Fuse, general symbol		The rated current in amperes may be shown.
102	Branch fuse		
103	Fuse, with alarm contact		
104	Heat coil		
121	Voltage limiter, general symbol		
122	Lightning protector, 1-wire		
122-1	Lightning protector, between two wires and earth		
123	Lightning protector, vacuum or gas type		
131 (A-501)	Transformer, general symbol		

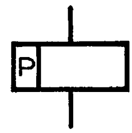
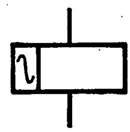
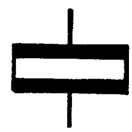
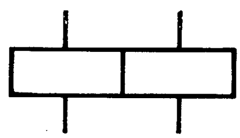
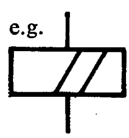
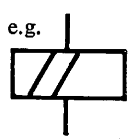
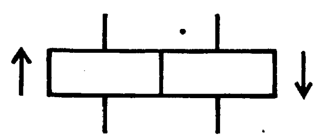
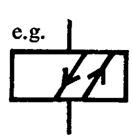
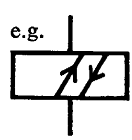
No.	Description	Symbols	Remarks
132 (A-501)	Transformer, simplified symbol		When the two wires of a circuit are represented by a single line.
133	Transformer with 3 windings		
134	Differential transformer		
135 (A-551)	Variable coupling transformer		
136	Transformer with ferro-magnetic core		
139	Screened transformer		

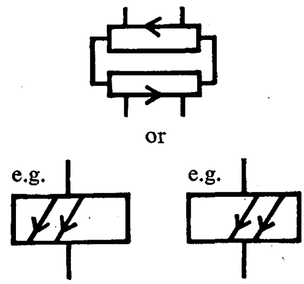
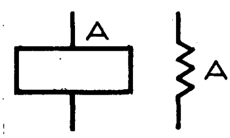
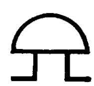
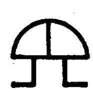
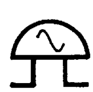
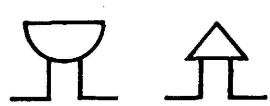
No.	Description	Symbols	Remarks
140	Auto-transformer		
151	Ringing generator (hand), general symbol		
161 (A-750)	Primary cell or accumulator, general symbol		The long line represents the positive pole and the short line the negative pole.
162 (A-751)	Battery of primary cells or accumulators (3 variations)	  	Voltage shown where necessary. Example : 
163 (A-752)	Battery of accumulators with end-cell tapping		E.m.f. of the battery may be shown at right top of the general symbol.
171	Voltmeter		
172	Ammeter		

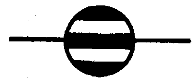
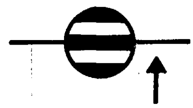
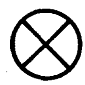
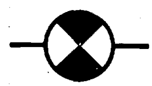
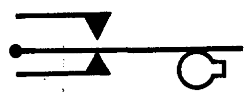
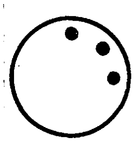
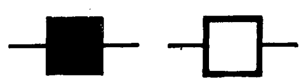
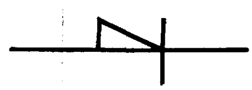
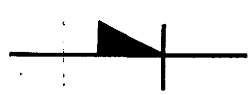
No.	Description	Symbols	Remarks
173	Frequency meter		
174	Ohmmeter		
175	Wavemeter		
176	Galvanometer		
177	Differential galvanometer		
181	Microphone		
181-4	Microphone, carbon type		
191	Receiver		
192	Loudspeaker		
193	Sound reproducing head (2 types)	 	

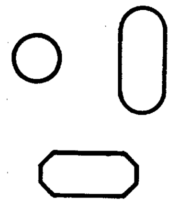
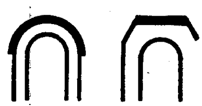
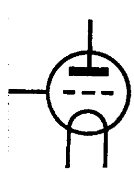
No.	Description	Symbols	Remarks
193-1	Sound recording head (2 types)	 	The type of microphone, receiver, loud speaker, recording or reproducing head may be indicated by the inclusion in the symbol of one of symbols N-193-2 to N-193-8 inclusive.
N-193-2	Moving coil, general symbol		
N-193-2 bis	Moving coil or ribbon type receiver (example)		
N-193-3	Moving coil with fixed magnet		
N-193-4	Moving coil with electro-magnet		
N-193-5	Capacitor		
N-193-6	Moving iron		
N-193-7	Piezo-electric		
N-193-8	Thermal		

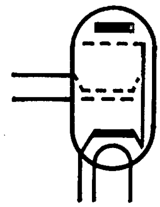
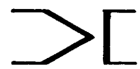
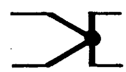
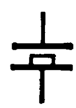
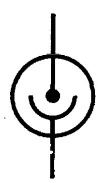
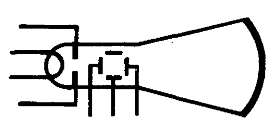
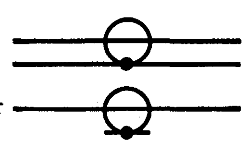
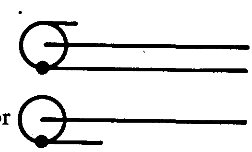
No.	Description	Symbols	Remarks
194	Handset		
201	Relay coil, general symbol		The resistance of the coil in ohms may be inserted in the rectangle.
203	Slow-releasing relay		
203-1	Very-slow-releasing relay		
204	Slow operating relay		
204-1	Very-slow operating relay		The symbol may also be used for thermal relays.
N 204-1-1	Chronometer relay		

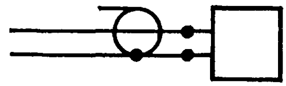
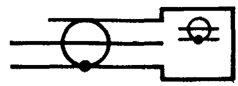
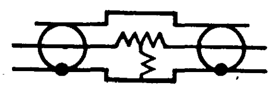
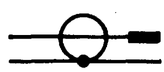
No.	Description	Symbols	Remarks
205	Polarized relay		
206	Alternating-current relay		
207	Relay, unaffected by alternating current		
208	2-winding relay (2 variations)	 or e.g.  e.g. 	This variant is used to represent the two windings separated from each other.
209	Differential relay (2 variations)	 or e.g.  e.g. 	This variant is used to represent the two windings separated from each other. In the second variant the relay will not function until the current in one of the windings is in opposition to that shown by the arrow in the centre of the rectangle.

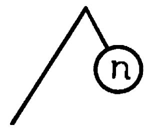
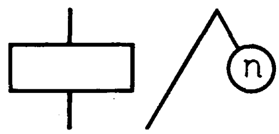
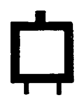
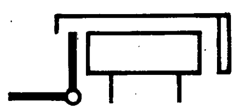
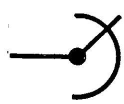
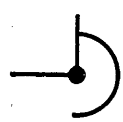
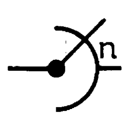
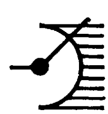
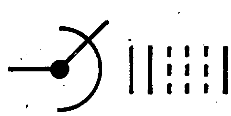
No.	Description	Symbols	Remarks
N-209-1	Shunt-field relay (2 variations)		With current in the direction of the arrows the relay does not operate. The reversal of either current causes the relay to operate. In the second variant the relay operates when the currents are in the direction of the arrows in the centre of the rectangles.
N-209-2	Relay with two windings, one of which is non-inductive		
211	Bell, general symbol		
212	Direct-current bell		
213	Single-stroke bell		
214	Alternating-current bell		
215	Buzzer		Symbols not definitively adopted.

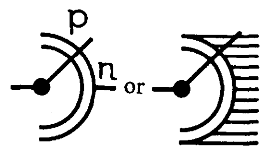
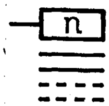
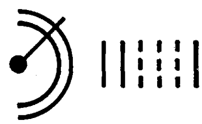
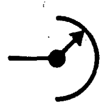
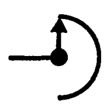
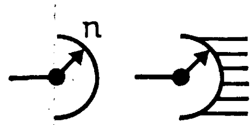
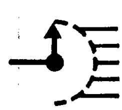
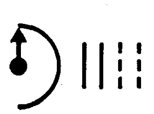
No.	Description	Symbols	Remarks
221	Indicator, general symbol		
222	Indicator, with alarm contact		
223	Lamp (signal)		
231	Interrupter, general symbol		
231-1	Interrupter, cam type		
241	Dial, simplified form		
251	Selector magnet (2 variants)		
261	Element with non-linear current voltage characteristic		
262	Asymmetrical element with non-linear characteristic (rectifier)		The direction of higher conductivity (forward direction) is from triangle to plate.

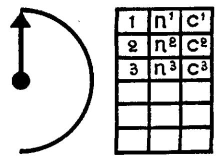
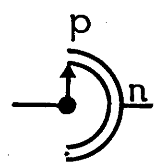
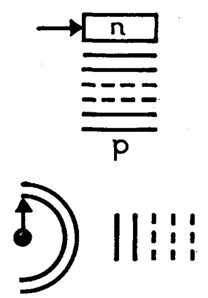
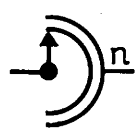
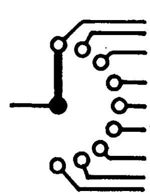
No.	Description	Symbols	Remarks
281	Vacuum or gas filled valve envelope		To indicate a gas filled envelope a black dot may be placed in the envelope, or the chemical abbreviation for the gas or the letter *g* may be shown outside the envelope. Hatching may also be used.
282	Anode		
283	Grid		Where the valve has several grids they should be drawn in their relative order.
283-1	Valve with a screen grid (example)		
285	Filament, directly heated cathode		
286	Indirectly heated cathode (2 variants)		
287	Cold cathode		
288	Mercury cathode		
289	Triode (example)		

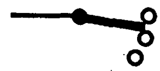
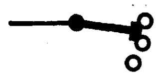
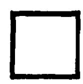
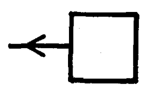
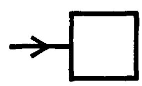
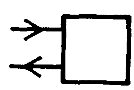
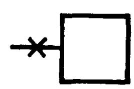
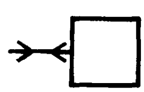
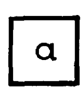
No.	Description	Symbols	Remarks
290	Indirectly heated pentode (example)		
301	Thermo-couple with indirect heating		
302	Thermo-couple with direct heating		
303	Piezo-electric cell		
304	Photo-electric cell		
305	Cathode ray tube		
N-305-1	Coaxial pair 2 variants : *a)* double line *b)* single line	 a) or b)	
N-305-2	Ends of coaxial pair 2 variants : *a)* double line *b)* single line	 a) or b)	

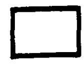
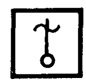
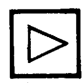
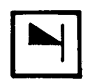
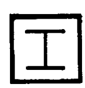
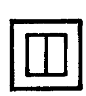
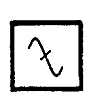
No.	Description	Symbols	Remarks
N-305-3	Connection of a coaxial point to equipment, general symbol		
N-305-4	Connection of a coaxial pair to equipment maintaining its co-axial character		
N-305-5	Balanced pair, screened, for high-frequency transmission		
N-305-6	Extremity of balanced pair, screened		
N-305-8	Connection between two coaxial pairs and equipment, e.g. net-work		
N-305-9	Coaxial cable·choke with iron core		
N-305-10	Plug for coaxial pair 2 variations : *a)* double line *b)* single line	 a)  b)	
N-305-11	Jack for coaxial pair 2 variations : *a)* double line *b)* single line	 a)  b)	

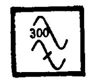
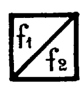
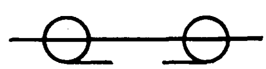
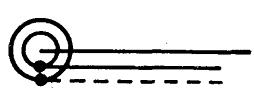
No.	Description	Symbols	Remarks
		B. *For use in block-schematic diagrams*	
351	Meter, simplified symbol		
351-1	Meter or message register, detailed symbol		
361	Drop indicator, general symbol		
362	Drop indicator		
371	Selector, hunter, free selection, general symbol		
N-371-1	Selector, with home position, general symbol		
N-371-2	Selector, hunter, on a single level (single form) (3 variants)	 or  	In this or the following symbols 'n' represents the number of lines per level.

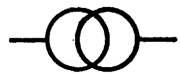
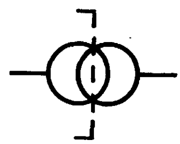
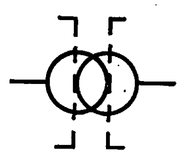
No.	Description	Symbols	Remarks
N-371-3	Selector, hunter, with two movements on several levels (simple form)		In this and the following symbols n represents the number of levels.
N-371-4	Selector, hunter, with two movements on several levels (detailed form) (2 variants)	 	
N-377-1	Directed selector, controlled selection, general symbol		
N-377-2	Directed selector, with home position, general symbol		
N-377-3	Directed selector, on a single level		
N-377-4	Directed selector with a single movement on several levels (simple form) (2 variants)	 	

No.	Description	Symbols	Remarks
N-377-5	Directed selector with single movement on several levels (detailed form)		The numbers 1, 2, 3 . . . indicate the different levels ; the numbers n^1, n^2, n^3. . . are the number of contacts of each level, the numbers c^1, c^2, c^3 . . . are the total numbers of links to the grading.
N-377-6	Directed selector of two movements on several levels (simple form)		
N-377-7	Directed selector with two movements on several levels (detailed form) (2 variants)		
N-377-8	Selector with two movements on several levels, having a directed movement followed by free selection		
N-377-9	Wiper and hank of a selector		

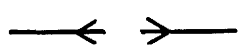
No.	Description	Symbols	Remarks
N-377-10	Non-bridging wiper and contacts		
N-377-11	Non-bridging wiper and selector hank contacts		
N-377-12	Bridging wiper		
381	Equipment or apparatus for telecommunication, general symbol		
382	Transmitting equipment or apparatus for telecommunication, general symbol		
383	Receiving equipment or apparatus for telecommunication, general symbol		
384	Apparatus working simultaneously as a transmitter and a receiver : *a* and *b* general symbols	 a  b	
	Apparatus working alternately as a transmitter or receiver : *c* general symbol	 c	
385	Apparatus not having an individual symbol		A reference letter is placed in the square.

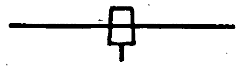
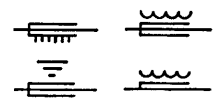
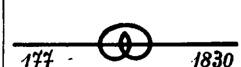
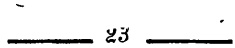
No.	Description	Symbols	Remarks
391	Switchboard, general symbol		
401	Ringing vibrator, general symbol		
411	Amplifying equipment		
421	Detector		
422	Amplifier-detector		The apex of the triangle indicates the direction of transmission.
431	Artificial line, general symbol		
432	Artificial line, reactive		
433	Balancing network		
441	Register		
451	Filter, general symbol		

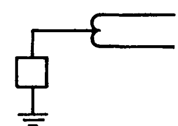
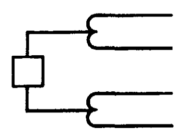
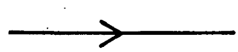
No.	Description	Symbols	Remarks
452	High-pass filter		Cut-off frequency indicated thus. For example :  
453	Low-pass filter		
454	Band-pass filter		
455	Band-stop filter		
456	Attenuation equaliser		
461	Frequency changer		
N-461-1	Coaxial pair of feeder		
N-461-2	Screened conductor(s)	 or 	
N-461-7	Coaxial pair with supplementary screen		

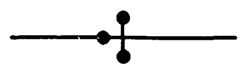
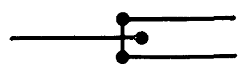
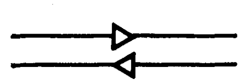
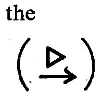
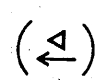
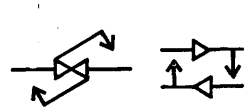
No.	Description	Symbols	Remarks
N-461-8	Transformer		
N-461-9	Transformer with one screen		
N-461-10	Transformer with separate screens		

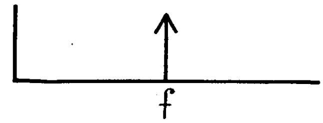
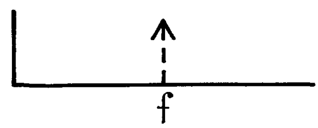
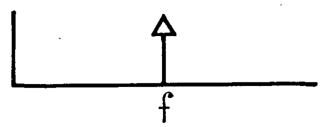
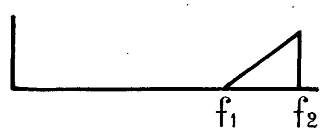
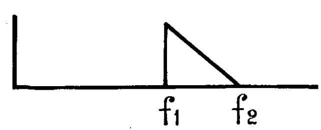
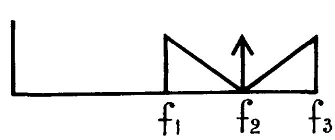
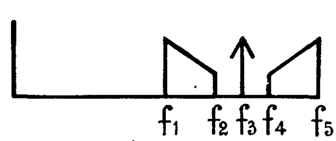
C. *Symbols for use on plans*

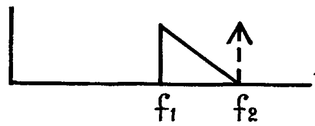
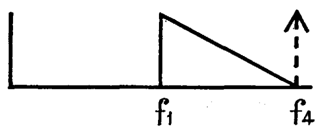
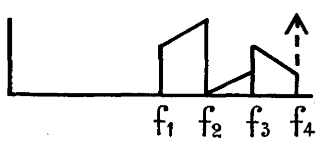
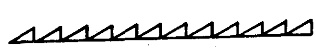
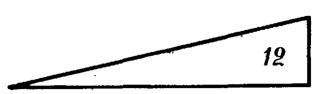
No.	Description	Symbols	Remarks
481	Telecommunication route or circuit, general symbol		
482	Telephone line		The relative importance of routes or circuits may be indicated by the thickness of the line. Details of the circuit should be placed under the line.
483	Telegraph line		
484	Radio circuit		To specify a radio telephone circuit insert F ; to specify a radio telegraph circuit insert T.

No.	Description	Symbols	Remarks
491	Open wire line		1. Generally the symbols are placed only at the ends of the line or section of line. 2. The symbols may be combined as necessary Examples : 
492	Cable line with metallic sheath		
493	Cable line without metallic sheath		
494	Aerial line		
495	Underground cable		
496	Sub-aqueous cable		
501	Loading coil, general symbol		
502	Loade circuit		The inductance in millihenries and the spacing in metres may be shown. Example : 
511	Continuously-loaded circuit		The inductance in mH per unit length may be specified.
531	Actual circuit of two wires		The line need not be interrupted for the number which indicates the cable pair.

No.	Description	Symbols	Remarks
532	Two actual circuits of two wires and their phantom circuit	23 23 × 24 24	
533	Actual circuit of four wires	23/63	
534	Two four wires circuits and their phantom circuit	23/63 23 × 24 / 63 × 64 24/64	
541	Phantom circuit		Symbol applicable to circuits, such as : *a)*  *b)* 
542	Double phantom circuit		
551	Testing point		
561	Single-way circuit		
562	Both way circuit		

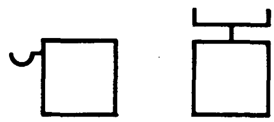
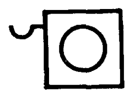
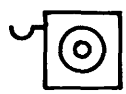
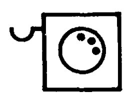
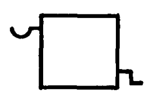
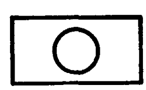
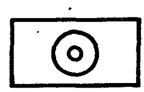
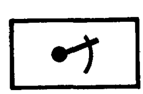
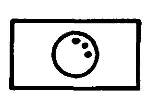
No.	Description	Symbols	Remarks
563	Simultaneous both way circuit		
571	Terminating set, simplified symbol		
571-1	Terminating set		
581	2-wire repeater		
582	Cord circuit repeater		
583	2-wire repeater with subaudio frequency signalling equipment		
591	4-wire repeater		
592	4-wire repeater		Used where the "go"  and "return"  circuits are shown separately.
593	Repeater with echo suppressor		

No.	Description	Symbols	Remarks
N-603-1	Carrier frequency		The letters f, f_1, f_2, ... designate the frequencies.
N-603-2	Carrier frequency, suppressed		
N-604-3	Pilot frequency		
N-604-4	Erect sideband		
N-604-5	Inverted sideband		
N-604-6	Carrier and both sidebands		
N-604-7	Carrier and both sidebands : if it is necessary to indicate that the lower audio frequencies are not transmitted the sidebands may be shown		

No.	Description	Symbols	Remarks
N-604-8	Single sideband, suppressed carrier (lower sideband only transmitted		
N-604-9	Single side-band, suppressed carrier, scrambled for secrecy	After the original modulation and before scrambling.  After scrambling. 	The height of the ordinate is proportional to the value of the original modulating frequency.
N-604-10	Twelve-channel group (individual channel sideband erect)		Detailed.
			Simplified.

SECTION 2

Symbols peculiar to telephony

No.	Description	Symbols	Remarks
651	Telephone set (general symbol) (two variants)		
652	Local battery telephone set		
653	Central battery telephone set		
654	Automatic telephone set		
N-654-1	Magneto telephone set		
661	Local battery switchboard		
662	Central battery switchboard		
663	Automatic exchange		
664	Auto-manual switchboard		

B. Insert after the Recommendation n^{o} 5, the new Recommendation hereafter:

RECOMMENDATION No. 5 bis
(New Recommendation)

Sequence Charts

THE INTERNATIONAL TELEPHONE CONSULTATIVE COMMITTEE,

Considering

— that some Administrations feel it desirable to use time diagrams (sequence charts) showing successive relay operations in switching circuits,

Issues unanimously the recommendation

— that for studying rules for establishing these diagrams, interested Administrations might consider the information contained in the appended Netherlands Standard " Rules for Sequence charts " (Netherlands Electrotechnical Committee, V 3088, 1956).

NETHERLANDS ELECTROTECHNICAL COMMITTEE

Netherlands Standard V 3088

OCTOBER 1956

Rules for sequence charts

CHAPTER I

GENERAL

1. Definitions.

Charts showing through symbols the sequence of operations in a circuit-arrangement are called *sequence charts.* They differ from *time-sequence charts* in that the latter have a linear time scale. The sequence charts do not give information about the duration of a phenomenon, but they show the sequence in which various operations are effected and the situation at any moment.

2. Efficiency.

By trying to convey more information in a sequence chart than is strictly necessary, much harm is done to the readability, which is a great drawback because readability is the most important requirement for these charts. Therefore it is not *completeness* which should be aimed at, but *restriction* to the *essential* requirements.

3. Essential requirements.

A sequence chart must clearly show:

a) The difference between the moment at which the energization of a relay [1] is changed in such a manner that the armature has to change its position, and the moment at which the contacts change over.

---

[1] Whenever the term «relay» is used in this standard, it may be taken in a very wide sense, to cover electronic relays, drum controllers, selectors, etc.; in general, any electrically controlled device fulfilling the function of bringing about a change in one or more electric circuits, in such a manner that a certain series of conditions at the input corresponds with one (or more) situation(s) at the output.

b) Which relays are energized at a certain moment, which valves are lit, which tones are given, etc.

c) The coherence between the changing over of the contact of one relay and the beginning (or end) of the energization of another relay and conversely.

d) The moments at which the energization of a relay, which may not release during a series of impulses, is interrupted for a moment and restored in such a manner that the armature remains in the operated position.

e) Through which winding(s) current flows in relays with more than one winding.

f) The moment at which a (holding) circuit, for a relay, (other than the circuit(s) already closed) is closed.

g) References to and from other equipment.

4. Undesired data.

To guarantee good readability in a sequence chart, it is *not* desirable to mention data which are not necessary for the sequence. These data are to be found in the functional diagram, e.g.:

a) Which *contact* of a relay effected or ceased the energization of another relay.

b) Whether a relay was released by short-circuiting or by the opening of the circuit via which it was energized.

c) Whether a relay switches off the winding via which it was operated, by a contact of its own.

d) Whether the current flowing through a winding reaches another value, provided the latter is such that the relay remains in the same position when the changed value is maintained for some time.

CHAPTER II

EXECUTION

The requirements mentioned in Chapter I, Paragraphs 3*a* to 3*g*, can be met in the following manner.

1. Operating, releasing.

As basic symbol a square is adopted: □

The diagram is supposed to have a vertical time axis, the positive time direction being taken from top to bottom.

To each relay a narrow vertical column is allotted.

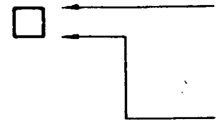
The operating or releasing of a relay is indicated by the square, in such a manner that the upper line of the square corresponds with the moment at which the electrical energization of the relay is started or finished and the lower line of the square corresponds with the moment at which the contacts are changed over. (Requirement 3*a*.)

In other words:

The upper side of the square indicates the moment at which the electrical energization changes; the lower side indicates the moment at which the relay responds to that change (i.e. changes over its contacts).

See also Chapter III below.

A



Moment at which the relay is energized or de-energized.

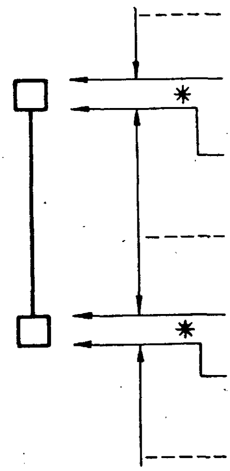
Moment at which the contacts are consequently changed over.

To indicate that a relay is in the operated condition, a line is drawn from the square indicating that the relay operates, vertically down to the square indicating that the relay releases.

A horizontal line can then be drawn corresponding to a moment at which no switching operations are effective. The vertical lines intersected by this horizontal line determine which relays are operated at that moment. (Requirement 3*b*.)

So:

B



During the operating and the releasing of the relay, (indicated in the aforegoing by an asterisk) the relay is unstable, i.e. if the external influences are not changed, it cannot infinitely maintain its position.

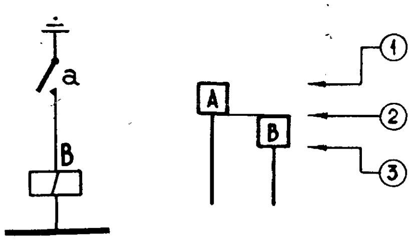
In general, it will only be necessary to ascertain which relays are operated or released when the condition of all the relays concerned is stable.

It is recommended to place the name of the relay inside the square indicating the operating of the relay.

2. Mutual co-operation between the various relays.

The direct influence of one relay on another can easily be indicated by means of horizontal lines. (Requirement 3*c*.)

C

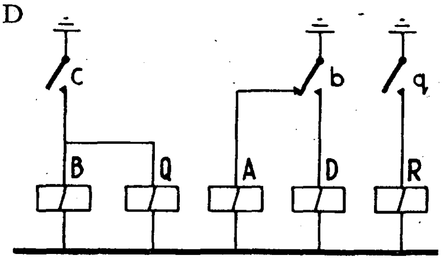


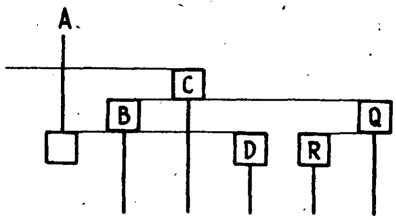
As far as (1): relay A is in the released position.
as far as (2): relay B is in the released position.
from (2): relay A is in the operated position.
from (3): relay B is in the operated position.
from (1) to (2): unstable condition for relay A.
from (2) to (3): unstable condition for relay B.

In this manner reading from cause to effect and from effect to cause is unambiguous and clear.

Below, a more complicated case is given:

D





Because of the symbolical method of drawing applied, the sequence chart clearly shows that e.g. the operation of Q does not affect the operation or not of D.

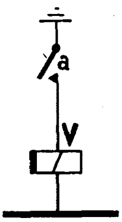
Remark: The sequence from left to right of the various relays in the sequence chart may be chosen in the manner which is most suitable.

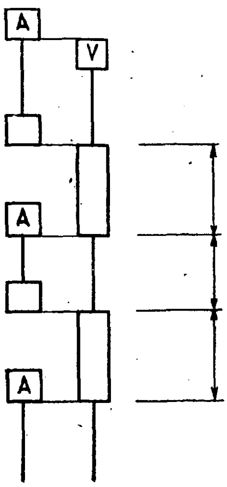
3. Relays which remain operated during a series of impulses.

When the energization of a relay is interrupted so briefly that the relay is not released, this may be considered as an incomplete release combined with an operation that has already started. (Requirement 3*d*.)

The logical consequence is:

E





The energization of V is interrupted so briefly that V cannot release.

V is not energized.

V is energized.

V is not energized.

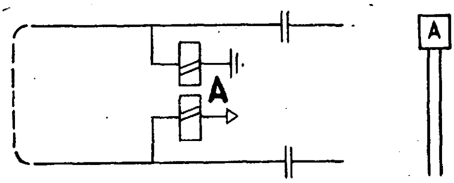
etc.

4. More than one winding.

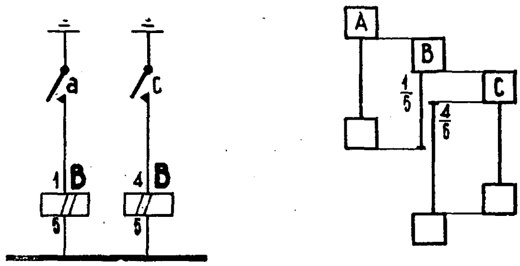
When the relay has more than one winding, each winding through which current flows can be indicated by means of a vertical stroke. (Requirement 3*e*.)

If necessary, the relavant winding(s) can be mentioned.

F



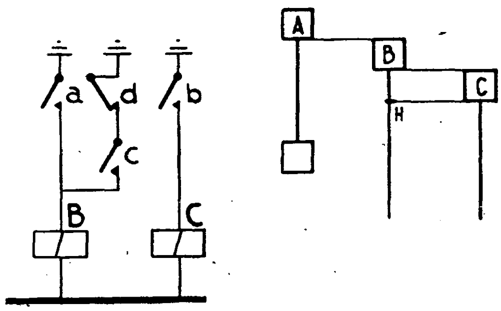
G



5. Holding circuit.

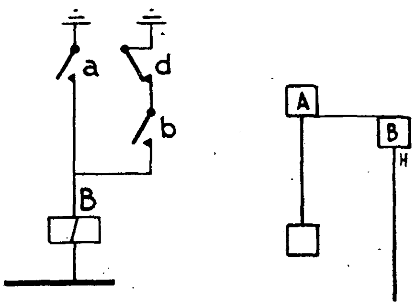
The closing of a circuit other than the one via which the relay was operated may be indicated by adding an « H » at a height corresponding to the beginning of the closing of that circuit, i.e. just *under* the line indicating the moment at which that holding circuit was switched on. (Requirement 3*f*.)

H



The holding circuit is closed by a contact of another relay.

I



The holding circuit is closed by a contact of its own.

6. Columns.

The relay unit considered usually co-operates with other relay units which are arranged in front of and behind the said unit.

It is then recommended to mention the former on the left hand side and the latter on the right hand side of the relevant sequence chart. If desired, a table of contents can be put on the extreme left hand side. If required, one or two narrow columns can be added, in which e.g. a number can be put which refers to a description.

Then the following columns will be obtained:

Indication of the chapters	Reference to description	Co-operation with apparatus in front	Relevant sequence chart	Co-operation with apparatus behind	Reference to description

At the top and at the bottom of the sequence chart the names of relays can be mentioned once more.

7. Co-operation with other apparatus.

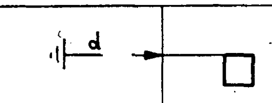
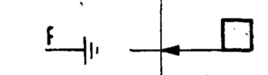
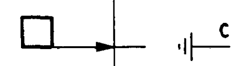
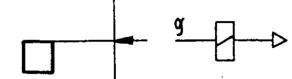
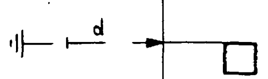
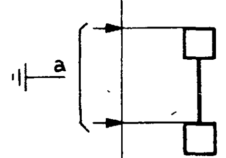
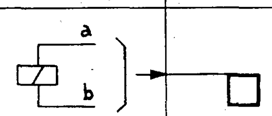
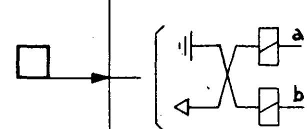
This is indicated on the same lines as mutual co-operation between various relays (see page 8), i.e. by drawing a horizontal line from the relevant square to the column: " Co-operation with apparatus in front (behind)."

All co-operation received from and given to other apparatus must be indicated. (Requirement 3*g*.)

This is done by means of a horizontal line with an arrow against the line separating the columns, which arrow indicates in what direction the influence is exercised. All information must be as brief as possible.

Some explanatory examples are given beneath.

The first column shows co-operation with the apparatus in front and the third column shows co-operation with the apparatus behind. The second column contains the relevant sequence chart. In the fourth column an explanation is given of the symbols used in the first three columns.

J		In the apparatus in front, earth is switched on the *d*-wire.
K		An earth on the *f*-wire is given to the apparatus in front.
L		An earth on the *c*-wire is given to the apparatus behind.
M		From the apparatus behind, voltage is applied via a relay winding to wire *g*.
N		The connection over wire *d* is interrupted in the apparatus in front.
O		Draws special attention to the fact that it was the earth on the *d*-wire in the apparatus in front that disappeared.
P		In the apparatus in front, an impulse is emitted by switching an earth on the *a*-wire for a short time.
Q		In the apparatus in front, the *a-b* loop is closed over a relay winding.
R		To the apparatus behind, on the *a*-wire and the *b*-wire, voltage and earth are reversed.

CHAPTER III

FURTHER DETAILS

1. Slow and quick functioning.

As described, the operating and releasing of relays are represented by squares. It stands to reason that the different types of relays have quite different times of operation and release, varying from a fraction of a millisecond to some seconds.

So the distribution of the time over the time axis is very irregular. 1 mm will sometimes correspond to e.g. 1 msec. and sometimes to 1 sec. So a linear scale, as applied in time-sequence charts, would not be suitable here.

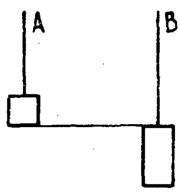
Even if quick functioning could be represented on a very small scale, too much paper would be required.

It may be remarked that the correct values of the operating and release times are in many cases unimportant and are usually not precisely known.

Sometimes it is desirable to draw attention to slow or quick functioning, e.g. for relays that may not release during a series of impulses and quick testing relays.

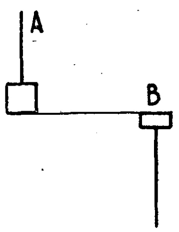
In these cases, slow functioning is represented by a rectangle bigger, and quick functioning by a rectangle smaller than the standard square.

S



Relay B is slow-releasing.

T

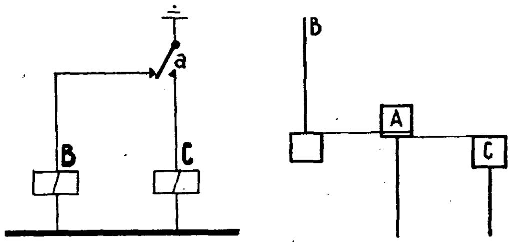


Relay B is quick-operating.

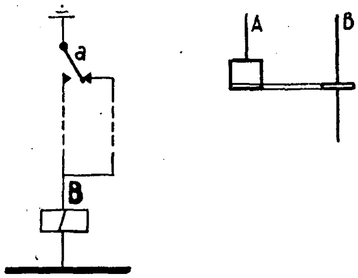
2. Different change-over times.

If it is necessary to indicate the difference in time between e.g. the opening of a contact and the closing of a contact on the same relay, this can be done by drawing a double line in the square.

U



V

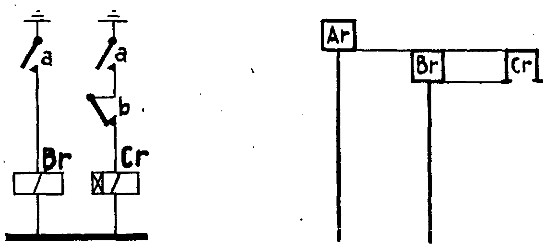


During the throw-over time of A, the energization of B is interrupted.
The time is, however, too short to make B release.

3. Too short an energization.

An energization too short to make the relay operate is represented by an " operating square " of which the bottom (indicating the change-over of the contacts) is omitted.

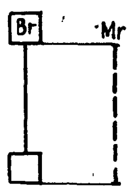
W



4. Insufficient current to make the relay operate.

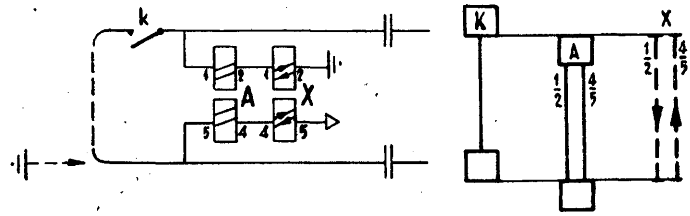
If the current flowing through the winding of a relay is insufficient to make the relay operate, this can be indicated by a line of dashes.

X

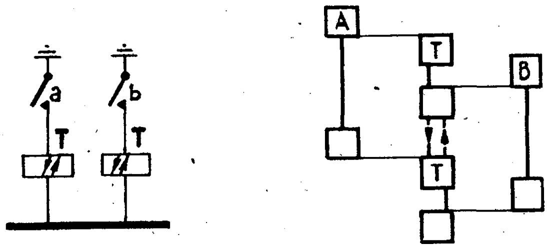


5. Differential relay.

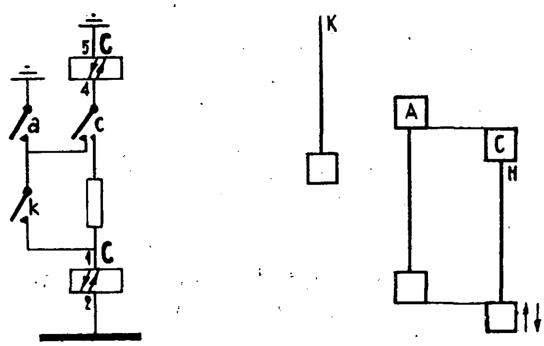
Y



Z

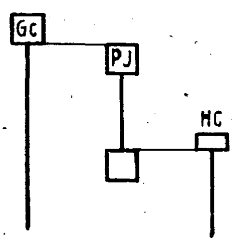


AA



6. Continuously hunting selector.

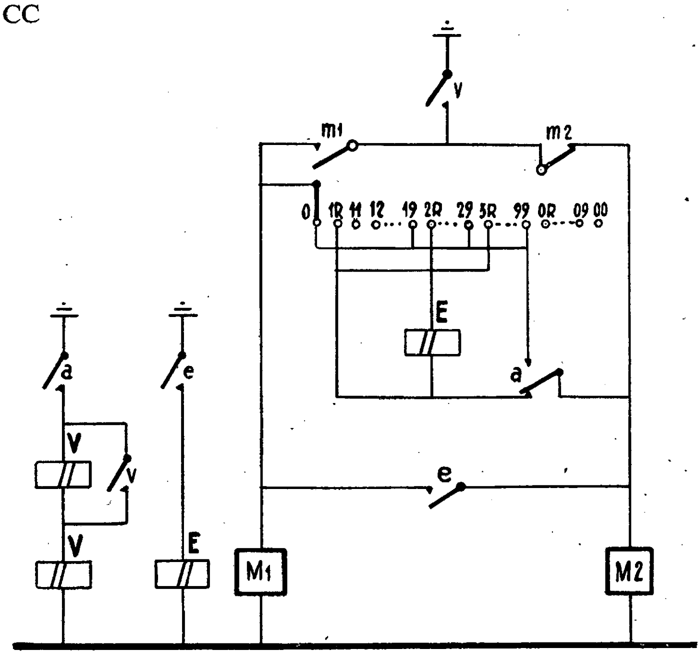
BB

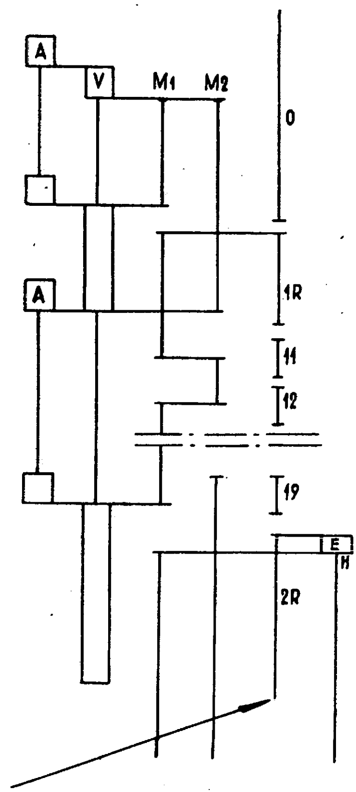


When PJ is energized, the selector starts rotating.
If the testing relay is operated over one of the terminals, the selector stops.

7. Motor-uniselector.

CC





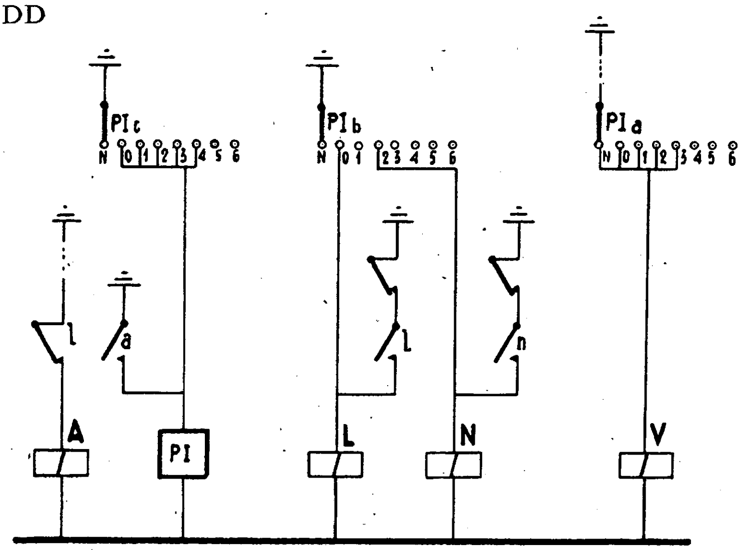
Remarks:

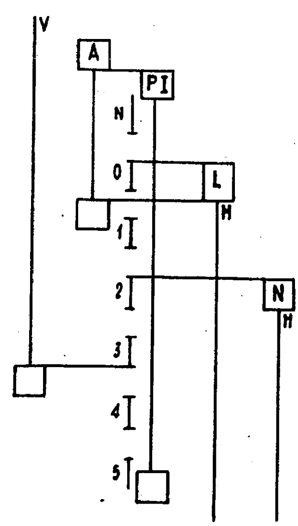
1. The line indicating on which terminal the selector is positioned is not terminated by a horizontal stroke, if the selector stops on this contact.

2. If the position of the selector affects the further functioning, the thin line indicating this position *may* be extended to the bottom of the page.

8. Continuously driven impulsing selector.

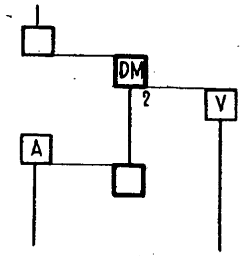
DD





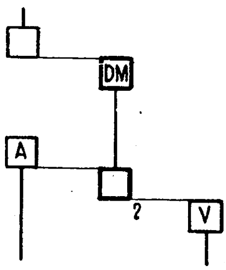
9. Step-by-step switch.

EE



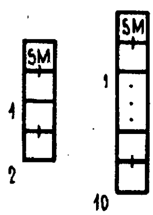
On energization, DM steps to position 2.

FF



On de-energization, DM steps to position 2.

GG



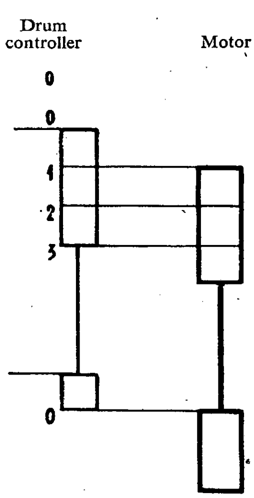
The energization of SM is interrupted and then restored by one of its own contacts.

The position is mentioned in the place in which that position has already been reached. So " 2 " is not mentioned before the stepping from 1 to 2 has already been effected, i.e. it is placed *under* the line indicating this changing of the condition.

The vertical stroke indicates the transition from the energized to the non-energized condition.

10. Motor.

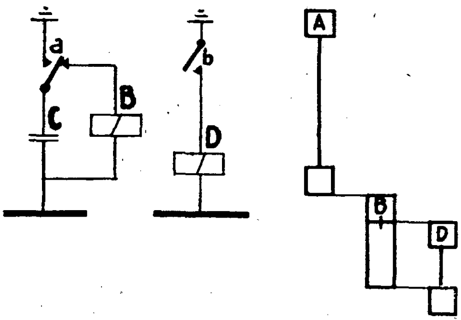
HH



The motor is supposed to be started by a drum controller with 4 positions. (0,1,2 and 3)
When the motor is stopped, the drum controller directly returns to position 0.
Other cases can be represented in an analogous manner.

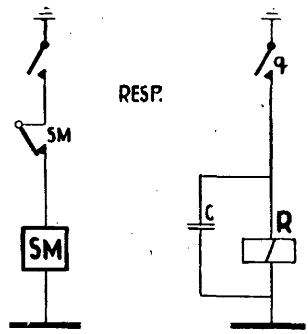
11. Energization by condenser discharge.

II



When relay A is operated, condenser C is charged. When A is being released, C is discharged via B.
B operates and releases after some time when the voltage on the condenser is reduced too much.

Compare this case with the step by step magnet, which interrupts its own energization, and also with the slow releasing of a relay when a condenser is connected parallel to a winding:



12. Briefly interrupted energization.

If energization is briefly interrupted, so that it is doubtful whether the relay can just manage to remain operated or whether it is released for a short moment, this can be indicated in the following manner:

JJ

Relay A loses its energization for a short moment. It is of no importance whether A is released for a short moment or not.

Similarly, a very brief interruption of the current through a lamp can be indicated by:

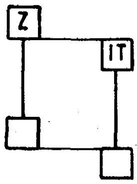
KK

No current flows through the lamp for a short moment.
It is of no importance whether this fact makes the lamp flicker or not.

13. Meter.

A meter is represented in the same manner as a relay.

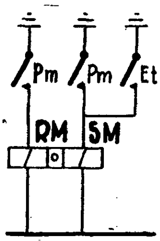
LL

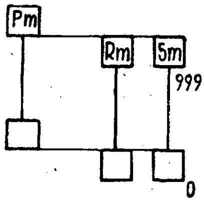


Here IT is the meter.

If the position of a meter has to be indicated, it is done in the same manner as for the step by step switches. E.g. when the meter has to be re-set to zero:

MM



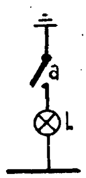


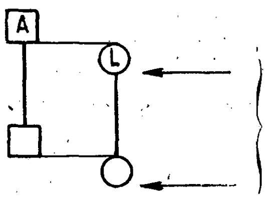
Both coils (RM and SM) of the meter are represented in the same manner as a relay. A short energization of the two coils brings the meter to the zero position. By means of a brief energization of the coil SM (via the Et contact) the meter steps on.

14. Lamp.

a) In the case of a lamp, a circle is used instead of a square. The top of the circle indicates the moment at which the lamp is switched on or off. The lower point can be used to indicate the beginning (or the end) of the lighting up.

NN



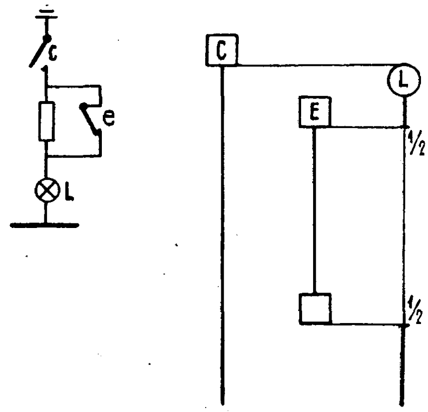


duration of the lighting up.

b) A dimly burning lamp is indicated by means of a thinner vertical line. At the beginning and the end of the thin line " ½ " is placed.

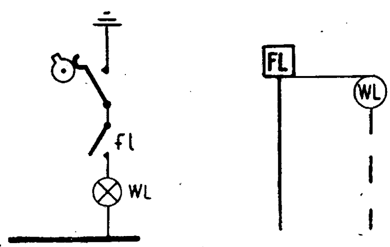
Example:

OO



c) Flickering of a lamp is indicated by means of a vertical line of dashes:

PP



15. Electronic valves.

The time during which an electronic valve is conductive is indicated by:

QQ

16. Voltage of a point.

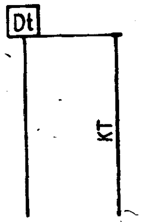
If it has to be indicated whether the voltage of a point in a circuit-arrangement is high or low, and if only these two conditions are possible (electronic relays), it is recommended to indicate only the period during which the voltage is high, i.e. by:

RR

17. Tones.

Interrupted or complex tones, such as interrupted ringing tones or tones referring to enquiries, are drawn as non-interrupted tones. The indication of the tone can be placed along the line.

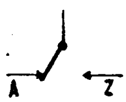
SS



The operation of the relay Dt causes the transmission of the dialling tone (KT).

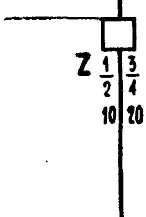
18. Polarized relays.

TT

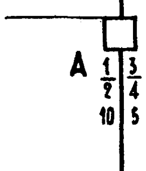


In the functional diagram, the positions of the contacts must be provided with an indication.
The C.C.I.T. recommends for teleprinter technique the indication A for start polarity and the indication Z for stop polarity.

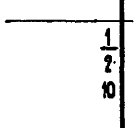
The winding 1-2 supplies an energization of 10 ampère-turns.
The contact is in the position A.



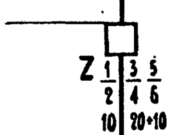
The winding 3-4 (20 ampère-turns) is switched on. The indication on either side of the vertical line shows that the energizations of the two windings are opposed to each other. The contact changes over from position A to position Z.



The energization of the winding 3-4 is reduced from 20 to 5 ampère-turns.
The contact is changed over to position A.

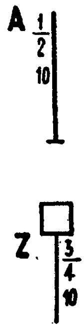


The winding 3-4 is switched off.
The contact remains in position A.



The windings 3-4 and 5-6 (20+10 ampère-turns) are switched on.
The contact changes over to position Z.
The windings 3-4 and 5-6 support each other, the winding 1-2 opposes the energization of the two other windings.

UU



The winding 1-2 supplies an energization of 10 ampère-turns.
The contact in position A.

The winding 1-2 is switched off.
The contact remains in position A.

The winding 3-4 is switched on and supplies an energization of 10 ampère-turns which is opposed to the first energization of the winding 1-2.
The contact is changed over to position Z.

On the left-hand side, the letters A and Z indicate the position of the contact. Near the vertical line, the windings through which current flows are indicated. If desired, the energization in ampère-turns can be shown under these indications.

Indications on the same side of the vertical line represent energizations which support each other; indications on both sides of this line represent energizations that are opposed to each other.

19. Direction in which the motor is rotating.

If there are two directions of rotation possible, it is sometimes desirable to indicate the relevant direction. This can be done in the same manner as described above for polarized relays, by means of standardized letters or, even better, by symbols.

It is recommended to indicate the opening and closing of sliding doors by:

VV

WW

Example: Motor MD closing the door of a lift:

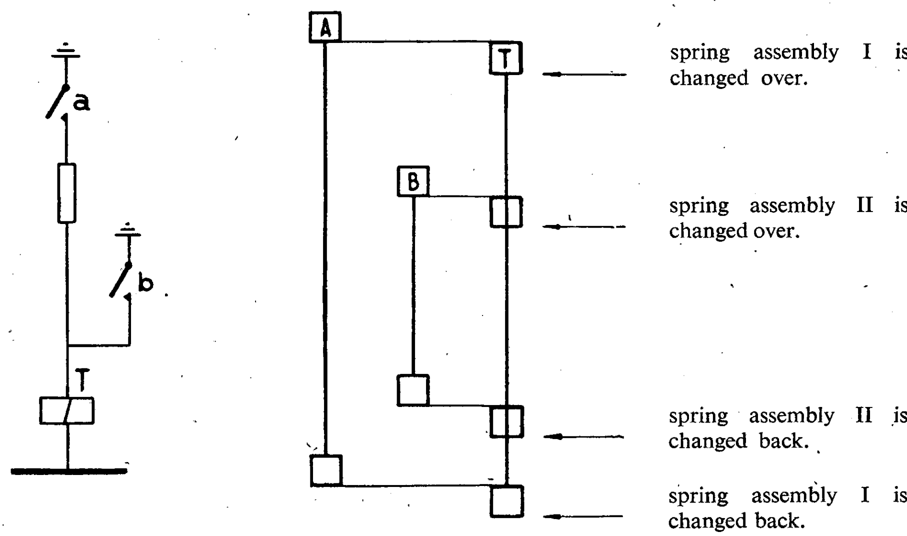
XX

20. Two-step relays.

Two cases can be distinguished, i.e.:

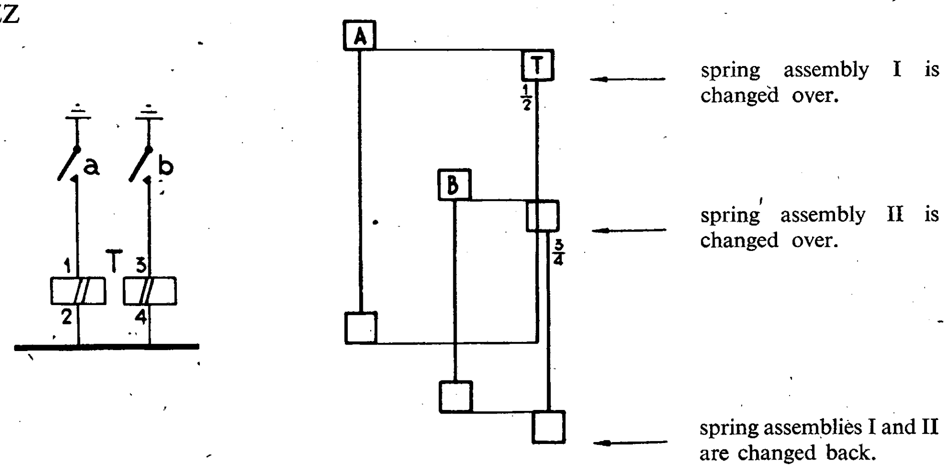
a) The relay has one winding. By varying the energizing current, one or both spring assemblies can be changed over:

YY



b) The relay has two windings and the current flowing through one of the windings develops more pulling force than the current flowing through the other winding.

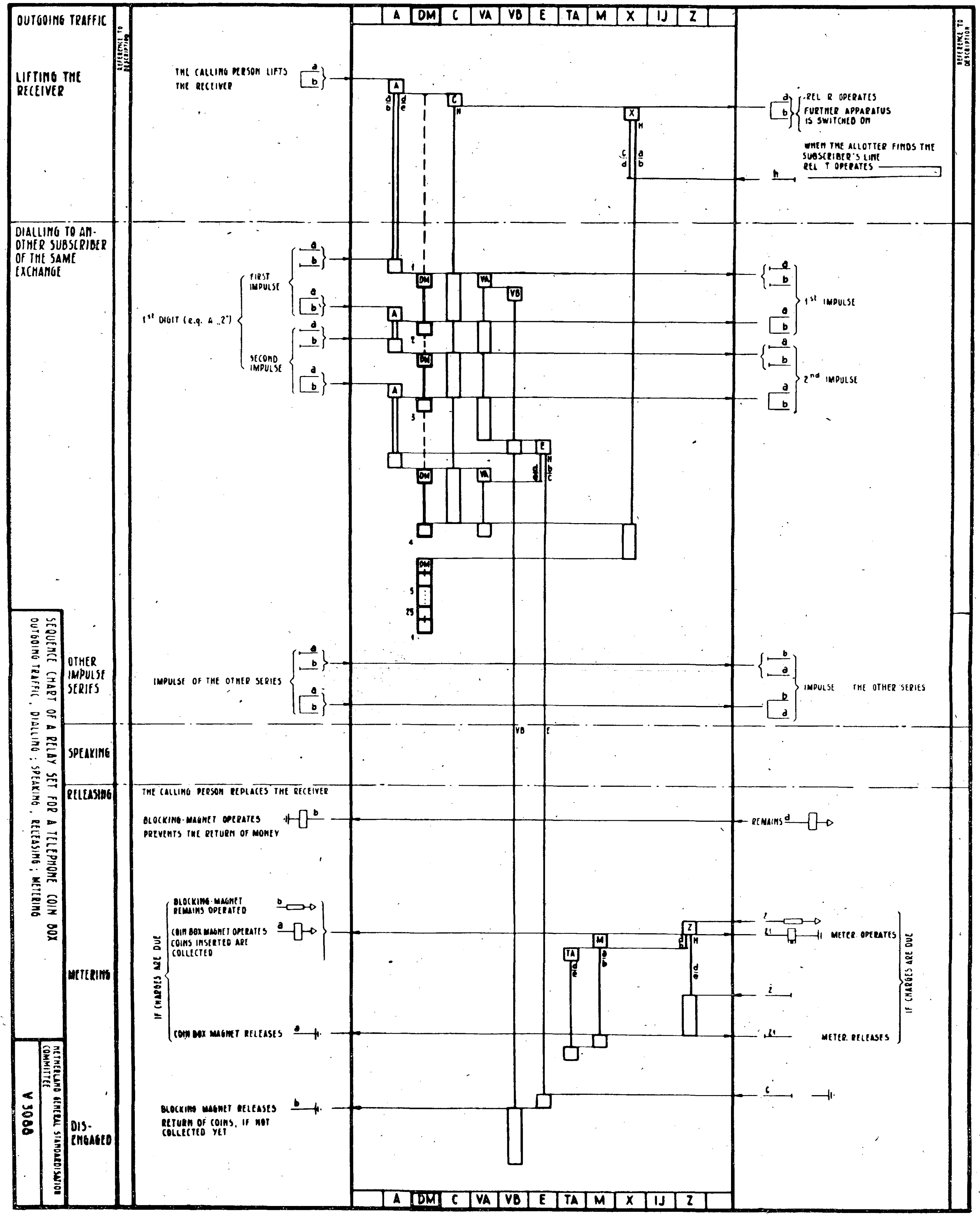
ZZ



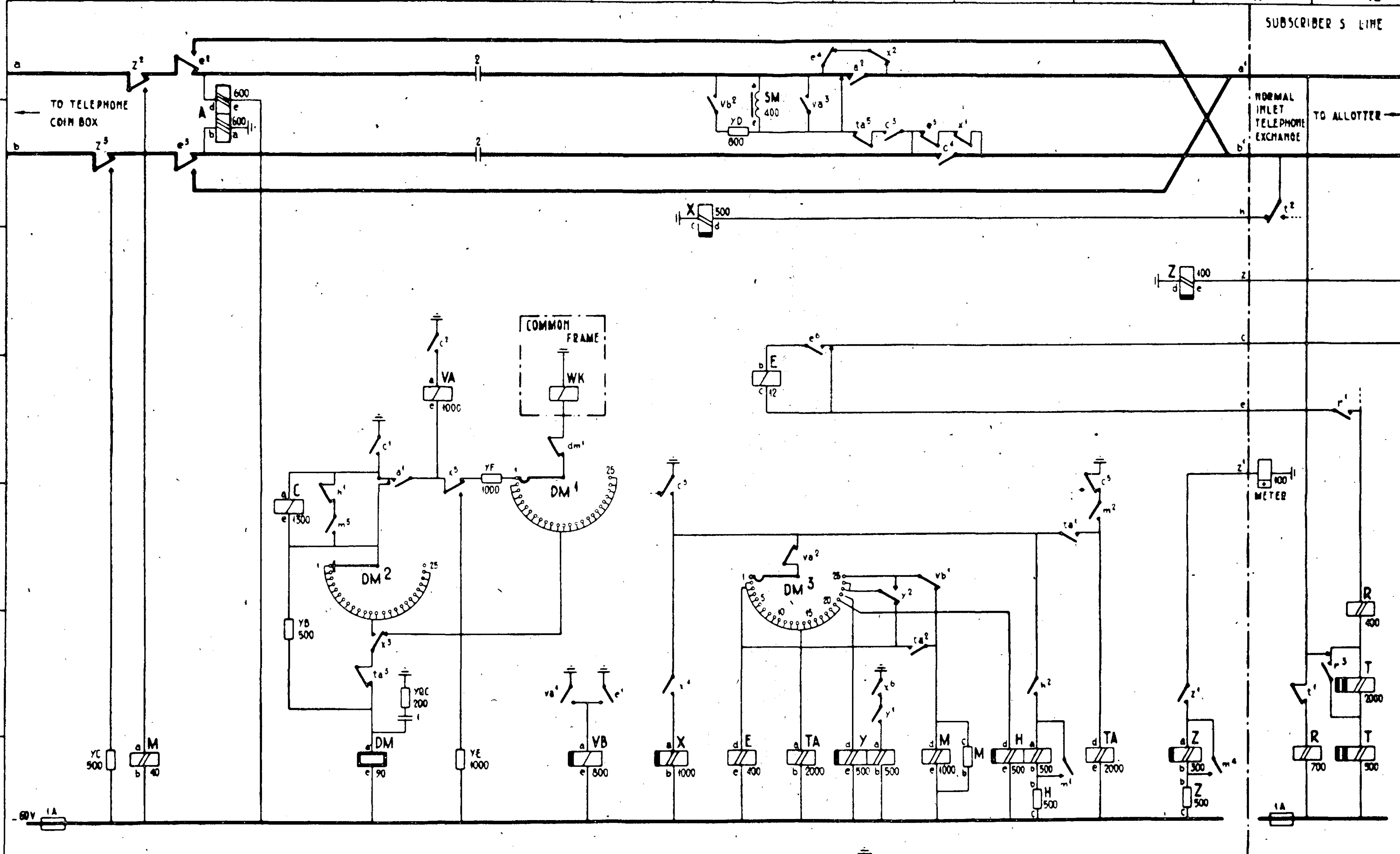
CHAPTER IV

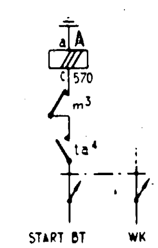
EXAMPLE

To show the manner in which a sequence chart should be laid out, part of the sequence chart of a relay set for a telephone coin box is annexed hereto.



OUTGOING TRAFFIC
REFERENCE TO DESCRIPTION
A DM C VA VB E TA M X IJ Z
LIFTING THE RECEIVER
THE CALLING PERSON LIFTS THE RECEIVER
REL. R OPERATES
FURTHER APPARATUS IS SWITCHED ON
WHEN THE ALLOTTER FINDS THE SUBSCRIBER'S LINE REL. T OPERATES
DIALLING TO ANOTHER SUBSCRIBER OF THE SAME EXCHANGE
FIRST IMPULSE
SECOND IMPULSE
1st DIGIT (e.g. A „2")
1st IMPULSE
2nd IMPULSE
OTHER IMPULSE SERIES
IMPULSE OF THE OTHER SERIES
IMPULSE THE OTHER SERIES
SPEAKING
RELEASING
THE CALLING PERSON REPLACES THE RECEIVER
BLOCKING-MAGNET OPERATES
PREVENTS THE RETURN OF MONEY
REMAINS
METERING
IF CHARGES ARE DUE
BLOCKING-MAGNET REMAINS OPERATED
COIN BOX MAGNET OPERATES
COINS INSERTED ARE COLLECTED
COIN BOX MAGNET RELEASES
METER OPERATES
METER RELEASES
DIS-ENGAGED
BLOCKING MAGNET RELEASES
RETURN OF COINS, IF NOT COLLECTED YET
SEQUENCE CHART OF A RELAY SET FOR A TELEPHONE COIN BOX
OUTGOING TRAFFIC, DIALLING, SPEAKING, RELEASING, METERING
NETHERLAND GENERAL STANDARDISATION COMMITTEE
V 3080





REL	NR	1	2	3	4	5	6	WINDING		
A	R539/A12R	[illegible] D4	[illegible] A8					a.b B2	a.c H8	d.e A2
C	R4816/B2ZR	M D4	M C4	M B8	M B8	W [illegible]		a.e E3		
E	R[illegible]/Z1CR	M F6	W A2	W B2	V A7	V B8	[illegible] C7		b.c D7	d.e G7
H	R1480 A2ZP	V E3	M F9	(M)				a.b G9	d.e G9	Bb.c G9
M	R332/R[illegible]	M G9	M E10	V H8	M G11	M E3		a.b G2	d.e G8	Bb.c G8
TA	R6442/C5ZR	M E9	M F8	V F4	M H8	V B8		a.b G9	d.e G10	
VA	R1345/D3ZR	M F5	V E7	M B7				a.e D4		

REL	NR	1	2	3	4	5	6	WINDING		
VB	R527/D14Z	V E8	M B6					a.e G5		
X	R1604/C1R3	V B9	V A8	W F4	M F6	W D4	M F8	a.b G6	c.d B6	
Y	R1104/C9ZL	M F6	W E8					a.b G8	d.e G8	
Z	R245/AP17	M F10	W A2	W B1				a.b G10	d.e C10	Bb.c G10
DM	R1155/D25	V E4						a.e G4		
SM	R5643							a e B7		

RELAY SET FOR TELEPHONE COIN BOX

NETHERLAND GENERAL STANDARDISATION COMMITTEE

V 3088

SYSTEM OF UNITS

RECOMMENDATION No. 6

Adoption of the M.K.S. (Giorgi) system

(Organizational Table, Volume I ter *of the* Yellow Book, *page 105)*

THE INTERNATIONAL TELEPHONY CONSULTATIVE COMMITTEE,

Considering :

(a) That the International Electrotechnical Committee meeting in 1938 at Torquay resolved to adopt the M.K.S. (Giorgi) system of units ;

(b) That the International Union for Pure and Applied Physics, meeting in 1948 at Amsterdam, informed the International Committee for Weights and Measures of its desire to see the adoption, for international purposes, of this system ;

(c) That the French National Bureau for Weights and Measures has prepared a draft regulation for the basis of discussion of units of measurements ;

(d) That the International Committee for Weights and Measures decided, by its Resolution No. 6 of the meeting of 21 October, 1948 of the 9th Conference, to make an enquiry into the opinion of the scientific, teaching and technical professions of the various countries (on the basis of the French document), to pursue the matter actively, to collate the replies and to make a recommendation concerning the adoption of this practical system of measurement likely to be ratified in all the signatory countries ;

(e) That the draft of the French document has not settled the problem fo unification of the system as concerns " rationalisation " ;

(f) That between the two systems, rational and non-rational, the first has the advantage of simplicity and puts in evidence the duality of form of electric and magnetic phenomena by the corresponding relative formulaes,

Express unanimously the wish :

That the Administrations and operating Companies recognise that they should take the opportunity of adopting the rationalised M.K.S. Giorgi system of units in their correspondence with the I.T.U. and its permanent organisations.

LIST OF QUESTIONS

THE STUDY OF WHICH SHOULD BE UNDERTAKEN OR CONTINUED IN 1955, 1956 AND 1957

The questions attached have been classed by the XVIIth Plenary Assembly of the International Telephone Consultative Committee (Geneva, October, 1954) in the following three categories :—

Category A 1. — Questions upon which there should be worldwide agreement.

Category A 2. — Questions upon which there should be European agreement only.

Category B. — Questions having a documentary character and upon which agreement is not necessary.

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LIST OF QUESTIONS

concerning protection against disturbances originating outside telecommunication systems, the study of which should be undertaken or continued by the 1st Study Group of the C.C.I.F. in 1955, 1956 and 1957

Question No. 1.

(Category A 1) [non urgent] (continuation of Question No. 1 studied in 1952/1954)

(a) Study of the equivalent disturbing voltage and if necessary the equivalent disturbing current of power installations and traction installations operating with a.c. and d.c. current.

(b) Importance of the equivalent disturbing current with respect to the return earth current in the case of three phase power lines with their neutral joined to earth.

(c) Limit of the normal values of the telephone form factor of the voltage —as a function of the load—to be observed in the construction of different sorts of machines and apparatus.

Note 1. — *(a)* The actual state of this question is explained in the following annex :

(b) To carry out measurements on electrical machines or on industrial lines, it is not necessary to use an apparatus having the highest sensitivity such as some psophometers for commercial telephone circuits have. Some simpler apparatus without an amplifier could perhaps be employed on condition that they meet the specification established by the C.C.I.F. for psophometers (*Yellow Book*, Volume VI, pages 180 to 188 and the Directives, Rome edition 1937, revised in Oslo in 1938 and brought up to date in Geneva in 1952, Chapter XV, Section A, § 74), as regards :

1. The characteristic curve of the filter network of the psophometer (*Yellow Book*, Volume VI, pages 180 to 183 and the Directives, § 74 *(a)* ;
2. The dynamic characteristic (Volume VI, page 187, § 5 and the Directives, § 74 *(f)* ;
3. The quadratic addition law of the harmonics (Volume VI, page 185, § 3 and the Directives, § 74 *(d)*),

and also that they have a sufficiently high impedance and must be unaffected by the action of extraneous magnetic and electric fields.

(c) In the study of the equivalent disturbing voltage when one wishes to make measurements on machines on the test bench, it would be of interest to make these measurements with the two types of coupling corresponding to the factors $k_f = 1$ et $k_f = \frac{f}{800}$ (see the Directives, Chapter XV, Section B).

It would be well to see if a relation exists between one or the other of the values obtained with the two types of coupling, and to compare the results with those obtained on the network when the machine is put into service.

(d) In the future, the measurements will have to be normally made with a psophometer having a filter network following the curve defined by the XIVth Plenary Assembly of the C.C.I.F. Each time measurements are made, they should if possible be effected with this apparatus and also with the psophometer used previously.

The study of this question will be followed by the 1st S.G. of the C.C.I.F. in co-operation with the 2nd S.G. of the 1st Section of the C.M.I.

ANNEX

(to Question No. 1)

Measurements of the *equivalent disturbing voltage* and of the *equivalent disturbing current* have been made in some countries by means of psophometers fulfilling the specification established at Budapest in 1934. But the results obtained to-date have not been sufficiently numerous for mean values representative of these two magnitudes to be deduced On the other hand, the adoption of the new specification of the characteristic curve of the filter network might entail some modification of these values, although different studies might enable verification to be obtained as to the values determined with the old psophometer being generally of the same order of magnitude as those determined with the new.

That is why it seems useful to mention certain results obtained so that an idea can be formed of the values which must be expected in the case of the different sorts of power and traction installations.

The results shown below must be considered not as confirmed values, but only as indications of measurements made, often in very different conditions, which explains certain discrepancies.

The various results of measurements have been obtained, either by connecting between the psophometer and the power installation studied, an additional apparatus having the effect of multiplying by the corresponding frequency, the relative amplitude of each harmonic, or without such additional apparatus. In the first case, the indication of the result of the measurement is followed by the sign $\times f$; in the second case, by the sign $\times$ 1 (multiplied by unity).

Table of values of the telephone form factor measured on various electric power installations

I. *Rectifiers without grids*

1. Six-phase rectifiers	1.5 to 4.5% (×1)
2. Twelve-phase rectifiers	1 to 1.5% (×1) 0.9 to 2.2% (×f)

II. *Rectifiers with grids*

1. Six-phase rectifiers

Percentage of control : 1.0	up to 3.3% (×1) up to 3 % (×f)
Percentage of control : 0.8	up to 12 % (×1) up to 11 % (×f)

Results of systematic tests effected on apparatus in service

(a) A rectifier of 75 kW (750 V, 100 A)

Percentage of control	Telephone Form Factor of the Voltage	
	at full load	at 1/3 of full load
1.0	2.7% (×1)	2.8% (×1)
0.9	3.7% (×1)	7.3% (×1)
0.8	4.8% (×1)	9.1% (×1)

(b) A rectifier of 220 kW (440 V, 500 A)

Percentage of control	Telephone Form Factor of the Voltage	
	at 3/4 of full load	at 1/4 of full load
1.0	3.1% (×1)	2.6% (×1)
0.9	6.9% (×1)	9.5% (×1)
0.8	9.3% (×1)	12.1% (×1)

2. Twelve-phase frequency rectifiers

Percentage of control : 1.0 $\left\{ \begin{array}{l} \text{up to 2 \% } (\times 1) \\ \text{up to 2.4\% } (\times f) \end{array} \right.$

Percentage of control : 0.9 up to 5.5% (×1)

III. *Single-phase lines*

(Contact lines of a.c. railways)

1. Measurements in a sub-station :
   0.1 to 0.25% (×f)
2. Measurements on a contact line :
   0.14 to 1.4% (×1)
   0.66 to 1.5% (×f)

IV. *Three-phase network* (measurements taken between 2 phases)

1. Cables network

(a) 5 kV — load : six-phase rectifier
0.5 to 3.8% (×f)

(b) 6 kV —
0.4 to 0.7% (×1)
0.1 to 0.3% (×f)

(c) 10 kV — load : twelve-phase rectifier
1.0 to 1.65% (×1)
1.1 to 2.1 % (×f)

2. Overhead network

110 kV — without rectifier load
0.4 to 0.55% (×1)
0.12 to 0.22% (×f)

110 kV — rectifier load
up to 1.8% (×f)

In general, it is not possible to determine the values of the telephone form factor of the characteristic voltage of power installations. For a given line, particularly, this factor varies along the line.

In this respect, having regard to the elements making up a complex network, it will be interesting to examine in the course of the studies to be undertaken, if it is possible at least in certain cases, to deduce information about the disturbing voltage for the whole of the network.

On the other hand, this factor depends notably on the type of load of the power line ; very different values can be observed on power installations of similar construction, according to whether they supply lighting, machines, railway installations or rectifier installations.

Question No. 2.

(Category A 1) [urgent] (new question)

(a) Comparison of the results of simultaneous measurements of the psophometric e.m.f. on a telephone circuit and of the equivalent disturbing voltage or equivalent disturbing current of the influencing or inducing power line.

(b) Do relations exist between the ratios K_v of the equivalent disturbing voltage V_p to the r.m.s. voltage of the power line ($K_v = V_p/V_{r.m.s.}$) or the ratios K_i of the equivalent disturbing current J_p to the r.m.s. current J of the power line ($K_i = J_p/I_{r.m.s.}$), and the ratios K_t of the psophometric voltage v_{tp} measured between the two wires of the telephone circuit at a given point, to the r.m.s. voltage v_t measured between these wires at the same point ($k_t = v_{tp}/v_{tr.m.s.}$), or the ratios k_l of the psophometric voltage v_{lp} measured between wire and earth at a point on the telephone circuit, to the r.m.s. voltage $v_{lr.m.s.}$ measured between wire and earth at the same point ($k_l = v_{lp}/v_{lr.m.s.}$) ?

Note 1. — Up to the present the Directives have allowed that a sufficient estimate of the psophometric e.m.f. likely to be found in the case of exposure of a telephone circuit to a power line, may be obtained by measuring the value of the equivalent disturbing voltage or the equivalent disturbing current of that line by relating the latter values to a voltage or current at 800 c/s.

In fact, voltages or current exercise an influence or induction, consisting always of many harmonics, for which the coupling coefficients between the lines are different. The introduction, in the definition of the equivalent disturbing voltage and the equivalent disturbing current, of coefficients k_f and h_f allow for this circumstance only in a rather imperfect manner.

In view of the search for a better way of calculating the estimated psophometric e.m.f. it will be interesting to make simultaneous measurements of psophometric e.m.f. and of equivalent disturbing currents and voltages in numbers of different situations (regions where the conductivity of the soil is different, different separations, exposure of large or short length, predominance of certain harmonics, etc...), to determine the differences between the measured values of psophometric e.m.f. and the values calculated by means of the formulae in the Directives and to try to determine if it is possible to establish a correlation between these differences and the different circumstances in the measurements.

Note 2. — The study of this question will be followed by the 1st S.G. in cooperation with S.G. 1 of the 1st Section of the C.M.I.

Question No. 3.

(Category A 1) [urgent] (continuation of Question 3 studied in 1952/1954)

Is there need to adopt a special rule for evaluating the risk of danger due to electric induction, in the case of industrial lines having an insulated neutral point or where the earthing is by means of a Petersen coil and equipped with a means of protection which is rapid in action, so that a fault on one phase has its duration sufficiently reduced to make the resultant risks of danger from contact with the affected wires small ?

Note. — The study of this question will be followed by the 1st S.G. in cooperation with S.G. 8 of the 1st Section of the C.M.I.

Question No. 4.

(Category A 1 [urgent] (new question)

To what risks is an underground telephone cable exposed when a high potential gradient is produced in its neighbourhood (as for example, by a short circuit to earth of a power line) and what are the measures of protection against these risks ?

Note 1. — It is necessary to examine in particular the following cases :

(a) cables serving stations or power stations where the neutral of the transformers is connected to earth ;

(b) cables serving stations or power stations where the neutral of the transformers is earthed through a Petersen coil ;

(c) cables placed in close proximity to the earthing point of a pylon forming part of a power line with the neutral directly earthed.

In cases *(a)* and *(b)* it is necessary to determine what is the value of the potential difference between the station earth at the power station and that of a distant earth plate, which is considered to be dangerous, and it is necessary to devise a method which will allow it to be calculated.

Note 2. — The study of this question will be followed by the 1st S.G. in cooperation with S.G. 12 of the 1st Section of the C.M.I.

Question No. 5.

(Category A 1) [urgent] (continuation of Question No. 5 studied in 1952/1954)

What is the value of the psophometric E.M.F. arising from power lines, which may be tolerated at the circuits terminals of the interurban exchange nearest to the subscriber. (Directives, Rome edition 1937, revised at Oslo 1938, and brought up to date at Geneva in 1952, § 93) ?

Note. — The basis for the study of this question will be provided by the conclusions of the work of the 4th and the 3rd S.G. of the C.C.I.F.

Question No. 6.

(Category A 1 [urgent] (new question)

It is permissible to apply the special rules in cases of exposures between power lines and telecommunication cables which include power feeding circuits for the supply of repeaters or include circuits which are permanently connected to apparatus supporting high voltages (for instance insulation watchers) ?
What rules should apply ?

Question No. 7.

Category A 1) [urgent] (continuation of question No. 7 studied in 1952/1954)

What are the special rules that are applicable in cases of exposures of high security power lines and telecommunication cables which contain circuits that are terminated by transformers with line windings not insulated from the sheath of the cable and from earth ?

Question No. 8.

(Category A 1) [non urgent] (continuation of Question No. 8 studied in 1952/1954)

Arrangements and measurements to be made in cases of parallelism of telephone lines and d.c. traction lines or d.c. power lines, especially in the case of abrupt variations of the traction current and in the case of short circuits.

Note 1. — For the study of this question the document " C.C.I.F. 1952/1954 — 1st S.G. — Document No. 25 " proposed by the U.I.C., will be considered particularly.

Note. — The study of this question will be carried out by the 1st S.G. of the C.C.I.F. in cooperation with the 4th S.G. of the 1st section of the C.M.I.

Question No. 9.

(Category A 1) [non urgent] (continuation of Question No. 9 studied in 1952/1954)

Conditions of coexistence of D.C. power lines of very high voltage and neighbouring telephone lines.

Note 1. — The following points should be studied :

1. The character of the transients on the high tension line which arise in normal operating circumstances at the moment the voltage is switched on. Also under abnormal conditions such as breaking of a conductor, accidental earth faults, etc.

2. The effect of these transients on neighbouring telecommunication lines.

3. The noise which may arise in the telecommunication lines as a result of the current fluctuations.

4. Increase in harmonics in the a.c. power lines feeding the substation which converts the direct current into alternating current or in the lines fed by that substation.

In the case of d.c. submarine power cables attention is drawn to the fact that the principal effect to be investigated appears to be that arising from aerial lines between the submarine cable and the current supplying substation.

It would be useful to determine what method could be recommended for the calculation of noise and of danger which telecommunication circuits may experience from neighbouring d.c. power lines of very high voltage.

Moreover, it would be desirable to investigate the best methods of reducing the fluctuations of the direct current in these power lines.

Note 2. — The study of this question will be undertaken by the 1st S.G. of the C.C.I.F. in collaboration with the 9th S.G. of the 1st section of the C.M.I.

Question No. 10.

(Category B) [urgent] (continuation of Question No. 10 studied in 1952/1954)

(a) Study of devices that may be inserted in telephone lines exposed to severe induction so as to reduce the voltage between wires and earth.

(b) In the case of open-wire telecommunication lines which it is desired to be equipped with a set of discharge tubes, associated or not associated with short-circuiting earthing relays, how can the number of tubes be determined that may be employed without impairing the transmission ?

A distinction should be made between the case of V.F. circuits and carrier-frequency circuits, with or without repeaters.

(c) What are the recommendation that could be made to obtain a reduction in the resistance of the earthing system for the discharge tubes in open-wire telecommunication lines in regions where the resistivity of the soil is very high (rock, sand...) or in regions where frost conditions permanently prevail ?

Note 1. — In cases where such devices are installed as permanent equipment, attention must be paid to the steps required for periodic control to maintain the circuits in good condition.

Note 2. — The study of this question will be pursued by the 1st S.G. of the C.C.I.F. in collaboration with the 10th S.G. of the 1st section of the C.M.I.

Question No. 11.

(Category B) [urgent] (continuation of Question No. 11 studied in 1952/1954)

(a) Determination of the circumstances in which there may be reason to assume that personnel, working on the construction or maintenance of telecommunication lines (open-wire lines or circuits in cables), in the neighbourhood of power lines or traction lines, are exposed to certain risks if special steps are not taken to ensure their safety or if they neglect to take precautions in their work.

(b) Study of the Regulations concerning the safety of the personnel working on the construction or maintenance of telecommunication lines (openwire lines or cables) with a view of placing them outside the risks of danger.

Note 1. — The present state of the inquiry is summarized in the following appendix.

Note 2. — The Administrations and Private Operating Companies are requested to communicate to the Secretariat of the C.C.I.F. :

(1) Statistics of accidents (electric shocks, etc...) that occurred to persons working on their lines and attributable to industrial lines (as a result of induction or any other cause). In each case, the nature, the origin and the circumstances should be indicated.

(2) The instructions concerning the safety of personnel that are issued to the personnel working on cables exposed to risk of danger from power lines.

In the case of telephone circuits in a cable which are completely insulated from the sheath of the cable and subjected to a longitudinal e.m.f., what is the value of the current that is liable to pass through the body of a workman who is in contact with the conductors of the circuits and earth ?

Note 3. — The study of this question will be undertaken by the 1st S.G. of the C.C.I.F. in collaboration with the 10th S.G. of the 1st Section of the C.M.I.

ANNEX

(to Question No. 11)

It is not yet possible to establish a regulation which can be recommended to administrations and to private telephone companies, but for the present these are invited to follow the rules relating to the security of workme entrusted with the maintenance of telephone lines likely to be raised to a high potential by the influence of induction from neighbouring power lines.

I. *General*

1. Special precautions to be taken apply to workmen who do not usually work on conductors carrying dangerous voltages. On the other hand, the application of these precautions complicates and generally slows down the execution of the work. It is usually desirable when possible to carry out work when the current supply of the power lines is cut off.

2. If workmen must work on a telecommunications line exposed to exceptionally dangerous effects of induction or electrical influence, they must be advised of the precise situation of that line, and reminded of the precautionary measures which they must take. It is an advantage for the telecommunication lines thus exposed to be specially drawn to the attention of workers in a permanent manner by an appropriate means.

It is recommended that working on a telecommunications line should be avoided when switching operations are taking place on the power line, if these can be foreseen.

3. In these cases, it is necessary to observe the need for taking all the normal security measures such as : the forbidding of work on aerial lines or cables when there is a storm in the locality ; the wearing of a safety belt by men working on the supports of aerial lines.

Furthermore, if the conditions of work are judged to be particularly dangerous, a workman must not be left alone during the execution of his duties.

4. In the case where it is necessary to use insulated clothing or tools, or apparatus insulated with respect to its frame (soldering irons, portable lamps, field telephones, etc...), before starting work it must be checked that the installation is suitable and that the insulating parts are not damaged.

II. *The case of aerial wires.*

1. It is an advantage if conditions permit, to make over the working area, a good metallic connection between the wires of the route and all metallic structures of the line with which the worker is likely to come into contact. Furthermore, the whole of these items should be connected to earth.

One can also, in certain cases, set up, over the working area, a temporary connection of each wire on the route to the earth by means of a lightning arrestor or a gas-discharge tube.

2. If this is possible, and in the case where the work will be of long duration, it may be an advantage to insulate from the rest of the route the section on which work has to be carried out, and to re-establish the continuity of the conductors by means of an interruption cable.

3. If this is not possible, the exposed lines must only be touched with insulated gloves or tools with insulated handles and all other contact with these lines must be avoided.

III. *Special recommendations in the case of cables.*

When it is necessary to work on a cable permanently subject to a high induction or laid in a very stormy region, before cutting the sheath of the cable, an electric connection of low resistance (e.g. a soldered wire) between the two parts of the sheath which will be separated by this cut, must be connected. In the case of armoured cables one must proceed in the same manner for the armouring.

2. According to the circumstances one of the following principles of protection can be followed :

(a) complete insulation with respect to earth,

(b) insulation with respect to the dangerous conductors,

(c) general connection to earth.

(a) *Complete insulation with respect to earth.* — This method can only be applied in the case of a chamber or an excavation of sufficient size and which it is possible to dry out. One must then :

— cover the floor, and if necessary, the sides of the excavation or chamber by means of dry planks or with sheets or insulating cloths.

— mask with an insulant all the accessible metal parts (sheaths and armouring of the cable, steel supports, other cables and metal channels present).

(b) *Insulation with respect to the dangerous conductors.* — This method can be applied when it is not possible to obtain complete insulation with respect to earth, e.g. in the case of narrow spaces and urgent work on faults.

It is recommended to ensure, as much as possible, the insulation of the workman with respect to other cables or underground works around.

The use of insulated clothing and above all insulated foot-wear is also recommended.

If the workman cannot insulate himself sufficiently from the dangerous conductors, he must only touch them with insulated gloves, or with tools having insulated handles, and he must avoid all other contact with the conductors.

(c) *General connection to earth.* — Before cutting a conductor, each side of the proposed cut must be connected to earth. To do this, the conductor must only be touched with insulated gloves, or with a tool connected to earth. After the execution of this work, the same precautions are taken to remove the connections to earth.

Note. — Experience in certain countries seems to indicate that, outside the general recommendations given in I and III 1, it is not necessary to take special precautions in the case of cables which normally do not carry high induced e.m.f.s.

IV. *Protection of exchange personnel.*

1. It should be the aim to render impossible or as difficult as possible a simultaneous contact of the body of a person with the metallic parts associated with the exposed external lines and, at the same time, with metal parts connected with the earth.

One should endeavour to point out in an apparent manner accessible parts of exposed lines.

2. In the case where the work must continue for a period, one can generally isolate from the exposed external line, the part on which work is being done, in which case there is no need to take other special precautions.

3. In the case of work of short duration on sections directly connected to the exposed line, one should use insulated gloves or tools with insulated handles.

Question No. 12.

(Category A 1) [urgent] (continuation of Question 12 studied in 1952/1954)

(a) Statistical study of the coefficients of sensitivity relative to magnetic induction (as these are defined in the Directives, Rome 1937, revised at Oslo in 1938 and brought up to date at Geneva in 1952, Chapter XVI, Section A, § 80) on existing interurban circuits. It would be of interest to find out if and to what extent the values of these coefficients depend upon the position of the circuit in relation to the other conductors in the overhead route or in the cable, upon the laws of transposition adopted, etc.

(b) Should the definition of the coefficients of sensitivity be improved in order to take better account of certain circumstances (length of exposures, attenuation of the circuit, termination of the longitudinal circuit, that is the circuit formed by the two conductors in parallel and earth) ?

(c) Should the definition of the various coefficients of sensitivity be amended by defining new coefficients that take into account not only the unbalance to earth (and to the neighbouring conductors), but also the dissymmetry of position in relation to the inclucing field ?

Note 1. — The definition of the coefficient of sensitivity arising from magnetic induction is given in the Directives (Rome, 1937, Oslo 1938 and brought up to date at Geneva in 1952, Chapter XVI, Section A, § 80). The present state of the question is summarized in the following annex.

Note 2. — The study of this question will be undertaken by the 1st S.G. of the C.C.I.F. in collaboration with the 7th S.G. of the 1st Section of the C.M.I.

ANNEX
(to Question No. 12)

It is convenient to refer to the coefficient of sensitivity defined in the Directives (Geneva 1952, Chapter XVI, Section A, § 80) under the name of " *coefficient of sensitivity relative to magnetic induction* ". On the other hand, a definition proposed to be introduced under the name of " *coefficient of sensitivity relative to electric induction* " is as follows :

Given a relatively short circuit closed at both ends in impedances approximately equal to the characteristic impedance of the circuit, insulated from the earth throughout its length as well as at its ends, and subjected to the effects of electric induction due to a power line,

— if V_f is the mean value of the sinusoidal voltage (of frequency f) between the wires and earth,

if v_f is the voltage component of frequency f between the terminal impedance arising exclusively from the unbalance of the circuit to earth, then the coefficient of sensitivity relative to electric induction for the frequency f is the ratio

$$\frac{2\ v_f}{V_f}.$$

On the other hand, if the voltage developped by induction contains components of several frequencies, the same expression applies for the "coefficient of sensitivity relative to electric induction " to the ratio :

$$\frac{2\ v_p}{V_p}$$

where v_p and V_p are the weighted values using the weighting table of the new psophometer standardised by the XIVth Plenary Assembly of the C.C.I.F.

No simple theoretical relationship between the " coefficient of sensitivity relating to electrical induction " defined above and the " coefficient of sensitivity relating to magnetic induction " appears to exist. However, it would be interesting to investigate whether, in practice, a statistical correlation can be established between these coefficients. It is desirable that Telephone Administrations should undertake measurements of these coefficients both with single frequencies and with complex frequencies corresponding to the usual types of noise (Six-phase rectifier, rotating machines).

Note. — During the course of the determination of the sensitivity coefficients it will be necessary to note the test conditions, the arrangement and method of installation of the conductors, the transposition rules, the number, the relative position and the electrical conditions (insulated or earthed) of neighbouring conductors, and the frequency.

It will also be useful to determine the difference between the values of the electrical characteristics of the two conductors (resistance, inductance, capacity, conductance).

These measurements should be made, not only at ordinary telephone frequencies but also at frequencies used with carrier currents.

Question No. 13.

(1st S.G. of the C.C.I.F. in co-operation with S.G. III and S.G. VII of the C.C.I.T.)
(Category A 1) [urgent] (continuation of Question No. 13 studied in 1952/1954)

(a) How can the different types of unbalance which can be defined for a telephone installation be distinguished, according to the nature of the installation (subscriber's installation or telephone exchange installation), or according to

whether one considers the effect of the unbalance on the magnitude of the noise observable in the receiver inside the installation or connected at its output terminals, when the entry to the installation is connected to a line which is subject to a longitudinal e.m.f., or whether one considers the effect of the unbalance on the transmission of an outside line connected at the input to the installation.

(b) In what manner can limits be defined for the different types of unbalance :

1. Of subscribers' installations,
2. Of telephone exchange installations.

What should these limits be ?

Note 1. — In the study of this question, the following considerations will be taken into account :

As regards the effect of unbalance with respect to earth of telephone exchanges on the magnitude of the noises when the incoming line is the seat of a longitudinal e.m.f., it appears that the unbalance should be characterised by a factor which is determined by measurement using a device fulfilling the following conditions :

(1) the unbalance factor should be defined in such a manner that it expresses in the simplest way the relation between the psophometric voltage at the output terminals of the installation and the e.m.f. causing the noise.

(2) The circuit of the measuring device should be so chosen, that the values of the unbalance factor obtained by the measurement can be compared with values determined by calculation from the impedances of the components of the installation under consideration.

(3) It should be possible to make the measurement quickly and in a simple manner, by means of the device which includes only measuring apparatus of a standard type.

(4) The value of the unbalance factor relating to an exchange should be determined without taking account of the possible unbalance of the line ; in the apparatus the latter should be represented by two equal impedances, representing the conductors of a symmetrical circuit with respect to earth.

(5) The method of determining the unbalance factor should lead to giving it the value *zero* in the case of perfect balance and should remain less than 1 (or 100 %), however great may be the unbalance.

It will be necessary to collect information relating to unbalance to earth of the feeding bridges of existing telephone exchanges, to find out on what basis limits could be chosen for the unbalance of different installations ; to determine which basic circuits of measuring devices for unbalance factor can be recommended taking into account the conditions indicated above.

In the case when installations serving circuits appropriate to simultaneous telephony and telegraphy, or parts of the telegraph equipment including an earth connection, are directly connected to the line wires, account should be taken of the presence of this equipment to determine the unbalance, from the telephony point of view, of the complete installation.

Note 2. — For the study of this question, the following documents, in particular, will be taken into consideration :

C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 17
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 31
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 39
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 43

Note 3. — The study of this question will be carried out by the 1st S.G. of the C.C.I.F. in co-operation with the 7th S.G. of the 1st Section of the C.M.I.

Question No. 14.

(Category B) [urgent] (continuation of Question No. 14 studied in 1952/1954)

(a) Should the protection principles at present in use be modified ?

(b) What would be the best method to define and measure the characteristics of the protection apparatus ?

See Volume VI of the *Yellow Book*, Recommendation No. 4, " Principle Characteristics of Protection Equipment ".

Note. — In the course of the study of this question, attention should be directed to the following points :

(a) Is it desirable to examine whether it is possible to simplify the protection schemes by eliminating certain elements from them and to determine particularly in what condition it is appropriate to use :

— a protection system comprising three elements (fuse, lightning arrestor and fuse) ;
— a protection system with two elements (fuse and arrestor) ;
— a protection system with a single element (arrestor).

It would equally be useful to examine the operating conditions of the various elements of a protection system, when they are used on a circuit in which entry into the exchange is by means of a cable, and to take into consideration different lengths of cable.

(b) It is desirable to associate the study of lightning arrestors (discharges), used in normal conditions, with that of the fuses used in the protection system employed. The use of lightning arrestors capable of discharging currents, which are larger than for certain existing models, reaching for example several tens of amperes during one or a few seconds, should also be envisaged.

(c) It would be very desirable to have available lightning arrestors having a large regularity and stability of operation.

(d) It would be useful to observe the relation between the régimes of operation (glow discharge or arc discharge) and the heating of the lightning arrestor under its service conditions (with or without fuse).

Question No. 15.

(Category B) [non-urgent] (continuation of Question No. 13 studied in 1952/1954)

(a) Study of the characteristics of devices for protection against acoustic shock, based on the use of rectifying elements, variable resistance elements and lightning arrestors in association with voltage transformers.

(b) Establishing of a note relating to the definition of the general characteristics of protection devices based on the use of rectifier elements.

Note. — Certain Administrations and private telephone undertakings have, in the past, already supplied information relating to this question. It would be useful if they would kindly make known what are the devices at present in use giving, in this connection, indications as to their nature, operating characteristics, method of use, position of installation, space occupied, etc...

For the study of the second part of this question the detailed specifications already communicated to the C.C.I.F., in the documents listed below, will be taken into account :

C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 14
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 21
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 31

Question No. 16.

(Category A 1) [urgent] (continuation of Question No. 16 studied in 1952/1954)

Conditions of coexistence of carrier current systems on telephone lines and carrier current systems on power lines in the case of proximity of these lines.

What method of calculation can be recommended for the predetermination of the action of the power line carrier current circuits on the telecommunication carrier current circuits ?

Remark 1. — While awaiting the results of tests in hand, it is recommended to use, when possible, different frequencies for the carrier current systems in the two types of lines, when parallelisms are foreseen between them, and to obtain, in future, for the stability of the carrier frequencies, conditions which are as good as possible and comparable on the two types of line.

For the study of this question document " C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 42 " should be particularly noted.

Remark 2. — The study of this question will be carried out by the 1st S.G. of the C.C.I.F. in co-operation with the 5th S.G. of the 1st Section of the C.M.I.

Question No. 17.

(Category B) [urgent] (continuation of Question No. 17 studied in 1952/1954)

Has telephonic operating trouble been experienced in the case of lines equipped with carrier current and situated near power lines, because of electric or magnetic induction due to the latter ?

Note 1. — The present position is explained in the annex below.

Note 2. — The study of this question will be continued by the 1st S.G. of the C.C.I.F. in cooperation with the 11th S.G. of the 1st Section of the C.M.I.

ANNEX

(to Question No. 17)

1. As regards transport or energy distribution lines, it will be necessary to examine, in particular, what is the interfering action exerted by these lines on the carrier current channels of the telecommunication lines, which could arise from the corona effect or from sparking developed in items of equipment with incipient faults. It would be useful to define the limiting spacing which can be adopted between these two types of line, in order to avoid trouble, account being taken of the method of construction of the high tension line which will determine the corona effect.

2. As regards traction lines the operating trouble which they cause to telephone lines equipped with carrier current systems, has been determined by the Telephone Administration of the U.S.S.R., where traction by direct current is utilised. Preliminary measurements on this subject and described in Document No. 6 of the 1st S.G. of the C.C.I.F. (pages 22-29) have led to the following conclusions :

(a) The contact wires of D.C. electric railways are undoubtedly the source of interference which has been observed in the high frequency bands on open-wire telephone circuits.

(b) In the frequency band between 4 kc/s and 10 kc/s the interfering voltages in the contact wires are produced by mercury vapour rectifiers and by sparks at the contact wire.

(c) In the frequency bands above 10 kc/s the interfering voltages are due principally to sparking at the contact conductor.

The study of this question should therefore be continued. It seems that for this study it would be useful to adopt the following method : to study, by means of band-pass filters, the magnitude of the components of voltage in the different frequency bands, between the contact wire and earth and between the conductors of the telephone circuit simultaneously. To determine, with greater accuracy, the interfering voltages arising from mercury vapor rectifiers on the one hand and the interfering voltages from sparking at the contact wires on the other hand, it appears useful to make, on the one hand, tests in which the mercury vapor rectifier will be loaded by a rheostat, and on the other hand by tests under normal operating conditions. Measurements on telephone circuits and on the traction lines should be made simultaneously.

Question No. 18.

(Category A 1) [urgent] (new question)

Is it desirable to modify or to complete the method of measurement described in the Directives (Rome Edition, 1937, revised at Oslo, 1938, brought up to date at Geneva in 1952), Chapter XVI, Section C, § 89, 90, 91 and 92, with a view to defining more accurately the unbalance of an open-wire telephone circuit to earth (and to neighbouring conductors) ?

Note 1. — To study this question the following documents will be taken into account :

C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 17
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 39

Note 2. — The study of this question will be carried out by the 1st S.G. of the C.C.I.F. in cooperation with the Study Committee No. 7 of the 1st Section of the C.M.I.

Question No. 19.

(1st Study Group in co-operation with the 8th S.G.) (Category A 1) [urgent] (new question)

Protection of signalling on long-distance automatic or semi-automatic telephone circuits against harmful effects of power lines.

Note. — The basis of study for this question will result from the conclusion of the work of the 8th S.G. on the subject of the limitation of circuit noises which is necessary to ensure the operation of signal receivers.

Question No. 20.

(Category A 1) [urgent] (new question)

Is there need to take special steps to eliminate the risks of noise in cable telephone circuits when the sheaths of these cables must be connected to power cables, gas or water mains, pipe-lines, electrified railway tracks, for the realisation of an electrical protection scheme against corrosion ?

Note. — The study of this question will be made by the 1st S.G. of the C.C.I.F. in cooperation will the C.C.I.F. 2nd S.G. and with the 12th S.G. of the 1st Section and No. 26 of the 2nd Section of the C.M.I.

Question No. 21.

Category A 1) [urgent] (new question)

When a general scheme of protection which includes special devices inserted in the line (for example, discharge tubes with or without relays) is applied to telecommunication circuits (open-wire or cable) which are subject to the risk of high induced voltages, to what value should the induced voltage between any point of the line and earth be limited :

(a) in the case of ordinary power circuits

(b) in the case of high security lines ?

Is it desirable to apply the same limit to both types of power line ?

Question No. 22.

(Category B) [non-urgent] (new question)

Protection against the adverse effects of power lines of a telecommunication cable with a metallic sheath completely insulated from the soil by a thick covering of rubber or thermoplastic material.

Question No. 23.

(Category A) [urgent] (new question)

Is it desirable to change the rules relating to the protection of telecommunication cables against the harmful effect of power lines to take account of the following characteristics :

(a) The use of a non-metallic sheath or of a sheath including only a thin metallic layer ?

(b) Use of insulants other than paper ?

Note. — Up to the present the Directives have taken into consideration only the case of lines with aerial conductors and that of paper insulated cable with a thick metallic sheath.

An adaptation or a modification of certain of the established rules for these types of line may be necessary in the cases now envisaged to take account particularly of :

— differences of order of magnitude in the capacitances between the conductors and between the conductors and earth or sheath ;
— the marked reduction of the effects of electric or magnetic induction acting in the loop of a cable circuit by comparison with that which is produced in the case of open-wire circuits ;
— the fact that the shielding factor of these types of cables can differ from those of classical type ;
— the fact that the breakdown voltages of cables insulated with thermoplastic material may be higher than those of cables with dry paper insulation ;
— the fact that the characteristic of the breakdown voltage of these cables as a function of time may be very different from that of dry-paper insulated cable.

Question No. 24.

(Category A 1) [urgent] (new question)

Revision of the Directives concerning the protection of telecommunications lines against the harmful effects of power lines

Note 1. — The preparation of this revision and the editing of a new text of the Directives will be carried out by the Committee for the Revision of the Directives which will report to the 1st Study Group of the C.C.I.F.

Note 2. — The following documents will, among others, be taken into consideration :

C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 3	
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 4	(U.I.C.)
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 8	(C.I.G.R.E. and U.N.I.P.E.D.E.)
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 10	(Federal German Administration)
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 14	(U.I.C.)
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 15	(Swiss Federal Railways)
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 16	(French National Railways)
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 17	(Italian Administration)
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 19	(French Administration)
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 20	(French Administration)
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 24	(French National Railways)
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 25	(U.I.C.)
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 26	(C.I.G.R.E., U.N.I.P.E.D.E. and U.I.C.)
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 31	(Federal German Administration)
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 32	(Federal German Administration)
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 33	(Japanese Administration)
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 35	(Federal German Administration)
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 38	(Administration of the U.S.S.R.)
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 39	(Italian Administration)
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 40	(Administration of the U.S.S.R.)
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 41	(Administration of the U.S.S.R.)
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 42	(Administration of the U.S.S.R.)
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 43	(Administration of the U.S.S.R.)
C.C.I.F. — 1952/1954 — 1st S.G. — Document No. 45	(Administration of the U.S.S.R.)

Note 3. — Attention will be drawn particularly to the following points :

1. The possibility of taking account of the earth resistance of the fault in the calculation of short-circuit current ;

2. Opportunity to maintain the special rules concerning the so-called " high security lines ".

3. Diminution of the compensating effect of steel tape or steel wire armoured cables by saturation of iron during the first few cycles of the short-circuit current.

4. Calculation of short-circuit currents in the case of traction lines with single phase or direct current.

5. Concepts of unbalance to earth of a line and of coefficient of sensitivity.

6. Conditions in which the voltages or current can be considered to be dangerous to human beings.

7. Use of nomographs, particularly for calculation of the coefficients of mutual inductance.

8. Method to be adopted for the determination of the distribution of discharge tubes inserted in lines.

SUMMARY

of protection questions the study of which should be undertaken or continued by the 1st Study Group in 1955, 1956 and 1957

Question No.	SUBJECT	CATEGORY	STUDY GROUPS (other than 1st S.G.) or International Organisations interested *	OBSERVATIONS
1	Equivalent disturbing voltage telephone form factor	A 1	C.M.I., 1st Section Study Committee No. 2	Non-urgent (continuation of the former Question No. 1)
2	Relation between equivalent disturbing voltage or current and induced psophometric e.m.f.	A 1	C.M.I., 1st Section Study Committee No. 1	Urgent (new question)
3	Danger due to electric induction	A 1	C.M.I., 1st Section Study Committee No. 8	Urgent (continuation of the former Question No. 3)
4	Danger to a cable due to high potential gradient	A 1	C.M.I., 1st Section Study Committee No. 12	Urgent (new question)
5	Tolerable psophometric e.m.f.	A 1	3rd S.G., 4th S.G.	Urgent (continuation of the former Question No. 5)
6	Telecommunication lines with power feeding conductors	A 1		Urgent (new question)
7	High security power lines	A 1		Urgent (continuation of the former Question No. 7)
8	D.C. traction or power lines	A 1	C.M.I., 1st Section Study Committee No. 4	Non-urgent (continuation of the former Question No. 8)
9	D.C. power lines at very high voltage	A 1	C.M.I., 1st Section Study Committee No. 9	Non-urgent (continuation of the former Question No. 9)
10	Devices reducing the voltage of wires with respect to the earth	B	C.M.I., 1st Section Study Committee No. 10	Urgent (continuation of the former Question No. 10)
11	Protection of workmen engaged on the maintenance of telephone lines	B	C.M.I., 1st Section Study Committee No. 10	Urgent (continuation of the former Question No. 11)
12	Coefficient of sensitivity	A 1	C.M.I., 1st Section Study Committee No. 7	Urgent (continuation of the former Question No. 12)
13	Types of unbalance of telephone telegraph installations	A 1	C.C.I.T. S.G.s III and VII (and C.M.I., 1st Section Study Committee No. 7)	Urgent (continuation of the former Question No. 13)

* The International Organizations listed below will also be consulted regarding those questions of the 1st C.C.I.F. Study Group which are likely to be of interest to them : the International Conference of large electrical networks (C.I.G.R.E.); International Union of Producers and Distributors of electric power (U.N.I.P.E.D.E.) ; International Railway Union (I.R.U.) ; International Union of Public Transport Undertakings (U.I.T.).

Question No.	SUBJECT	CATEGORY	STUDY GROUPS (other than 1st S.G.) or International Organisations interested *	OBSERVATIONS
14	Principles of protection : characteristics of protection apparatus	B		Urgent (continuation of the former Question No. 14)
15	Devices for protection against acoustic shock	B		Non-urgent (continuation of the former Question No. 15)
16	Coexistence of carrier current systems on telephone lines and on power lines	A 1	C.M.I., 1st Section Study Committee No. 5	Urgent (continuation of the former Question No. 16)
17	Carrier current on telephone lines situated near power lines	B	C.M.I., 1st Section Study Committee No. 11	Urgent (continuation of the former Question No. 17)
18	Measurement of the unbalance of an open-wire telephone circuit to earth	A 1	C.M.I., 1st Section Study Committee No. 7	Urgent (new question)
19	Protection of telephone signalling	A 1	8th S.G.	Urgent (new question)
20	Noise due to the electrical protection of cables against corrosion	A 1	2nd S.G. : C.M.I. 1st Section Study Committee No. 12 and 2nd Section Study Committee No. 26	Urgent (new question)
21	Tolerable induced voltage in telecommunications circuits protected by special devices	A 1		Urgent (new question)
22	Protection of a cable with an insulated sheath	B		Non-urgent (new question)
23	Protection of a non-metallic sheathed cable or the use of an insulance other than paper	A 1		Urgent (new question)
24	Revision of the Directives	A 1		Urgent (new question)

* See note on the preceding page.

LIST OF QUESTIONS

concerning the protection of telephone cables against corrosion due to electrolysis or chemical action of the soil, and of questions concerning the composition of cable sheaths, the study of which is to be undertaken or continued by the 2nd Study Group of the C.C.I.F. in 1955, 1956 and 1957

Question No. 1.

(Category B) [non urgent] (continuation of Question No. 1 studied in 1952/1954)

(a) The substitution (entire or partial) for lead : of certain organic materials, of certain metals (e.g. steel, or aluminium) or certain alloys for the construction of cable-sheaths ;

(b) The use of plastic materials to protect metal cable-sheaths (lead, aluminium or other metals) against corrosion ;

(c) Use of plastics to protect the covering of cables against corrosion ;

(d) The use of cables in which the conductors are not insulated with paper and which are covered with a sheath which is not perfect by moisture proof.

Note 1. — The information received up till 1949 is summarised in § 3 of Chapter IV of the "Recommendations concerning the protection of cables against corrosion" ;

In 1953, it can be mentioned that considerable lengths of the following types have been laid in several countries :

— Alpeth cables, in which the sheath consists of a coating of polythene over a sheath of thin aluminium strip ;

— Stalpeth cables, the sheath of which consists of an inner covering consisting of a thin stip of aluminium (for electrical conductivity) surrounded by a steel sheath welded along the seam (to ensure watertightness) ; the latter sheath having an outer covering of polythene ;

— Cables in which the conductors are insulated with polythene and in which the core is surrounded by a sheath of plastic material and then by non-watertight metallic screen ;

— Cables of which the sheath consists of a metal or alloy other than lead, with a covering of plastic material (including rubber).

Note 2. — It is desirable that the Administrations or groups who carry out the trials of the cables thus constructed should communicate the following information :

1. Construction of the cable and its sheath, the nature and physical and mechanical properties of the materials used, conditions of their use ; the nature of substances which attack these materials and which may be found in the ground or in ducts, specially after drawing-in other cables (vaseline, soap, etc.) ; from this point of view it would be very useful if each newly laid cable (with a plastic sheath) were marked (by means of a figure printed on the envelope or by means of a sheet of paper around the core) with a reference number permitting the exact identification, by the cable maker, of the composition of the plastic used for the sheath. In practice, in the case of plastic sheaths, modifications of the chemical structure of the material used may occur with time and it may not be possible to determine what the initial composition of the material was at the time of construction of the cable. By these indications, Administrations may be able after a certain number of years to be informed on the plastic materials for cables which have been shown to be unsatisfactory under service conditions.

2. The techniques used for making satisfactory joints (between two cables with plastic sheaths or between plastic-sheathed cables and lead-sheathed cables) ; attention is particularly drawn to this point for the joints are at present the weak point of cables with plastic sheaths and it would be useful to collect as much information as possible on this matter.

3. The results of trials in the laboratory and in service ; information concerning conditions of use of the cable (aerial cable, cable drawn into ducts, cable buried in the ground) ; the protection obtained against electrolytic and chemical corrosion ; and, possibly, the longitudinal resistance and apparent insulation resistance of the sheath to earth.

4. The preservation of insulation in cables, insulated with plastic materials, without a moisture proof sheath.

5. Arrangements for the localization of faults.

Regarding points 4 and 5 above, it is desirable that the Administrations and Private operating agencies state :

— whether they use barriers to prevent the longitudinal circulation of water which has penetrated into the interior of the cable, what is the form of construction of these barriers and what results are obtained ;

— whether they make use of procedures for removing the water which has penetrated into the interior of the cable ;

— whether thay use bare wire in the interior of the cable for automatic checking of insulation and what are the results obtained.

Note 3. — At present, the following comments can be made :

1. The use of an external sheath of plastic material can offer the advantage of providing a remedy against chemical or electrical corrosion.

2. At the present time no plastics are available which can be used for the construction of cable sheaths and which are perfectly impermeable to humidity. Hence in the case of paper insulated cables the sheath should at least include a metal covering which is moisture-proof unless other arrangements are made to extract the humidity which has penetrated into the cable.

3. The total replacement of lead by a plastic sheath leads to the following difficulties :

(a) the electromagnetic or electrostatic screening effect on the internal and external fields is lost, and this protection must, if necessary, be provided in other ways ;

(b) it is no longer possible to use the metallic sheath for signalling.

(c) the space occupied by the cables is increased.

In the case where only the thickness of the lead sheath is reduced and protection is given by a plastic covering, some of the difficulties listed above are eliminated whilst others are diminished. This is also the case if a metallic foil is included in the sheath.

It should be mentioned that for certain applications one of the considerations in the choice of the plastic to be used, either as simple sheath or as the covering of a sheath will be its resistance to combustion.

4. Certain plastics deteriorate when exposed to light or to sunlight. Precautions must be taken when using aerial cables with a plastic sheath. In particular, polyethylene can be improved in this respect by the addition of carbon black.

It would be desirable to collect information on the action which such colouring matters may have on plastic sheaths.

5. It would be useful to collect information on the behaviour of plastic sheaths in the presence of certain substances. The annex gives in this connection the results of a bibliographical study the case of polythene.

Note 4. — The study of this question will be continued by the 2nd Study Group of the C.C.I.F. in cooperation with Study Group No. 25 of the 2nd section of the C.M.I.

ANNEX

(to Question No. 1)

Behaviour of polyethylene in the presence of certain substances (Bibliographical study)

A bibliographical study has been made with the object of discovering what substances are likely to have a harmful effect on polyethylene used for cable sheaths. It results from this that the following substances are mainly concerned :

1. *Wetting agents and certain detergents.* — Exposed to the influence of such agents polythene splits and forms cracks. The magnitude of the effect depends essentially on the composition of the agent.

2. *Plasticisers, chiefly those of the ester type.* — Same effect as that mentioned above. A plasticiser being able to penetrate by contact from a plasticised plastic into the polythene, such a contact must be avoided. In the sheaths composed of a combination of polyvinyl chloride and polythene, metal foils may be placed between the layers of plastic. The effects are very different for different types of plasticisers.

3. *Hydrocarbone, aliphatic and aromatic.* — At ordinary temperatures, there is practically no effect ; but above 60° C, the solubility rises with temperature.

4. *Oils.* — Mineral oils are slowly absorbed at ordinary temperatures, but the absorption is more rapid at higher temperatures. Under prolonged influence, there will be splits and cracks as in 1.
Vegetable and animal oils produce the same effect, but to a lesser degree.

5. *Polar organic matters such as alcohols, aldehydes, acids, esters and ketones.* — These substances cause polythene of low molecular weight to be breakable, particularly when it is subjected to mechanical strain (internal or external tensions).

6. *Silicones.* — (See under 4).

7. *Sulphur and sulphurous accelerators.* — During prolonged influence, sulphur can to a certain degree be absorbed by polythene, causing deterioration of the electrical properties of the latter. A similar effect, but to a more marked degree, can be caused by sulphurous accelerators used in the vulcanisation of rubber. In the case of mixed sheaths, it is necessary in consequence to take the same precautions as those mentioned under 2.

8. *Soaps.* — Soft soaps produce the same effects as the substances mentioned under 1.

In a general way, it should be pointed out that the attacks caused by the above substances are more marked on polythenes of low molecular weight or those which are submitted to mechanical strain than on polythenes of high molecular weight which are not submitted to mechanical strain.
In the appreciation of the above data, it should be remarked that these substances are rarely to be found in the soil, while lead is likely to be attacked by substances such as humic acids, non-calcareous water, mortar, etc... substances which are often found in the soil and which have no action on polythene.

Question No. 2.

(Category B) [non urgent] (continuation of Question No. 2 studied in 1952/1954)

(a) A study of the conditions producing or accelerating intercrystalline disintegration of telephone cable-sheaths made from lead alloys (vibration, temperature changes, etc.). Remedial measures (laying methods, self-supporting cables, cables in steel pipes, etc.).

(b) Reduction of these disintegrating effects by the use of sheaths made from suitable alloys.

Note 1. — The special arrangements made in various countries during cable-laying to reduce intercrystalline disintegration are mentioned in Volume II of the *Yellow Book*, page 75, under the title " Methods of reducing intercrystalline disintegration of cable-sheaths ".

Information on the lead alloys used for cable-sheaths and their resistance to intercrystalline disintegration is given in Chapter IV of the " Recommendations concerning the protection of cables against corrosion " (Paris, 1949), § 134, page 21) ; account should also be taken of Recommendation No. 15 for the Protection of cables against corrosion (Florence 1951, page 198, of Volume VI of the *Yellow Book*).

Note 2. — For the carrying out of laboratory tests on the resistance to mechanical disintegration offered by various alloys particular consideration could be given to the method described in the Annex 1 below.

Note 3. — Radiographic examinations have been made on lead plates or tubes but these have not, up to the present time, given satisfactory results owing to the high atomic number for lead. By way of information the attached Annex 2 describes the apparatus used at the Milan Polytechnic for radiography of metallic plates and tubes by the aid of radio-active cobalt.

Note 4. — While examining cases of intercrystalline disintegration, it would be of interest to ascertain if possible, over a period of time, details of the vibration (amplitude and frequency) to which the cable is subjected.

ANNEX 1

(to Question No. 2)

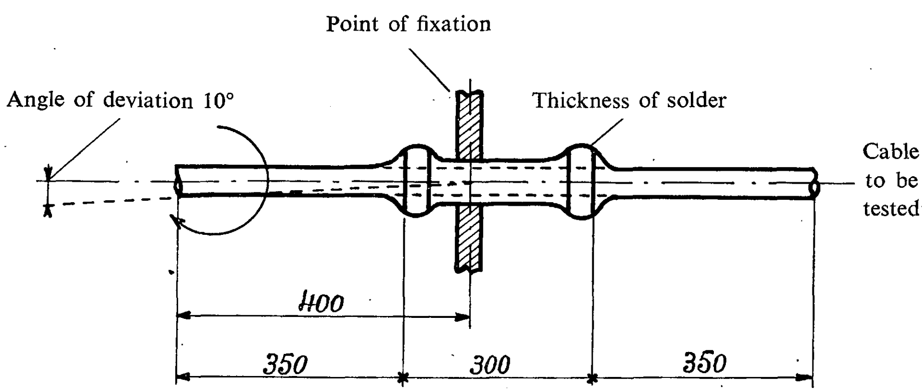
Laboratory study of breaking conditions of cables by intercrystalline disintegration resulting from repeated bending (note transmitted by the Swiss Telephone Administration)

It has been noticed that the lead sheaths of cables placed under the platforms of bridges are often affected by intercrystalline disintegration (breaks due to fatigue). It was first thought that these breaks were due to the transversal vibrations imparted to the bridges by the movements of vehicles. But further observations have shown that the breaks noticed were always caused by the longitudinal movements of the platforms of the bridges.

A method was then sought that would permit the comparison in the Laboratory of the different cables used and to submit them to strains similar to these to which they would be submitted on the bridges. One of the ends of the cable to be tested, is solidly fixed : a machine impresses circular vibrations on the other extremity. The cable is thus bent in all directions following an angle and a frequency variable at will.

The sheaths of cables submitted to these tests show a state of disintegration identical with that of the sheaths of cables placed in the ground.

In order to be able to examine at the same time the behaviour of joints, lead sleeves are soldered on the ends of the cable to be tested. The sketch below shows the form of the cable as prepared for testing.



As an indication the results of four tests are given in the table below :

Test	Outside diameter mm	Hickness of the sheath mm	Number of vibrations before breaking minimum	maximum	average value	Remarks
Pure lead	15.1	2.0	314,983	450,500	377,703	sleeve soldered without special precautions
Pure lead	17.8	1.8	108,476	243,200	158,129	
Lead with 0.7% antimony . . .	17.3	1.7	1,166,167	1,727,673	1,276,720	
Lead with 0.7% antimony . . .	19.0	1.7	941,520	1,430,740	1,186,130	

In all the tests, the breaks were in the sheaths and not in the sleeves.

The thicknesses of the sheaths play an appreciable part in the resistance to repeated bending.

For equal sheath thickness, the cables having the greatest diameter are most liable to breakage.

The sheaths consisting of an alloy of lead with 0.7% antimony show a resistance to breakage by intercrystalline disintegration 4 to 6 times as great as pure lead sheaths.

ANNEX 2

(to Question No. 2)

Description of the apparatus used at the Milan Polytechnic for the radiography of metallic plates and tubes by the aid of radio-active cobalt

Detection of faults in materials with X and gamma rays.

1. *General notes on the method.*

The object of the radiographic method is to obtain a picture of discontinuities in the materials tested, based on the difference of transparency of the materials to X and gamma rays.

The amount of radiation absorbed depends on the nature and thickness of the material traversed and the degree of absorption, which may be shown by changes in the density of darkening of a photographic plate exposed to the radiations leaving the specimen under examination.

If I_o is the intensity of the incident radiation and I_d that of the emergent radiation, these two quantities are linked by the general equation :

$$I_d = I_o \cdot e^{-\mu d}$$

where : e = base of Napierian logarithms
d = thickness traversed
μ = coefficient of linear absorption, proportional to the fourth power of the atomic number of the substance irradiated and to the third power of the wavelength of the radiation employed.

The contrast that can be obtained with radiography increase, therefore, with the wavelength and with the difference between the atomic numbers at the discontinuities.

2. *Sources of radiations.*

For these researches two types of sources of radiations were used :

(a) apparatus used for industrial X-ray radiography

(b) radio-active materials, either natural (radium, mesothorium) or artificial (Co^{60}, Ta^{182}, Ir^{192}).

The fundamental characteristics of the two methods are compared below.

Radiographic apparatus has an intensity of emission much superior to that of radio-active bodies ; the time of exposure is therefore reduced.

The wavelengths which can be obtained with X-ray apparatus depend on the excitation voltage of the tube ; in accordance with the relation

$$\lambda_{min} \text{ (in Angströms) } = \frac{12.3}{\text{kV}}$$

The apparatus can therefore be adjusted to the thicknesses and the materials to be examined.

The wavelength of radio-active bodies is, on the contrary, fixed and particular to each substance.

Approximately

I_{max} Ir^{192} corresponds to X-rays obtained with an excitation voltage of 450 kV
I_{max} Ta^{182} corresponds to X-rays obtained with an excitation voltage of 1200 kV
I_{max} Co^{60} corresponds to X-rays obtained with an excitation voltage of 1200 kV

There is, therefore, a range of wavelengths which cannot be obtained with X-ray apparatus of the portable type.

As can be seen from the formula, if λ diminishes, the corresponding radiation penetrates more readily into the substance, but there is a decrease in the contrast on the radiograph and, hence, a loss in sensitivity.

The price of radio-isotopes is considerably lower than that of X-ray apparatus, but consideration must be given to the mean life, which is quite short.

Radio-isotopes are very easy to handle, but the continual radiation is a source of danger for the operators.

For tensions up to 250 kV, very compact radiographic apparatus has been constructed ; one case, of quite small size and weighing approximately 80-120 kg, contains the high-tension transformer, the X-ray tube, the cooling pump, etc...

Apparatus of this type, similar to that used at the Milan Polytechnic for non-destructive tests is very easily handled and can be set up in any position without need of special staging.

3. *Possibility of radiographic supervision of cables.*

Some tests, already made, demonstrate that the radiographic method can give useful results for cables with rubber or plastic sheaths. The possibilities of an extension of this method to cables with lead sheaths is doubtful owing to the thickness and principally the high atomic number for this metal.

Question No. 3.

(Category A 1) [urgent] (continuation of Question No. 3 studied in 1952/1954)

Modifications and additions that may possibly be made to the text of " Recommendations concerning the protection of underground cables against corrosion " (Paris, 1949).

Note 1. — It would be useful to collect information on the modifications to be expected to take account of the ever-increasing use of electrical protection schemes, and

Note 2. — See the replies to Questions Nos. 1, 2, 14 and 17.

Question No. 4.

(Category B) [urgent] (continuation of Question No. 4 studied in 1952/1954)

Protection of cables against lightning (composition of cables with special protection, methods of laying, etc...).

Note 1. — The documentation received up to 1954 is summarised in Volume II of the *Green Book.* (Protective measures against lightning).

The following remarks should be added :

1. Tests carried out in various countries, to increase the protection of cables with metallic sheaths, by covering them with a thick layer of insulating material of high dielectric strength (notably rubber) have sometimes given satisfactory results ; however, it is not certain that this protection will be sufficient in all cases.

In particular, it has been pointed out that certain insulating layers specified with the object of affording protection against corrosion only are found damaged over long lengths as a result of lightning and due to this fact have lost a large part of their efficiency against corrosion.

2. It seems that the immediate proximity of railway tracks ensures an efficient protection against lightning. During the study of the statistics of damage caused by lightning, it would be interesting to examine particularly this point, in order to confirm it.

Note 2. — It would be desirable to collect as much information as possible on the following points :

1. Use of screening wires : nature of the conductors to be used, number of wires, distance of the wires between themselves and with respect to the cable to be protected ; connection to earth of these wires.

Details regarding this appear in the document " C.C.I.F. — 1952/1954 — 2nd S.G. — Document No. 11 ". Methods for the verification of the continuity of screening wires. These wires may be cut, or interrupted over distances of some magnitude, when they have been struck by lightning. It is therefore necessary to allow for a periodical verification of their good condition.

A possible solution could consist in the use of screening wires which include in their centre an insulated wire.

2. Laying of cables in the vicinity of trees, pylons, stays or other metallic masses.

It would be useful to put forward some indications on the distances to be allowed between an underground cable and the trees (singly or in rows), pylons, stays or other metallic masses, as a function of the factors on which depend the dangers of proximity (notably the soil resistivity...). The influence of the species of the tree would have to be examined.

In the case where sufficient distance cannot be allowed, it would be useful to specify what methods of protection could be adopted (e.g. laying of screening wires parallel to the cable, between the cable and the trees and its connection to earth at certain points).

Note 3. — The study of this question will be pursued by the 2nd Study Group of the C.C.I.F. in cooperation with Study Committee No. 28 of the 2nd section of the C.M.I.

Question No. 5.

(Category B) [urgent] (continuation of Question No. 5 studied en 1952/1954).

(a) Supervision of the continuity of sheaths of cables or the maintenance of their insulation.

(b) Maintenance of pressurised cables.

(c) Methods using tracer gases (radio-active or other gases) for the localisation of faults.

Note 1. — The documentation received up to 1954 is summarised in Volume II of the *Green Book* (Use of compressed gas in cables — Use of tracer gases — Apparatus for permanent insulation checking).

2. It would be convenient to add thereto the following indications concerning fault localisation tests in the sheaths of pressurised cables, by means of tracer gases.

(a) Tests have been carried out in France by the Société Alsacienne de Constructions Mécaniques by means of a radioactive gas, methyl bromide. More complete information appears in the document " C.C.I.F. — 1950/1951 — 2nd S.G. — Document No. 12 " and in the journal " Câbles et Transmission " January 1952 — pages 96 to 102 (J. Guéron et A. Pages — Experiments in the localisation of leaks in underground telephone cables by means of a radioactive tracer gas).

Similar tests have been carried out by the British Telephone Administration (see the document " C.C.I.F. — 1952/1954 — 2nd S.G. — Document No. 12 ").

(b) Tests have been made on underground cables in various countries by means of non-radioactive halogen gases, used as refrigerating fluids. These gases have the advantage in that they can be stored and kept in containers and that they can be transported and handled without precautions and without meticulous care.

The Chile Telephone Company has used arcton (freon 12). More complete information on this method appears in the document " C.C.I.F. — 1952/1954 — 2nd S.G. — Document No. 3 ".

The Australian Telephone Administration has used a gas of the freon class. More complete information on this method appears in the document " C.C.I.F. — 1952/1954 — 2nd S.G. — Document No. 24 ".

3. It would be desirable to study whether it is possible to establish recommendations which could be a guide to Administrations and Private Operating Agencies for the maintenance of pressurised cables.

The points that should be examined are, notably, the following :

— what pressure should be maintained in the cable ?

— what spacing should be allowed between the supply units of compressed gas ?

— at what distance apart should the manometers be placed ?

— at what pressure and with what precision should the manometers operate ?
— what gases, radioactive or not, can be recommended to facilitate the localisation of faults ?

Question No. 6.

(Category B) [non-urgent] (continuation of Question No. 6 studied in 1952/1954)

(a) Determination of the value of flow coefficients as defined in Annex 1, § 222, page 30 of the " Recommendations for the protection of buried cables against the action of stray currents from electric traction installations (Florence 1951) " in relation to different methods of laying and construction of electrified railways. Extension of the concept of coefficient of flow to a duct-line insufficiently insulated and liable to exchange currents with the surrounding earth.

(b) The study of the dispersion of current in the vicinity of special situations along an electrified railway line : level-crossings, bridges or other permanent structures and in the neighbourhood of points where the railway line is connected to earthed metallic structures.

(c) The study of the variation in the difference of potential existing between the rail of an electrified railway line and points in the earth, more or less distant, in a direction perpendicular to the railway line.

Note 1. — The study of this question will be pursued by the 2nd Study Group of C.C.I.F. in cooperation with the Study Committee No. 22 of the 2nd section of the C.M.I.

Note 2. — During its study this question should be associated with question No. 9 below.

Question No. 7.

(Category A 1) [non-urgent] (continuation of Question No. 7 studied in 1952/1954)

Amendments and additions to be made, if necessary, to the text of the " Recommendations for the protection of buried cables against the action of stray currents coming from electric railway installations " (Florence, 1951).

Note 1. — Is there a need, in particular, to modify or complete the information concerning the general conditions of applying cathodic protection, shown at present in § § 142 (pages 20 and 21) and 171 (page 23) and in 4 (pages 60 to 62) ?

It would be useful to specify precisely how, at the time of working out a scheme of cathodic protection designed to protect certain duct-lines (whether a new scheme or a modification of a scheme already existing), it could be ensured that there is no risk of harming other duct-lines existing in the same ground.

On this subject, there is need to define what tests can be recommended to ensure that this is the case.

When, for particular reasons, it is undesirable to allow the inclusion of a cable or a duct in an electrical protection plan, it would be proper to specify the special precautions which should be made in the elaboration of this plan.

Note 2. — See the replies to questions Nos. 6 and 9.

Question No. 8.

(Category A 1) [non urgent] (continuation of Question No. 8 studied in 1952/1954)

Conditions for the co-existence of very high-tension direct-current power lines and telecommunication cables.

Note 1. — According to the tests carried out up to the present time, the principal risks that can be expected, in the case of the use of a permanent or temporary earth-return, are the corrosion of metallic duct-lines and of buried cables, and the disturbance to signalling systems (signalling using an earth-return for part of the current ; railway signalling using track circuits).

In the event where, for reasons of economy, consideration is to be given to the distribution of power at a very high D.C. voltage, it would be desirable to collect information on the following points :

(a) What separation would it be desirable to allow between the telecommunication cables and the earthing points of the high voltage D.C. power distribution lines with earth-return, as a function of the soil conductivity and the value of the current flowing in the earth connection ?

(b) What separation would it be desirable to allow between the telecommunication cables and the high voltage D.C. power distribution lines for that section of the latter line situated between the earthing points of the terminal poles ?

(c) What measurements can be contemplated for the protection of telecommunication cables against stray currents due to very high voltage D.C. power distribution lines (e.g. the use of electric drainage), if it is not possible to satisfy points *(a)* and *(b)* above ?

Note 2. — The study of this question will be pursued by the 2nd Study Group in cooperation with Study Committee No. 29 of the 2nd section of the C.M.I.

Question No. 9.

(Category A 1) [urgent] (continuation of Question No. 9 studied in 1952/1954)

How can the results of measurements of the leakage of current on short sections of railway-line, suitably selected, be used to characterize the general condition of an electric railway network from the point of view of the importance of exchange of current between the rails and the earth ?

Note. — The study of this question will be undertaken by the 2nd Study Group in cooperation with the Study Committee No. 22 of the 2nd section of the C.M.I.

Question No. 10.

(Category B) [non urgent] (continuation of Question No. 3 studied in 1952/1954)

(a) Information concerning cases of the corrosion of the sheaths of underground cables noticed even though these sheaths were acting as cathodes.

(b) Nature of electrolytic corrosion noticed in the case of alternating stray currents or of direct and alternating stray currents in superposition. Possibility of corrosion by a direct current resulting from the effect of rectification of alternating currents during their passage from the cable into the nearby soil.

Note 1. — 1. For the study of this question, particular consideration will be given to the indications concerning the corrosion diagram for lead and contained in the document " C.C.I.F. — 1952/1954 — 2nd S.G. — Document No. 18 " to which should be added the similar publication made, in English, in the Journal of the Electrochemical Society (98 (1951) 57).

This diagram is only valid in the cases where the surroundings contain carbon dioxide (CO^2).

It would be useful to complete the study by the establishment of diagrams of the corrosion of lead in other surroundings (e.g. in the presence of acetic acid, phenol, etc...).

2. With the object of better defining the causes of corrosion, it would be desirable to collect more extensive information on the character of the attack as expounded at the present time in the " Recommendations for the protection of underground cables against corrosion " (Paris, 1949), § 2.2.3.3.1., sub-division 38, page 10.

3. Regarding the part *(a)* of the question, the document " C.C.I.F. — 1952/1954 — 2nd S.G. — Document No. 9 " points out a case of corrosion that could be included under this heading. As is also shown by the above-mentioned corrosion diagram, this case of corrosion can probably be explained by the alcalinity of the surroundings (high pH value) and by an insufficient electro-negative potential.

It would be proper to examine from this point of view if, and in what conditions the passage of an electric current can render cement (or asbestos-cement) aggressive with respect to lead or lead alloys, in particular, in the case of cables laid in conduits of cement or asbestos-cement and forming part of an electrical protection system.

4. Regarding part *(b)* of this question, the document " C.C.I.F. — 1952/1954 — 2nd S.G. — Document No. 7 " cites instances where it is thought that alternating currents have played a part in corrosion phenomena.

Note 2. — The study of this question will be pursued by the 2nd Study Group of the C.C.I.F., in cooperation with Study Committees Nos. 21, 25 and 26 of the 2nd Section of the C.M.I.

Question No. 11.

(Category B) [urgent] (new question)

Possibility of using plastic materials for protecting the lead sheaths of telephone cables against corrosion.

Note 1. — 1. The subject of this question is covered in principle by part *(b)* of question No. 1, but its study is considered as being urgent.

2. In the study of this question, the following points, in particular, should be examined :

(a) What conditions should be fulfilled by the thermo-plastic covering destined to protect the lead sheath from corrosion ?

(b) What methods could be used to verify the efficacity of the protection afforded by this plastic sheath ? It would be desirable in this respect to obtain information on rational and rapid laboratory methods.

In view of the possible preparation at a later date of a draft which could serve as a basis for the drawing up of their technical specifications, it would be desirable that Administrations and Private Operating Agencies communicate to the C.C.I.F. Secretariat either the specification which they now use or their proposals.

3. Besides the protection of cable sections, attention should be drawn to the interest presented by a study of the precautions which should be taken for the protection of jointing points of these cables.

Note 2. — The study of this question will be pursued by the 2nd Study Group of the C.C.I.F. in cooperation with the Study Group No. 25 of the 2nd section of the C.M.I.

Question No. 12.

(Category A 1) [urgent] (new question)

Should special measures be taken when telecommunication cables, power cables, gas and water mains, electrified railway tracks, pipelines, etc... are to be connected between themselves with the object of achieving electrical protection, more particularly in the case where other considerations render the separation of certain of these installations desirable ?

What should these measures be ?

Note 1. — 1. In the case of protection in common to power cables, telecommunication cables, gas or water mains, pipe lines, etc... by electrical protection, the following points should be kept in view :

(a) Do there exist, either permanently or during a short-circuit on a power cable included in the electrical protection plan, any possible disadvantages, such as : dangers of gas explosions, fire risks, deterioration of cable sheaths, dangers resulting from the rise in potential of these sheaths, etc ?

(b) What special measures are to be taken and, if required, the arrangements to be expected for protection against these phenomena ?

2. It would be reasonable in this connection, to find out whether the indications of § 5.4, pages 24 and 25 of the " Recommendations for the protection of underground cables against the action of stray currents due to electric traction installations " (Florence, 1951) should not be considerably extended.

Note 2. — The study of this question will be pursued by the 2nd Study Group of the C.C.I.F. in cooperation with the 1st Study Group of the C.C.I.F. and with the Study Groups No. 12 of the 1st section and No. 26 of the 2nd section of the C.M.I.

Question No. 13.

(Category B) [urgent] (new question)

Protective measures to be taken against explosive and poisonous gases which may be encountered in cable chambers of underground telecomminication cables.

Note. — The documentation received on this question up to 1954 is summarised in Volume II, of the *Green Book* " Protective measures against explosive and poisonous gases which may be encountered in cable chambers of underground telecommunication cables ".

Considering the importance of this problem which involves risk to the lives of workmen, it is to be desired that Administrations and Private Operating Agencies communicate to the C.C.I.F. Secretariat the provisions that they apply in this connection in their own country, the apparatus that they use and the additions which they consider may usefully be made to this above mentioned text.

Attention is drawn in particular to the following points :

1. Jointing and soldering of the cables. In the documentation received, it is recommended that the use of unprotected flames be avoided for the performance of these operations in manholes where the presence of gas has been noted. In certain countries, this practice is easily followed ; on the contrary, other countries find some difficulty in applying it. It would be desirable to specify what conditions should be fulfilled to remove these difficulties. It is possible, in particular, that the sizes of the manholes as well as the arrangement of the cables in them be studied.

2. Drying of the joints. Other than drying by silica-gel, certain other procedures under test seem to give good results.

- drying by means of plaster of Paris. Examination should be made to find out whether corrosion is to be feared.
- electric drying. The British Telephone Administration uses hot air electric drying apparatus. The apparatus operates on 24 volts with a power of 500 watts; it can be supplied by means of the generator and battery used for the lighting of the manhole.

3. Static ventilation. Besides the static ventilation of the manholes, certain countries install ventilation systems at high and low points in the actual ducts.

4. Penetration of the gases into neighbouring buildings via the telecommunication ducts. Incidents of this type have occurred in certain countries. A study should be made of the arrangements to be adopted to avoid such incidents (sealing of the individual branch ducts or of the ducts themselves).

5. Rules for the protection of workmen against explosive and poisonous gases. Rules of this type exist in certain countries ; in particular, an example will be found in the document " C.C.I.F. — 1952/1954 — 2nd S.G. — Document No. 19 ".

Examination should be made to see whether it is possible to establish rules on this point which could serve as a guide to Administrations and Private Operating Agencies for the completion of their own rules.

Question No. 14.

(Category A 1) [urgent] (new question)

Study of the corrosion of the lead sheaths of telecommunication cables in the presence of products for the impregnation of the coverings or armourings of these cables :

Note 1. — 1. Considering the controversy raised by this subject and the anomalies sometimes noticed, a systematic study of this question is necessary in order that particularly the problem of the corrosion of lead sheaths in the presence of phenol contained in the coverings or armourings of cables be elucidated in the greatest possible detail.

The C.M.I. has pointed out in this connection that the chromatographic method may possibly be useful in the separation of phenols.

2. In view of complexity of the problems, consideration should be given as to whether there is reason to extend the scope of the study to the examination of the various physico-chemical phenomena which may occur in this problem.

3. It should be examined whether it would not be useful to set up a detailed programme of laboratory or field tests, which could form a guide to Administrations and Private Operating Agencies desiring to go forward with tests on this question.

Note 2. — The study of this question will be pursued by the 2nd S.G. in cooperation with the Study Group No. 23 of the 2nd section of the C.M.I.

Question No. 15.

(Category B) [non urgent] (new question)

What measures can be recommended for the protection of telecommunication trunk cables (and possibly other neighbouring ducts) against electrolytic corrosion due to currents caused by remotely fed intermediate repeaters, when this remote feeding is made by means of D.C. transmitted over the conductors of the cable and with an earth return ?

Note 1. — For the study of this question, the following points in particular could be examined :

(a) Theoretical and practical studies concerning the remote feeding currents thus transmitted, on the value and the sign of the potential and on the value of the leakage current along the cable sheath, as a function of the construction of the sheath and the armouring of the cable, the soil conductivity and the distance between the cable and the earthing points at the two ends of the amplification section.

(b) Definition of the most effective practical provisions that can be recommended to ensure the protection of the cable (installation of an earth point at a positive potential at a suitable distance ; electrical drainage at the end of an amplification section where the earthing point is at a negative potential ; use of cathodic protection or protection by reactive anodes, etc...).

Note 2. — The study of this question will be pursued by the 2nd Study Group of the C.C.I.F. in cooperation with the Study Group No. 24 of the 2nd section of the C.M.I.

Question No. 16.

(Category B) [non urgent] (new question)

Protection of submarine coaxial pair cables and their overland extensions against corrosion.

Note. — For the study of this question, in particular, examination will be made of the following points :

(a) Methods which can be considered for terminations and interconnections :
- — of the outer conductor of the coaxial pair,
- — of the armouring of the cable,
- — of the various earth connections.

(b) Precautions to be taken in the event of the use of submarine repeaters fed from shore repeater stations.

Question No. 17.

(Category B) [non urgent] (new question)

(a) Problems concerning the corrosion of uncovered lead sheathed cables installed in the interior of buildings together with means for detecting the risk of corrosion.

(b) Methods that may possibly be advised for the correct installation of these cables and for the maintenance of the cables already laid.

Question No. 18.

(Category B) [non urgent] (new question)

Preventive measures that can be taken in the construction and the laying of telecommunication cables to protect them from damage caused by insects, rodents, etc.

Note. — In the study of this question the following points should be examined :

— origin of the faults (insects or animals which cause them).

— nature of the faults.

— particular conditions, such as the attack by insects coming from the drums on which the cables are wound, etc.

Question No. 19.

(Category B) [non urgent] (new question)

1. What methods for the impregnation of wood poles for telecommunication lines are successfully used in each country (methods of impregnation before erection and subsequent re-impregnation of poles already erected) ?

2. What tests can be made to establish that a pole is no longer in a satisfactory condition and how are these tests made in practice ?

SUMMARY

of the questions relating to corrosion which the 2nd Study Group is to undertake or continue to study during 1955/1956/1957

Question No.	SUBJECT	CATEGORY	STUDY GROUPS (other than the 2nd S.G.) or International Organizations interested *	OBSERVATIONS
1	Replacement of lead by plastic materials or other metals for the construction of cables	B	C.M.I., 2nd Section, Study Committee No. 25	Non-urgent (continuation of the former Question No. 1)
2	Cristalline disintegration	B		Non-urgent (continuation of the former Question No. 2)
3	Modifications to the " Recommendations for protection against corrosion (Paris 1949) "	A 1		Urgent (continuation of the former Question No. 3)
4	Protection of cables against lightning	B	C.M.I., 2nd Section, Study Committee No. 28	Urgent (continuation of the former Question No. 4)
5	Continuity of cable sheaths	B		Urgent (continuation of the former Question No. 5)

* The international organizations listed below will also be consulted regarding those questions of the 2nd Study Group which are likely to be of interest to them : The International Conference of Large Electrical Networks (C.I.G.R.E.) ; International Union of Producers and Distributors of Electric Power (U.N.I.P.E.D.E.) ; International Railway Union (I.R.U.) ; International Union of Public Transport Undertakings (U.I.T.) ; International Union of Gas Industries (U.I.G.).

Question No.	SUBJECT	CATEGORY	STUDY GROUPS (other than the 2nd S.G.) of International Organisations interested *	OBSERVATIONS
6	Influence of the method of laying ductlines on the magnitude of the stray currents	B	C.M.I., 2nd Section, Study Committee No. 22	Non-urgent (continuation of the former Question No. 6)
7	Modifications to the " Recommendations for protection against electrolytic corrosion (Florence, 1951) "	A 1		Non-urgent (continuation of the former Question No. 7)
8	Very high voltage direct current power distribution lines	A 1	C.M.I., 2nd Section, Study Committee No. 29	Non-urgent (continuation of the former Question No. 8)
9	Measurements to determine the condition of a traction network from the point of view of electrolytic corrosion	A 1	C.M.I., 2nd Section, Study Committee No. 22	Urgent (continuation of the former Question No. 9)
10	Unusual cases of corrosion	B	C.M.I., 2nd Section, Study Committees Nos. 21, 25 and 26.	Non-urgent (continuation of the former Question No. 3)
11	Plastic materials for the protection of lead sheaths	B	C.M.I., 2nd Section, Study Committee No. 25	Urgent (new question)
12	Special arrangements for cathodic protection in common to several networks of ductlines	A 1	1st Study Group, C.M.I., 1st Section, Study Commitee No. 12 — 2nd Section, Study Committee No. 26	Urgent (new question)
13	Protection against explosive and poisonous gases	B		Urgent (new question)
14	Influence of products used for impregnation on the corrosion of lead	A 1		Urgent (new question)
15	Corrosion due to currents for the remote feeding of repeaters	B		Non-urgent (new question)
16	Corrosion of coaxial submarine repeaters	B	C.M.I., 2nd Section, Study Committee No. 23	Non-urgent (new question)
17	Corrosion of cables within buildings	B	C.M.I., 2nd Section, Study Committee No. 24	Non-urgent (new question)
18	Damage caused by insects and/or rodents	B		Non-urgent (new question)
19	Wooden poles, impregnation and condition	B		Non-urgent (new question)

* See note preceding page.

LIST OF QUESTIONS

concerning general transmission problems, the general characteristics of long-distance telecommunications circuits and the specifications for the construction and provision of metallic telecommunication lines which the 3rd Study Group of the C.C.I.F. should undertake or continue the study of in 1955, 1956 and 1957

Question No. 1.

(Category A 1) [non urgent] (continuation of Question No. 1 studied in 1952/1954)

What limits should be recommended for the general characteristics given below for intercontinental circuits routed mainly in land cables with one or more short submarine sections where necessary and exceeding 2500 km in length ?

A. For variation of equivalent with frequency.

B. For variation of equivalent with time.

C. For non-linear distortion.

D. For internal noise of the transmission system irrespective of its origin.

Note. — For information see the following annex.

ANNEX

(to Question No. 1)

Proposals by various Administrations on the subject of limits to be recommended for the general characteristics of intercontinental circuits routed mainly in land cables

I. — Proposal by the French Administration

The French Telephone Administration thinks that the recommendations for planning purposes, based on the definition of the " Coaxial type nominal maximum circuit ", should be applicable to land circuits with one or more submarine sections.

II. — Proposal by the British Administration.

An effective band of 300 to 3400 c/s should be possible for intercontinental circuits on land lines with one or more short submarine sections, and no great difficulty should be encountered in reaching agreement on limits for the variation of equivalent with frequency and time, and for noise, it being understood that such circuits may be of great length and the reply therefore might have to be given in terms of a " nominal maximum circuit ".

It is considered unnecessary to specify the non-linearity of an intercontinental circuit.

III. — Proposals by the Administration of the Federal German Republic for circuits routed entirely on land.

A. *Variation of equivalent with frequency for an intercontinental circuit.*

In multi-channel carrier systems, attenuation distortion in the frequency band 300-3400 c/s is mainly determined by the channel filters. It is only in the case of very long circuits that the inevitable defects of equalisation at the intermediate repeater stations contribute appreciably to attenuation distortion on a channel. In such cases it is useful to arrange for the insertion of a special equaliser in the channel, so that the variation of the equivalent, as a function of the frequency, cnforms with the diagram given in the C.C.I.F. *Yellow Book*, Volume III *bis*, page 94.

In the case of very long circuits it can be expected that the curve (loss/frequency) will vary with time, in particular when the variation of cable attenuation with temperature (a variation which is not the same at all frequencies) is not entirely corrected by temperature equalisers at intermediate stations. It is not possible at present to say at what distance this influence becomes important for very long circuits. Nevertheless it can be expected that these variations with time could be corrected without difficulty during maintenance tests at several frequencies which should be made at suitable intervals.

The Federal German Administration proposes that the recommendations published in Volume III *bis* of the *Yellow Book*, page 94, should provisionally be applicable to intercontinental circuits, in particular, at first, to those up to 2500 km long. It will be useful if Administrations and private operating companies will study and indicate the way in which the curve of variation of equivalent with frequency varies with time in the case of very long circuits. The conditions for international and intercontinental circuits longer than 2500 km could then be fixed on this basis.

B. *Variation of equivalent with time for an intercontinental circuit.*

For the circuits considered here it may be supposed that a number of carrier circuits forming one or more basic 12 channels groups are required with a channel translation only at the ends. For this reason the use of a group reference pilot and an automatic level control for each group is assumed.

Experience to date obtained by the Federal German Administration on national circuits only, on carrier systems with manual regulation, shows that longer circuits (up to 2500 km) with a group pilot and automatic regulation, meet the requirements set up by the C.C.I.F. in the *Yellow Book*, Volume III *bis*, page 99, i.e. the variation of equivalent with time is $\pm$ 0.2 neper maximum. For circuits longer than 2500 km it is not yet possible to indicate the variations occurring in practice.

To be sure in every case of the stability of very long circuits, it appears useful to increase the equivalent and its tolerance a little and to accept provisionally the following recommendations.

TABLE 1

Equivalent and its variation with time in relation to the length of the circuit

Length (kilometers)	Equivalent (neper)
up to 2 500	0.8 ± 0.2
up to 5 000	0.9 ± 0.3
up to 10 000	1.0 ± 0.4

The application of such a measure would only slightly increase the total reference equivalent between subscribers. Nevertheless in view of the efforts being made in all countries to reduce the reference equivalents in national networks, a slight increase of equivalent in the exceptional cases of very long circuits appears to be justified.

C. *Non-linear distortion.*

Non-linear distortion for carrier circuits is mainly produced by the channel amplifiers. Distortion in modulators and line amplifiers can, on the other hand, be neglected. For this reason the C.C.I.F. recommendations in the *Yellow Book*, Volume III *bis*, page 104, can be extended without change to international and intercontinental circuits of any length.

D. *Internal noise of the system irrespective of its origin.*

For economic reasons it is necessary to use for intercontinental circuits the same cables, line amplifiers and translation equipment as are used for the international and national networks. Under these conditions the psophometric noise power (refered to a point of zero level) is necessarily a function of length.

$$P_{ps} = 10\,000 \times \frac{l\,.\,\text{km}}{2500\ \text{km}}\, pW.$$

Table 2 shows the values of psophometric power and voltage corresponding to various lengths of circuit.

TABLE 2

Psophometric power at a point of zero relative level, and psophometric voltage at the end of a circuit, as a function of the length of circuit

Length	Psophometric power pW in 600 ohms at a point of zero relative level	Psophometric voltage	
		mV	at relative level (see Table 1)
2 500	10 000	1.1	— 0.8 N
5 000	20 000	1.4	— 0.9 N
10 000	40 000	1.8	— 1.0 N

The psophometric voltages shown in table 2 cause, as given in the information published by the C.C.I.F., *Yellow Book*, Volume IV, page 133 et seq, a reduction in the quality of transmission of 0.15 to 0.3 nepers. This can still be accepted for circuits of these lengths.

In normal carrier systems, the low frequency channels have psophometric powers smaller than those at high frequencies. For this reason, it is desirable to choose if possible, telephone channels corresponding to the lowest frequencies for long international and intercontinental circuits. It can then be expected that the psophometric voltages would be less than those in table 2.

Question No. 2.

(3rd Study Group, in cooperation with the 1st and 5th S.G. and the C.C.I.R.) (Category A 1) [non urgent] (continuation of Question No. 2 studied in 1952/1954)

Considering that it is desirable that all intercontinental circuits should, in the future, transit effectively a band of frequencies from 300 to 3400 c/s, would it be possible to fix for these circuits an admissible limit for the psophometric voltage measured at the jack of the incoming switchboard ?

Note 1. — The noise existing on radio relay links using frequencies greater than about 30 Mc/s is considered in Questions No. 23 and No. 24 below.

Note 2. — Distinction should be made between three categories of international circuits :

1. Circuits entirely on land.

2. Circuits on land with one or more submarine sections :

   (a) case of a short submarine cable,

   (b) case of a long deep-sea submarine cable ;

3. Radiotelephone circuits :

   (a) radio telephone circuits using only U.H.F. links,

   (b) long wave and short wave radio telephone circuits.

As far as categories 1, 2 *(a)*, and 3 *(a)* are concerned, the present state of techniques is such as to justify the hope, that it will always be possible to satisfy the C.C.I.F. specifications in the future. (The case of a long intercontinental line on open wires should be specially considered—see especially question No. 38 below).

As far as category 2 *(b)* is concerned, if the design of submarine repeaters develops as expected, it would seem to be technically possible for the C.C.I.F. specifications to be met for each telephone channel of an intercontinental line, even though this should have a long submarine section. Economic considerations may in certain cases sometimes modify this conclusion.

As far as category 3 *(b)* is concerned (radiotelephone circuits on long or short waves) there are obviously uncontrollable factors, but the attention of the Administrations and/or private companies interested should be drawn to the importance of using the best equipment available.

Question No. 3.

(Corresponds to Question No. 111 of the C.C.I.R.) (3rd Study Group in cooperation with the 4th and 9th S.G.) (Category B) [urgent] (continuation of Question E bis *studied in 1952/1954).*

(a) Furnish to the C.C.I.R. as complete a description as possible, gathered by the C.C.I.F., relative to the statistical distribution of the values of speech volume transmitted by a subscriber when speaking, this volume being measured at the international trunk exchange (centre tête de ligne internationale).

(b) Furnish to the C.C.I.R. the mean and standard deviation of the variation of the equivalent of international circuits as a function of time.

Note. — The documentation already collected in 1953/1954 and forwarded to the C.C.I.R. includes :

(a) The annex below which concerns the statistical distribution of the values of speech volume transmitted by a subscriber when speaking.

(b) As regards the variation of the equivalent of circuits as a function of time, the report of the permanent maintenance sub-Committee concerning the slow variations of equivalent (Question No. 4 of the 3rd Study Group in 1952/1954) and on the short variations (Question No. 8 of the 3rd Study Group in 1952/1954) have been forwarded to the C.C.I.R. These questions will henceforth be studied by the 9th Study Group under the Nos. 1 and 3 respectively.

ANNEX

(to Question No. 3)

Results of measurements of speech power made in various countries at the input to trunk or international circuits

(Note by the C.C.I.F. Secretariat)

Reproduced herewith are various studies of the subscriber's speech power measured at the input of telephone circuits. The results that are summarised, correspond to a " normal " statistical distribution and can therefore be completely defined by the mean value and the standard deviation. We have summarised, in this form, in the following table the results relating to measurements of effective "volume" (with speech voltmeter having an integration period of the order of 200 ms) at the input to international or long distance national trunk circuits at a zero level point. In order to facilitate comparison, all the mean values have been expressed in the same terms. The term " volume unit " used in the U.S.A. has been used but this does not in any way modify the specification for the volume meters used in the C.C.I.F. Laboratory.

SUMMARY OF VOLUME MEASUREMENTS AT ZERO LEVEL POINTS

Reference in the text reproduced below	Date of measurements or of publication	Administration or author	Mean Value			Standard deviation db
			As indicated	Reference volume (power of calibrating sinewave at 1000 c/s)	Equivalent with reference to 1 mW in 600 ohms v.u.	
I	1934	British Administration	— 15 db	6 milliwatts in 600 ohms	— 7 db* *x*	7.8 *
II	1939	Holbrook & Dixon (Bell System Technical Journal)	— 16.0 db	6 milliwatts in 600 ohms	— 8 db**	5.8
I	1947	American Telephone and Telegraph Company	— 10 v.u.	1 milliwatt in 600 ohms	— 10 v.u.	6
III	1949	British Administration	— 20 db *	6 milliwatts in 600 ohms	— 12 db *x*	6.2
IV	1951	Langlois (Research Department of the French Administration)	— 12 v.u.	1 milliwatt in 600 ohms	— 12 v.u.	5.3
V	1950/1951	Subrizi (Bell Laboratories Record, août 1953)	— 15 v.u.	1 milliwatt in 600 ohms	— 15 v.u.	5.3

* This value has been calculated or determined graphically by the C.C.I.F. Secretariat ; the original figures were not quoted in this form.

** The v.u. meter gives for such a level of speech power an indication of about — 10 v.u.

x In these tests, the indications on the voltmeter have been read according to the method recommended by the C.C.I.F. (*Yellow Book*, Volume IV, page 183) ; the results are not therefore rigorously comparable with those which have been obtained with a v.u. meter used in the standard U.S.A. manner.

I. — *Results submitted to the C.C.I.F. in 1934 and 1947.*

(Extract from the *White Book* of the C.C.I.F., Volume IV, Budapest, 1934, page 267 and 268 with the corrections submitted in 1947 by the American Telephone and Telegraph Company, for the draft of Volume IV of the *Yellow Book.*)

Measurements of volume have been carried out on international telephone circuits at trunk switchboards in order to assess the mean statistical level of the subscriber at a zero level point of an international circuit.

The American Telephone and Telegraph Company has found that the mean value of this volume is equal to —10 " units of volume ", that is to say it is 10 db below the American reference volume, which corresponds (in measurements made by a volume indicator) to 1 mW in resistance of 600 ohms at 1000 c/s with a standard deviation of about 6 db *.

* It has been found by chance that this mean value of 10 u.v. below American reference volume (corresponding to a power of 1 mW at 1000 c/s in 600 ohms) is numerically equal to the mean value of 10 db (below reference volume as defined by the C.C.I.F. and corresponding to a power of 6 mW at 1000 c/s in 600 ohms) given on page 267 of Volume IV of the *White Book* of the C.C.I.F. In fact the transfer of this older value to the new value (— 10 v.u.) results in appropriate correction at the end of the newer measurements, to the statistical values given in the same period as that of reference volume.

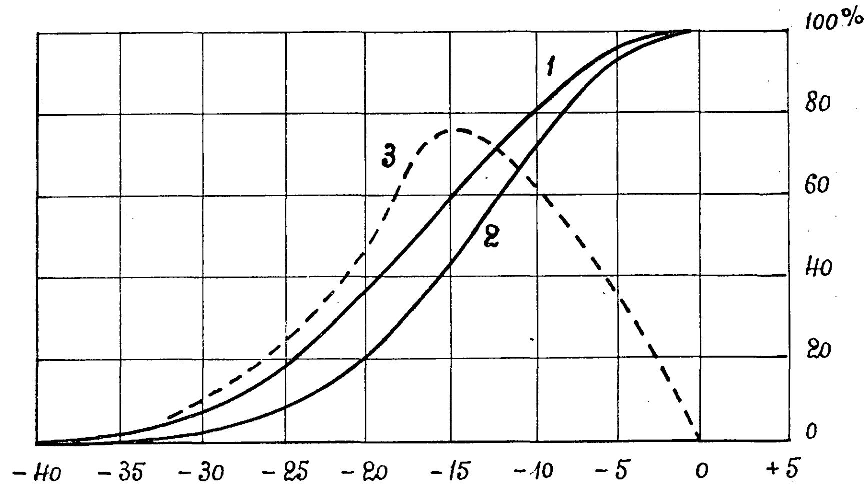
The British Administration has found in the course of tests on two-way conversations that :

1. In less than 10% of the conversations the volume is above −5 db relative to reference volume of the C.C.I.F. (see *Yellow Book* of the C.C.I.F., Volume IV, page 183).

2. The mean value for all conversations observed is below about 15 db relative to C.C.I.F. reference volume.

The above measurements were made in the United Kingdom with volume indicators having an integrating time of 200ms and in the U.S.A. with V.U. meters (see *Yellow Book* of the C.C.I.F., Volume IV, page 186).

On the other hand, the German Administration has connected to 4-wire circuits a peak level recorder with an integration period of about 2ms : this equipment measures the peak levels of the speaker, being connected automatically every second to the termination of the 4-wire circuit (that is to say to a point about — 1.2 nepers below the zero level point).



Volume, in db, relative to the calibrating power of 6 milliwatts 600 ohms pure resistance 1000 c/s

FIGURE 1. — *Speech volume, in the case of commercial circuits, at the zero relative level point of the international circuit*

Curves 1,2. — Percentage of calls during which the volume is lower than, or equal to, the value plotted as abscissa.

Curve 3 (Great Britain). — Relative frequency of repetitions.

The statistical values given above and found in the U.S.A., the United Kingdom and Germany at the end of a series of measurements on international circuits are probable values for peaks (Germany) or for the mean value (U.S.A. and United Kingdom), measured across the terminals of a 600 ohms resistance in the course of a commercial telephone conversation. The distribution curves (Figure 1) have been given at the end of the tests carried out in Germany and the United Kingdom; they give some indication of the maximum and minimum values as well as the mean values in commercial telephone speech.

II. — *Results published by B.D. Holbrook and J.T. Dixon in 1939.*

(*Bell System Technical Journal*, October 1939, pages 628 and 629.)

These results are given in Figure 2 : they are characterised by a mean value of — 16.0 db relative to C.C.I.F. reference volume and a standard deviation of 5.8 db.

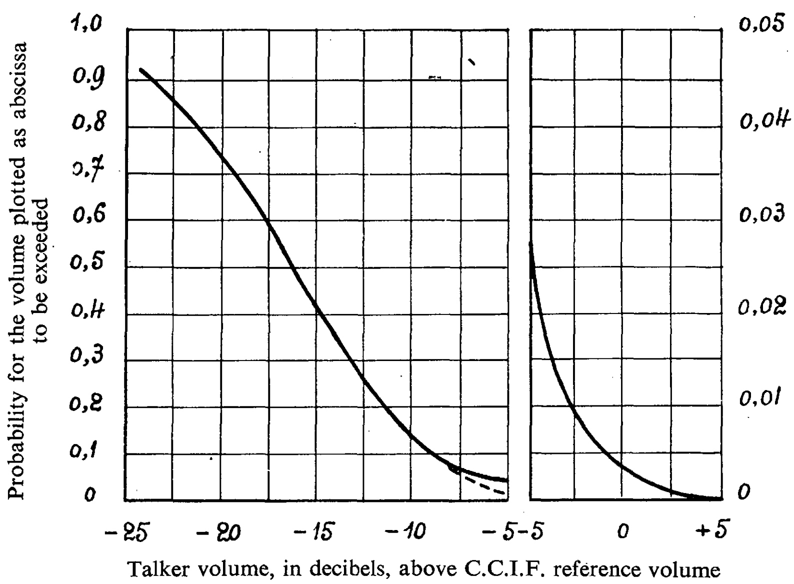


FIGURE 2. — *Talker volume distribution, at trunk switchboard*

(from Holbrook and Dixon, *Bell System Technical Journal*, October 1939)

III. — *Results of measurements made by the British Administration in 1949.*

(Extract from Document 46 presented to the VIth Plenary Assembly of the C.C.I.R., Geneva 1951, pages 9 and 12.)

It is possible to estimate the minimum speech volumes at an international switchboard from consideration of the reference equivalent of the national transmitting system, but such an estimate involves also a knowledge of the distribution of speech volumes at some other point in the national transmitting system, and it may involve an assessment of the way in which the attenuation corresponding to the reference equivalent is distributed in the various sections of the national system.

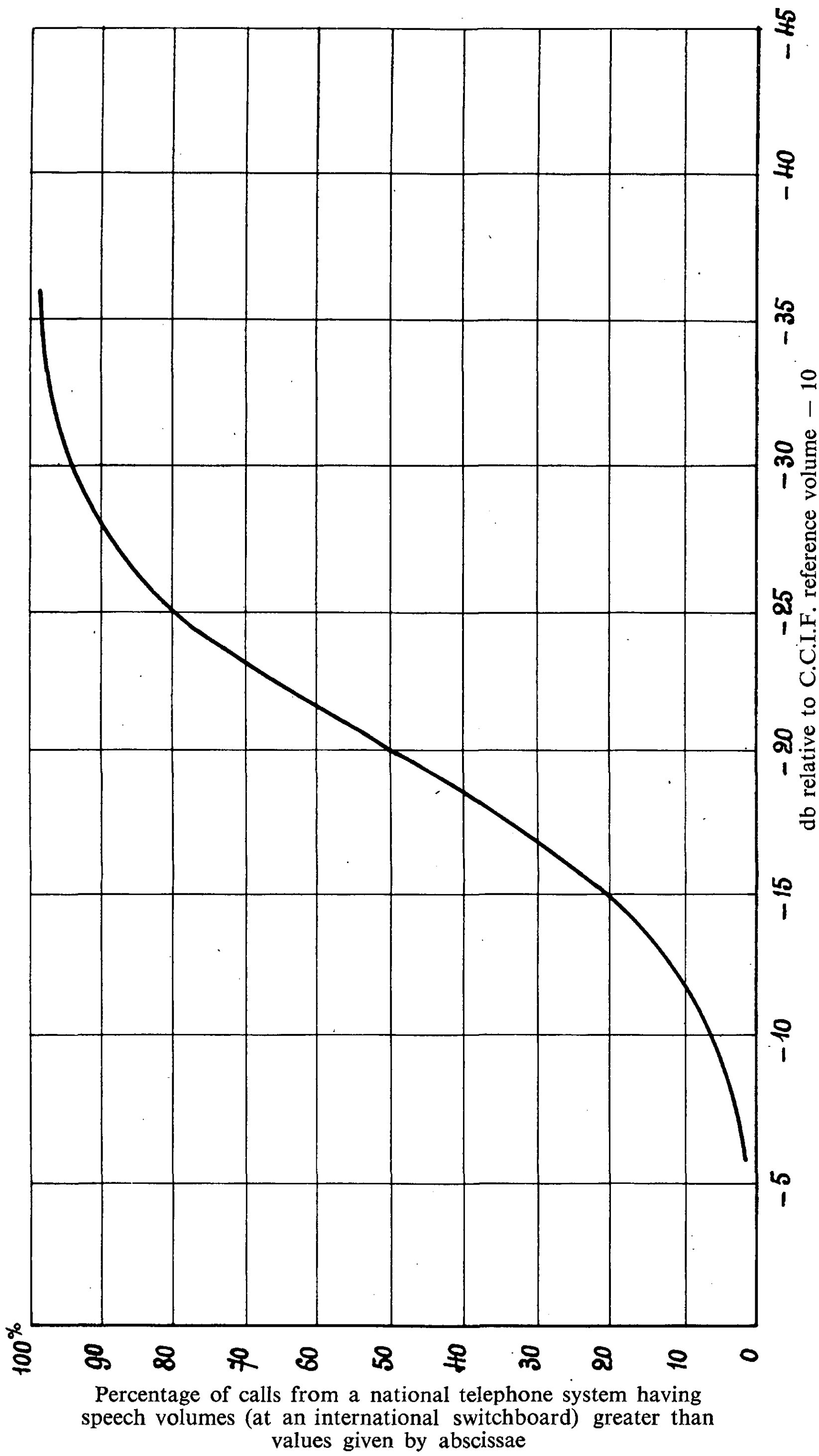


FIGURE 3. — *Results of tests carried out in London in 1949*

It appears, therefore, that the most satisfactory way of estimating the distribution of speech volumes in international and intercontinental circuits is by direct measurement of the volumes in a large number of calls. Such measurements have been made at the London International Exchange in 1934, 1939, 1945 and 1949. The distribution of speech volumes with numbers of calls has not changed very greatly in the period 1939 to 1949, and the 1949 distribution is shown in Figure 3 attached.

In the present reply to Question 29 of the C.C.I.R. and in the present annex the ratio " speech to noise " is expressed as a function of the readings of a volume indicator (C.C.I.F.).

IV. — *Study of the Statistical Distribution of Levels at the Input of French Inter-Urban Telephone Circuits by Mr. Langlois.*

(Extract from the Study No. 180 T issued by the Department of Research and Technical Development of the French Administration.)

Method of Measurement

In order to determine the statistical distribution it is necessary to measure the speech volume at instants whose distribution in time is not correlated to those of the speech under observation. To achieve this, measurements have been recorded by photography of the dial of speech indicators every 10 seconds or so throughout the effective duration of a local subscriber's call ; no measurement was made during the far-end replies or during interventions from operators.

The equipment used was a speech voltmeter complying with the specification of the " v.u. meter ". Measurements were made in the following localities : Lille, Halluin, Nancy, Wassy, Mulhouse, Dijon, Marseille, Perpignan, Toulouse, Bordeaux, Rennes.

Presentation of Results

(a) *Histogram.*

The distribution curve shown in Figure 4 describes the statistical distribution of speech volumes for each hour of effective speech.

As ordinates we have the mean of the number of observations corresponding to the volume within a bracket denoted by the two values shown as abscissae. The different brackets, for a uniform value of 2 v.u., are given, with the exception of the first level which corresponds to a number of measurements having speech volumes below – 24 v.u.; the sensitivity of the measuring equipment did not permit discrimination of volumes below this value.

(b) *Deduction.*

With the exception of speech volumes below –24 v.u., the application of classical statistical methods shows a satisfactory agreement between the observed distribution and distribution of Laplace-Gaussian type, having the characteristics of mean value, of $\nu = -12$, and standard distribution of $\sigma_\nu = 5.3$.

Speech volumes below –23 v.u. cannot always be neglected, for their proportion is about 6%. They can be considered however as corresponding to instants during which the talker under observation was not speaking.

According to this theory therefore, for 90% of the time that there are actual conversations, the observed distribution can be said to follow very closely the Laplace-Gaussian law.

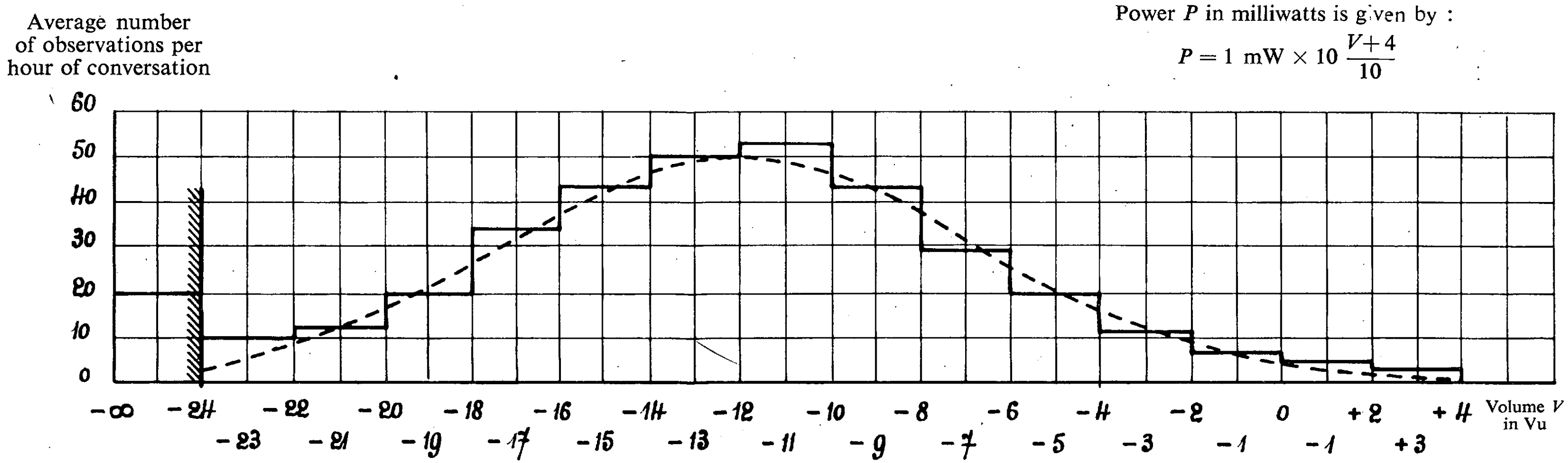


FIGURE 4. — *Statistical distribution of speech volumes measured at the input of French trunk telephone circuits*

V. — *Results of a Statistical Study made by the American Telephone and Telegraph Company in 1950 and 1951.*

(Extract from an Article by V. Subrizi, called "A Speech Volume Survey on Telephone Message Circuits", published in the August 1953 number of the *Bell Laboratories Record.*)

... Most of the telephone instruments in use at the time of the survey were the 302 anti-sidetone type commonly employed today. Measirements were made on near-end talkers using volume indicators which included standard v.u. meters.

The results of this survey indicate that present-day speech volumes are lower than those in the past. This was expected since the many improvements in the modern telephone system make it possible for the listener to hear clearly and distinctly when the talker uses a lower speaking volume than was possible in the past. On the average, this reduction amounts to about 3 decibels for each of the various types of connections. Some of this reduction is due to the finer gauge wire used in subscriber loops with the introduction of the 302 telephone set. The remainder is believed to be due to the subscriber who seems to have taken advantage of the improved transmission characteristics of the 302 set to reduce his talking effort.

Considerable information was obtained from the data gathered in the survey by plotting a series of graphs of the type shown in Figure 5. These are called cumulative distribution curves, and they all turned out to be straight lines when plotted on arithmetic probability paper, indicating that the original data occurred in the familiar " normal " distribution. In this type of graph, the abscissa represents the range of speech volumes measured and the ordinate represents the percentage of the volumes measured that equal or exceed that of the corresponding abscissa value. Average speech volume can be determined directly from these curves by noting the abscissa value that corresponds to the 50 percent point on the ordinate scale. Figure 5, for example, indicates an average value of -19 v.u. in this way. The slopes of these curves are related to the standard deviations in the data which are a measure of the range of speech volumes included in a given percentage of the measured values.

... The results of these tests are summarized in Figure 6 which indicates the average volumes for each area surveyed and an over-all average for each type of connection. As indicated, the over-all average is -19 v.u. for local connections, -17 v.u. for long tandem connections, and, -15 v.u. for long-distance circuits. Since the long distance measurements were made at the toll boards of the various localities, they include the effects of losses in the toll-connecting trunks as well as the subscriber loop.

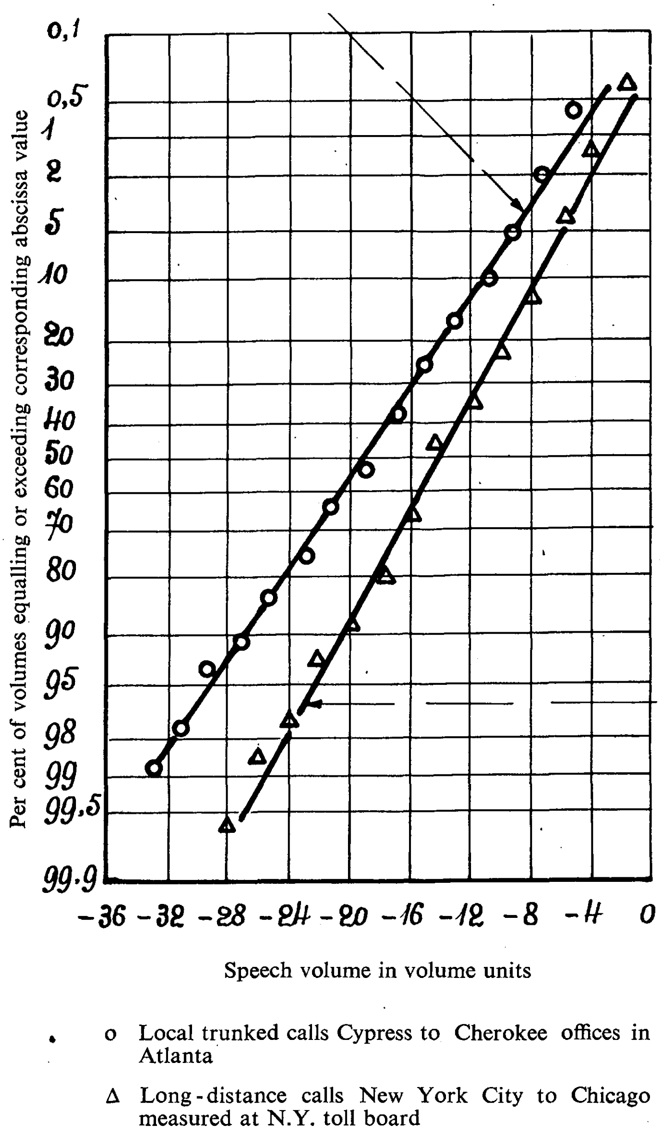


FIGURE 5. — *Typical cumulative distribution curves of speech volume data obtained by the American Telephone and Telegraph Company in 1950/1951*

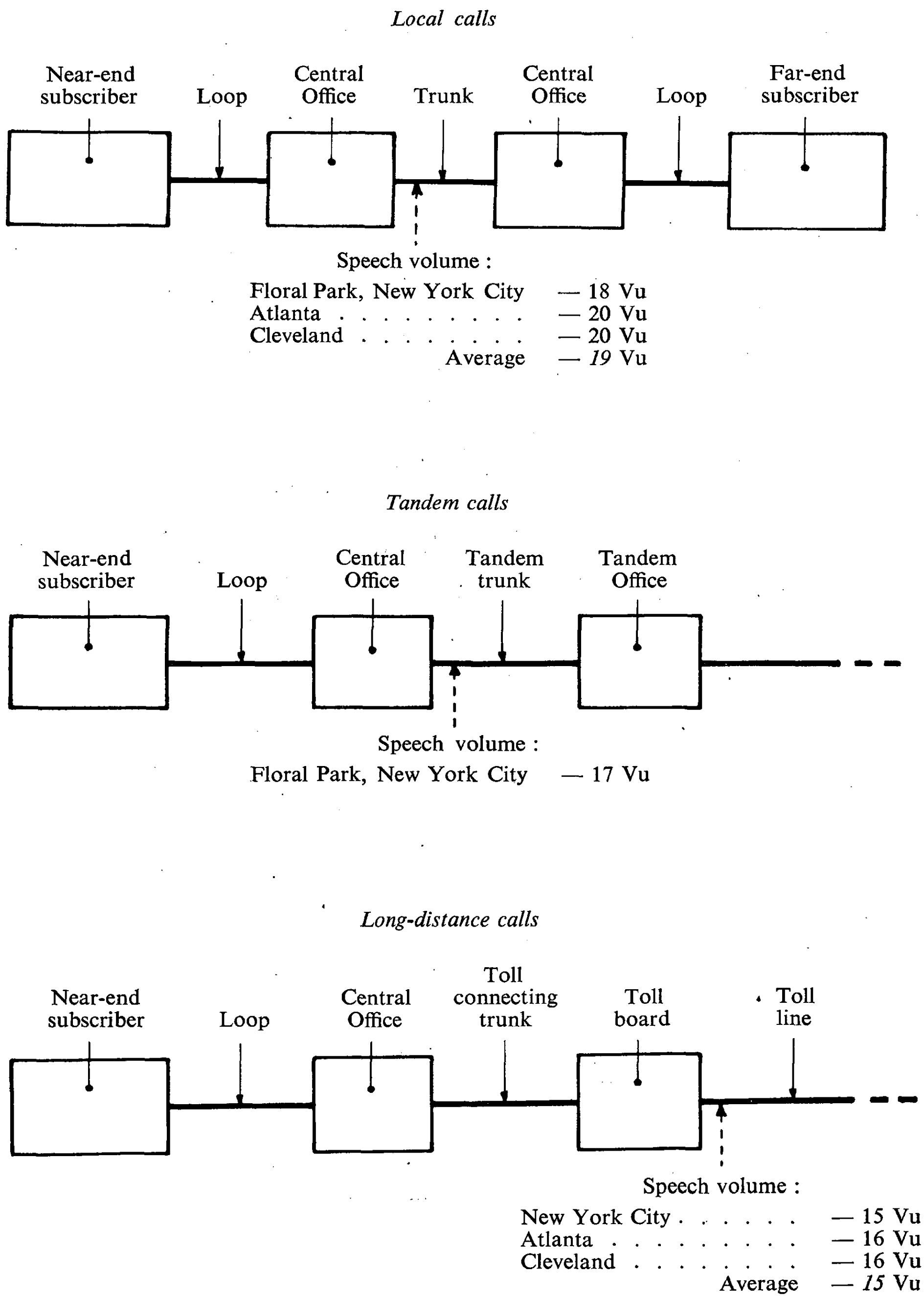


FIGURE 6. — *A summary of the speech volumes for each area surveyed with an over-all average for each type of connection*

... For example, with a particular type of telephone connection, the average subscriber talks in such a way that the acoustic pressure reaching the diaphragm of his transmitter is the same whether he is a native of New York, Atlanta, or Cleveland. An increase in line noise, however, would cause him to raise this volume level several db to override the additional noise. Increasing the length of the connection would again cause him to increase his acoustic volume. In this case, the increase over the local call average will amount to about 2 db on longer tandem connections and 1 db on average long-distance connections. Moreover, some reaction prompts the average subscriber to raise his talking volume about 1½ db for every 1,000 air mile increase in the length of his call. He may do this through habit or in an attempt to reduce repetitions.

This survey has also shown that the average speech volume used by the typical male subscriber is 1 to 2 db higher than that employed by the average female.

VI. — *Observations of the Cuban Telephone Company.*

A number of studies have been made on transmitting-end calling volume ; the data available does not yield a specific answer to this question because the studies were not made on international calls and do not relate to modern types of telephone instrument.

It may be of interest, however, to draw attention to some points which have been observed under practical conditions and about which comparatively little has been published.

For example, Fig. 5 below shows that the spread of volume levels is rather less for international calls than for national calls. This is rather similar to indications obtained by the Cuban Telephone Company that the spread is less on long local loops than on short loops, and is explainable in this case by the greater care to talk close when conditions are more difficult, as on long loops, than when communication is easy as on short loops. This explanation is supported by the considerable skewness of the distribution on short loops and the tendency towards a symmetrical normal distribution on long loops. In the case of international calls the greater importance and cost of the calls is likely to encourage similarly greater care in close talking.

The standard deviation of the distribution of calling volumes appears to diminish with lowered side tone, other factors being constant ; the reduction of standard deviation is partly due to reduction of skewness as side tone falls.

Another detail of interest that has been observed is the variation of calling volume through a conversation, when the duration of the call is sufficient to give such data. Observations on local calls have indicated an average increase in calling level during the first 1½ to 2 minutes of duration and subsequently a lowering of calling level ; the initial increase in level has been observed as averaging 1 to 3 db under different circuit conditions.

Indications have been obtained that overall circuit loss, and side tone have an influence on the average duration of local calls.

The tentative conclusions that have been indicated are in need of further study for verification.

Question No. 4.

(3rd and 8th Study Groups in cooperation: Question No. 8 of the 8th S.G.) (category A 1) [non-urgent]

Is it necessary to take special precautions, in particular at an international terminal centre, such that, when a call in the semi-automatic service has been set up, but the called subscriber has not answered, there will be no risk of singing on the international circuit, and if so, what conditions should be laid down?

Note. — Annex 1 below describes the provisional solution adopted on the field trial network for international semi-automatic telephone operation. Annex 2 describes in detail the arrangements made from the transmission point of view at the international terminal exchange of Amsterdam; the Annex No. 2 to Question No. 8 of the 8th Study Group gives, in addition, circuit arrangements adopted in other centres of the field trials network to achieve the neccessary switching facilities.

ANNEX 1

(to Question No. 4)

Provisional solution adopted on the field trial network for international semi-automatic telephone operation

(Extract from the "General specification for the field trial networks for International semi-automatic operation", Document "C.C.I.F. — 1952/1954 — C.E.A. Document No. 12", 1st part, § 15.)

Steps should be taken to reduce the risk of singing during the period between the moment when the speech path is established at the outgoing international tête de ligne exchange and the moment when the called subscriber answers. This result can be obtained in principle by one of the following methods:

(a) The insertion of an attenuator in each path on the 4-wire side of the connection.

(b) The insertion of an attenuator in the 2-wire side of the connection.

(c) The connection in parallel of a terminating impedance on the 2-wire side of the connection.

It is recommended that, whatever method is adopted, it should always be effected at the incoming end of the international circuit but that each Administration will be free to adopt the arrangement which it considers as the most convenient.

Taking into consideration the experience acquired with manual circuits, it is considered that initially and for circuits set up to an equivalent of 0.8 nepers (7 db) it will be sufficient if arrangements are made to increase the stability of the circuits by 0.4 nepers (3.5 db).

ANNEX 2

(to Question No. 4)

Arrangements made by the Dutch Administration at Amsterdam to avoid the the risk of oscillation on internation circuits

The prescribed equivalent for international circuits measured between the 2-wire ends of the terminations is 7 db.

In the Netherlands the connection between an international circuit and the national network is made on a 4-wire basis. The termination of the circuit in question is then situated in the national network and not in the international circuits.

On the 2-wire side of this termination there will always be an attenuation of 3.5 db inserted between the termination and the required subscriber. This attenuation if it is not presented by a loaded cable, will be inserted automatically.

If an international circuit is connected to the national network, the diversion of attenuation is such that the equivalent recommended internationally is produced by the attenuation of 3.5 db always present in the national network (in other words the international circuit is terminated on the subscribers' side by an attenuation of 3.5 db in the national network).

Meanwhile until the attenuation of 3.5 db of the national network has been introduced in the extension of the international circuit towards the national subscriber a supplementary attenuation of 3.5 db is inserted in each of the channels of the 4-wire side of the connection in the Netherlands international terminal exchange thus ensuring the value recommended internationally for the stability of the communication.

In the Netherlands national network all the outgoing national circuits from the international exchange (acting as the incoming international centre) are carrier circuits with 4 or 6 kc/s frequency spacing.

The single propagation time of such circuits is about 1.5 and 1.0 milliseconds respectively. These circuits are worked with an equivalent of 0 db measures between the 2-wire ends.

The constitution of the national network is such that at most two 4-wire circuits are connected following the international circuit. From the trunk exchange it will not be possible to connect in series two carrier circuits with 4 kc/s frequency spacing but only two carrier circuits with 6 kc/s spacing or one circuit with 4 kc/s spacing on another circuit with 6 kc/s spacing.

In the 4-wire national network the echo time is at most 5 milliseconds (2×1.5 2×1 milliseconds).

Furthermore non-amplified loaded (consequently 2-wire) circuits are used in the national network with an attenuation of 3 to 4 db having a propagation time of about 2 milliseconds or about 0.5 milliseconds according to the type (two types are used).

Between the 2-wire circuits with propagation time of 2 milliseconds and the trunk exchange there may be at most one 4-wire circuit whilst between those having a propagation time of 0.5 milliseconds and the said centre there may be at the most two 4-wire circuits. However following one 2-wire circuit with a propagation time of 2 milliseconds there may be only one 2-wire circuit with a propagation time of 0.5 milliseconds.

Consequently one might expect in the Netherlands national network a maximum echo time of 8 milliseconds (2×1.5 milliseconds (circuits 4-wire/4 kc) $+ 2 \times 2$ milliseconds $+ 2 \times 0.5$ milliseconds (circuits 2-wire loaded)). By applying the measures described in *(b)* and *(c)* of annex 1 above after the termination an echo attenuation of at least 12 db is attained in the Netherlands network. This is as much the case before as during the conversation and afterwards.

Question No. 5.

(Category A 1) [only part (a) *of this question is urgent] (3rd Study Group in co-operation with the 1st, 4th and 8th S.G. and with the C.M.I.) (continuation of Question No. 5 studied in 1952/1954)*

(a) Determination of a curve of general application giving the transmission impairment due to circuit noise as a function of the readings of the C.C.I.F. standard psophometer connected across the end of the chain of international and trunk circuits.

(b) What means should be recommended for reducing the different types of circuit noise, other than induced noise, to such values that they no longer produce any appreciable impairment of the quality of telephone transmission ?

Note concerning parts (a) *and* (b). — It is understood that in order to fix the admissible limits of psophometric voltage (part *(a)* of Question No. 5) account must be taken of all circuit noises : induced noise, telegraph noise, clicks, crosstalk, etc.

Only after having considered all the useful steps taken on lines and telephone installations to reduce as much as possible noise other than induced noise (part *(b)* of Question No. 5), will it be possible to determine definitely what proportion of this induced noise may be attributed to electrical power lines (part *(c)* of Question No. 5).

In particular, attention will have to be given to reducing as much as possible, repeater noise (valve noise or noise due to battery supplies), by revising, if necessary, the clauses relating to noise in the recommendations and specifications of the C.C.I.F. concerning repeaters. Generally speaking, care will be taken to coordinate the various recommendations laid down in the instructions of the C.C.I.F. relating to admissible circuit noise in the different systems of transmission (ordinary telephony, carrier telephony, radio telephony etc.).

(c) What is the value of the psophometric voltage produced by power lines which can be considered as admissible at the terminal group centre serving a subscriber ?

Note concerning part (c). — In studying this question, it should not be overlooked that the national transmitting and receiving systems generally have more sections on open wire than do international circuits, and in consequence are more likely to have a higher level of induced noise.

As regards the international circuit, a distinction will be made between the case of an international call over a direct circuit and the case of an international transit call ; in this latter case the maximum admitted value for the psophometric voltage will be shared between the various international circuits interconnected.

Notes concerning Question No. 5 as a whole. — Part *(a)* of this question should first be considered by the 4th study group; part *(b)* should then be studied by the 3rd Study group with representatives of the 4th and 8th Study groups ; finally part *(c)* will be studied by the 3rd Study group with representatives of the 1st Study group.

2. The above considerations assume that the new psophometer recommended by the XVIth Plenary Assembly for commercial telephone circuits will measure all types of circuit noise (permanent or transitory) ; this point is now being studied by the 4th Study Group).

3. The annex below deals with noise inherent in telephone systems and its reproduction for laboratory tests.

ANNEX

(to Question No. 5)

Noise inherent in a telephone system

The types of noise concerned are as follows ; repeater noise (caused by amplifying valves) ; intelligible crosstalk, unintelligible crosstalk, " babble " (crosstalk from many sources simultaneously), transitory noise (caused by transitory phenomena), switching noise or " frying " (due for exemple to bad contacts on lines or in automatic switches or due to faulty line insulation), battery noise (produced by the exchange battery which supplies the microphone current or by power supplies to repeater valves), clicks (noises caused for example by rapid discharge of condensers or by rapid switching), telegraph noise (noise on the telephone circuit caused by telegraph circuits using the same wires or other wires on the same route).

For laboratory tests, it is convenient to use recordings of all these noises simultaneously and which may be obtained by mixing electrically, recordings made on different types of telephone circuits in use which are not exposed to induction from power lines or traction systems. Such recordings could be :

(a) on a telephone circuit exposed to telegraph induction ;

(b) on a telephone circuit with " babble " ;

(c) on a long distance telephone circuit, disturbed by automatic switching ;

(d) on telephone lines connected to local exchanges in order to obtain the effects of switching, " frying ", etc...

When mixing electrically the different recordings, a weighting should be applied to each, based on the probability of occurrence under service conditions. The mixture thus obtained will be recorded, either on a gramophone record, or on a tape which should run for at least one minute (20 metres of Philips-Miller film or about 37 metres of ordinary sound film). The reproducing system could be either an ordinary turn-table with a light weight pick-up and automatic return, or a device suitable for playing back, if possible continuously, a long film.

Question No. 6.

(3rd Study Group of the C.C.I.F. in co-operation with the C.C.I.T.) (Category A 1) [urgent]

The C.C.I.T. is considering recommending, in the more or less distant future, the use of double-current voice-frequency telegraph systems with frequency modulation. The C.C.I.F. has therefore to consider the possible repercussions of using such systems on telephone channels.

Consequently, the following points should be studied :

(a) What should be : (1) the recommended sending level for the telegraph signals ; (2) the characteristics to be recommended for telephone channels used for double-current frequency-modulated voice-frequency telegraphy ?

(b) In particular, would the use of such systems enable a relaxation to be made in the limits for variation of equivalent, noises (' white ', noise, clicks, etc.) and short interruptions on the circuits ?

Note. — The C.C.I.T. has put to study the characteristics of these systems and it will be asked to communicate to the C.C.I.F. those characteristics which have been judged to be the most favourable.

Question No. 7.

(3rd Study Group in co-operation with S.G. IV of the C.C.I.T.) (Category A 2) [urgent] (continuation of Questions No. 12 and 12 bis *studied in 1952/1954)*

Coordination and possible revision of the provisions of the recommendation of the C.C.I.F. concerning phototelegraphy transmissions and the recommendations No. D 2, D 3 and D 4 of the C.C.I.T. to cover simultaneously :

(a) the case of audio circuits and the case of carrier circuits,

(b) the case of transmissions with amplitude modulation and the case of transmissions with frequency modulation.

Note 1. — The present recommendations make no distinction between audio or carrier circuit for phototelegraphy.

Note 2. — In the recommendation D 1 of the C.C.I.T. a different values are fixed for the co-operation index and for the speed of rotation of the drum of the phototelegraphy apparatus. The limits recommended by the C.C.I.F. for transient phenomena (*Yellow Book*, Volume III *bis*, page 166) should be correlated with the co-operation index and the corresponding speed of rotation of the drum, and also with the type of modulation employed (amplitude or frequency modulation) as regards the carrier frequency and the speed of transmission.

Note 3. — As regards the influence of noise, tests should be carried out to see if the difference of 4 nepers or 35 db between the absolute level of the phototelegraph signals and the absolute level of the disturbing currents, indicated in the *Yellow Book* of the C.C.I.F., volume III *bis*, page 167 is sufficient.

1. For phototelegraphy transmissions with frequency modulation.
2. For phototelegraphy transmissions with amplitude modulation.

Note 4. — The results of this joint study, carried out in co-operation by the C.C.I.F. and the C.C.I.T. will be communicated to the C.C.I.T./C.C.I.R. Committee since this Committee studies the case of phototelegraphy over a circuit consisting of a section of line and a radio link.

Question No. 8.

(3rd Study Group in co-operation with the C.C.I.R., I.B.O., and E.B.U.) (Category A 2) [urgent] (new question)

(a) What methods should be recommended for the measurement of near-end of far-end crosstalk ratios between two circuits for broadcast programme transmissions, or between a broadcast programme circuit and a telephone circuit?

(b) What limits should be recommended for these ratios ?

The two types of circuit (old type circuits and normal type circuits) will be examined as separate cases.

Question No. 8bis.

(3rd Study Group) (Category A 2) [urgent] (new question)

Is it necessary to modify the values of the crosstalk ratio at present in specification A 111 for a repeater section of loaded cable (*Yellow Book*, Volume III *bis* page 232) ?

In the affirmative, what should be the new limits taking into account that these limits should correlate with those which will be fixed for telephone circuits in reply to the supplementary question below and for program circuits in the reply to Question 8 above.

Question No. 9.

(3rd Study Group in co-operation with the 4th and 1st S.G. and with the C.C.I.R., I.B.O. and E.B.U.) (Category A 1) [non-urgent] (continuation of Question No. 15 studied in 1952/1954)

Administrations are asked to carry out tests, in co-operation with the Broadcasting Organisations of their own countries, with the object of verifying whether the modifications to the weighting network of the psophometer for broadcast programme circuits and the relative tolerances as proposed in Annex 1 below can be recommended. These tests should be carried out in accordance with Annex 2 below.

Remark. — Unless there are very good reasons it is not desirable to change this curve. It is understood that until tests have shown the need for such a change the curve now recommended should be retained.

ANNEX 1
(to Question No. 9)

Proposals for the modification of the curve of the weighting network of the psophometer for international music circuits

(Note from the Telephone Administration of the Federal German Republic.)

1. *Introduction. Modifications proposed.*

1.1 The results of tests made by the boardcast authority " Nordwestdeutscher Rundfunk " are given below. To facilitate the consideration of the problem the results are given as they were obtained during the tests. For this reason the characteristic curves of the psophometer weighting network obtained with the disturbing tones and test programs are only shown with their relative slopes and are not referred to 1000 c/s (= calculation factor : 1). The curve given in Figure 3 for a "silent period between transmissions" in a room having a noise of 30 phones agrees relatively well with the characteristic curve of the weighting network of the psophometer used for measurements on circuits for music transmissions (published in 1949). The difference at the low frequencies is without doubt due to the influence of the audibility characteristics of the observers. The difference at the high frequencies are also just within the major part of subjective dispersal. (Also as shown in Figure 12 the characteristic curve of the weighting network of the psophometer which was published in 1949 is from 10 kc/s to the limit below the zone of dispersion of the tests made here.) The object of these tests was not to determine the signal-to-noise ratio necessary for program circuits.

1.2 From the results of these tests it would appear necessary to modify the provisional curve for the weighting network of the psophometer to be used on international music circuits in such a way that the frequencies between 6 and 12 kc/s receive a greater weighting than with the curve of the weighting network of the 1949 psophometer (see § 3.6 and § 4 and also figures 10 and 11 below). Nevertheless before modifying in the manner indicated the provisional curve of the psophometer weighting network and considering that the curve has already been modified a number of times it is recommended that the proposed new curve should be examined in the light of new tests.

An investigation should also be made if the indication of the R.M.S. values recommended by the C.C.I.F. gives a reading which properly corresponds to the true impression of the subjective disturbances. The observations made up to the present have indicated that it is necessary to rate impulsive noise higher than continuous noise. For this reason the psophometer used by the Federal German Republic for measurements on music circuits is arranged to indicate the peaks of impulses with a time constant of some milliseconds (< 10 m.s.). The tests have proved that the indications of impulsive noise given by this equipment correspond better to the subjective impression of disturbance than an indication reading the R.M.S. values. The dynamic properties of this equipment are so chosen that impulses of 20 milliseconds duration are indicated as 80% of their value if permanent. The equipment, therefore, on this point, fulfils the recommendation published in the *Yellow Book*. (see Vol. IV under 4.1.7).

1.3 In the *Yellow Book* the attenuation of the weighting network above 60 c/s and below 10 kc/s is not fixed. In order to avoid falsifying the reading by extraneous voltages outside the band of frequencies 60 to 10,000 c/s the Posts and Telecommunications Administration of the Federal German Republic propose to add the following to the recommendations concerning the weighting network.

At 20 c/s and below and also at 15,000 c/s and above, the attenuation relative to 1000 c/s should be at least 4.6 nepers (40 db). The attenuation should rise in a straight line between 60 and 20 c/s and between 10,000 and 15,000 c/s.

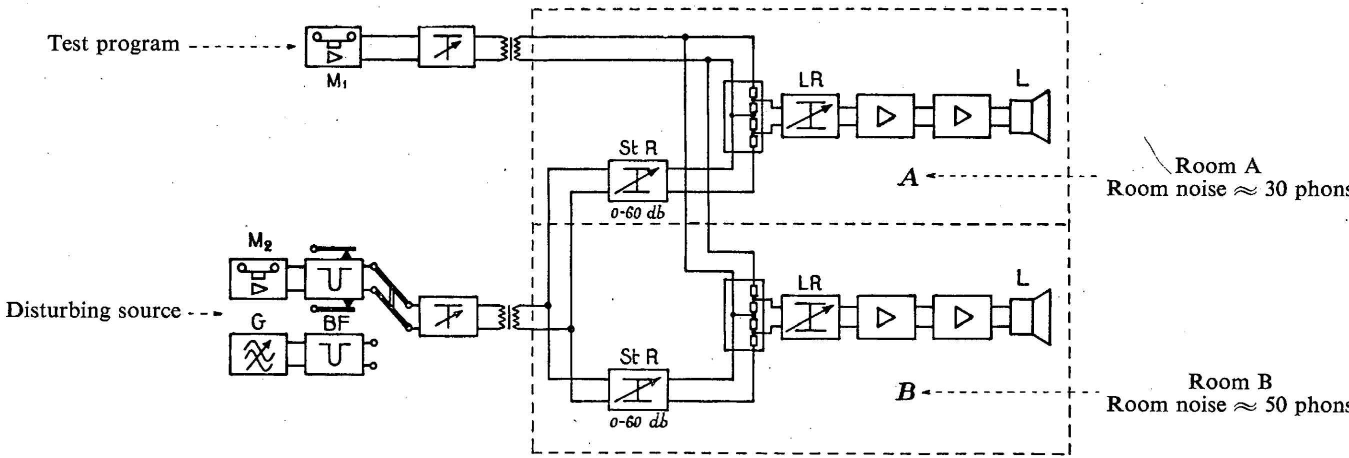
1.4 Volume IV page 193 of the *Yellow Book* gives no indication of the tolerances allowed for the weighting network. The Posts and Telecommunications Administration of the Federal German Republic proposes the following tolerances :

60 c/s to 100 c/s	± 3.0 decibels
100 c/s to 1,000 c/s	± 1.5 decibels
1,000 c/s	± 0.2 decibels
1,000 c/s to 8,000 c/s	± 1.5 decibels
8,000 c/s to 10,000 c/s	± 3.0 decibels

Note. — When considering the results of the tests mentioned in § 1 it should be considered if, for the frequency band 8,000 to 10,000 c/s, a smaller tolerance is possible or if it should only be + 3 db.

2. *Conditions of test.*

The tests were carried out in accordance with " The conditions for tests to determine the characteristics to be adopted for the psophometer for music transmissions " published in the *Yellow Book*. Vol. 1 *ter* (Annex 2 to Question No. 15 page 291) and brought up to date in Annex 2 below. The measurements taken to this effect are described in § 2.1 to 2.7 below in the order of § 3 to 9 of Annex 2 below. Fig. 1 shows the arrangement of the tests.



M_1 = Tape Recorder (test program)
M_2 = Tape Recorder (Thermal noise and sinusoidal tones 0.05 to 12.5 kc/s)
G = Generator (amplitude modulated sounds 3.5 to 16 kc/s)
BF = Band Pass filter
StR = Regulator for adjusting the disturbing noise
LR = Regulator for adjusting the listening volume
L = Loudspeaker system (test loudspeaker of high quality with spherical radiator for high frequencies)

FIGURE 1. — *Arrangement of tests*

2.1 " The observations should be made during the silent intervals of a radio program or during the times when the signal is very small ".

The observations have been made when no program was transmitted and with musical passages of low amplitude. Subjects were chosen having the smallest dynamic range possible in order to keep the difference between observers due to variation of acoustic intensity of the modulation small.

2.2 " Normal radio programs or special records of equivalent quality (recordings of music, speech etc.) should be used. All the reproductions should be as free from background noise as possible."

The programs used had a low amplitude (piano, organ, and musical instruments of high tone quality) and were amplified about 15 db, recorded on high quality magnetic tape and attenuated by 15 db on reproduction. By this means the background noise of the tapes was practically not perceptible.

2.3 " Each observer should adjust to his wish the volume of sound from the loudspeaker. The values thus fixed for the sound volume should be given. The operators should adjust this volume to the level they normally listen to radio programs."

The observers were allowed to adjust the sound volume to their wishes by means of a potentiometer LR (see Fig. 1). With a low-level program of small dynamic range there is a risk that observers who are not aware of this condition will adjust the sound level too high.

For this reason the test modulation was preceded by a short passage of the same piece of music with a large dynamic ratio during which the observers adjusted to normal the sound volume. The low-level program which followed was then fixed relative to the level they normally hear.

2.4 " The sound reproducing systems should be free from distortion throughout the frequency band and at all amplitudes used in the tests " Since there was in each case a ratio of at least 5 db between the test modulation and total modulation the non-linear distortions produced by the recorder did not exceed the threshold of audibility. For the reproduction a high-quality loudspeaker was used with a spherical radiator for high frequencies *.

The attenuation distortion of the loudspeaker and the audition room was corrected electrically. The remaining distortion was measured by means of thermal agitation noise used in the tests (bandwidth : one third ; frequency band from 50 c/s to 12.5 kc/s) and by amplitude modulated sinusoidal tones for the high frequencies (frequency band 3.5 to 16 kc/s) in such a way as to take into account the whole test equipment. Since the attenuation distortion was subject to close variations (around $\pm$ 3 db) the position of the microphones and the observer were interchanged and an average of 6 measurements taken. The results obtained by this means (see Figure 2) were used to correct the characteristic curves of the psophometer weighting network.

2.5 " The disturbing noise should be composed of a small band of frequencies (for example, sinusoidal currents periodically interrupted, frequency bands extracted from thermal agitation noise etc.). Narrow bands of frequencies should be used of average values 50, 100, 200, 400, 800, 1600, 3200, 6400, 8000 c/s.

Other types of noise may be used but they should be capable of being accurately described."

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* See Dr. H. HARZ and Dr. H. KOSTERS : " Ein neuer Gesichtspunkt für die Entwicklung von Lautsprechern ", *Technische Hausmitteilungen des Nordwestdeutschen Rundfunks*, No. 12/1951, pages 205 to 208 and Dr. H. HARZ and Dr. H. KOSTERS : " Kugelstrahler als Lautsprecher für Musikwiedergabe ". *Radio Mentor*, No. 7/1952, pages 320 and onwards.

In the tests the disturbing frequencies described above were used and also the frequency of 22.5 kc/s. The disturbing noise (thermal agitation *, and sinusoidal sounds periodically interrupted at a frequency of 2 c/s) were recorded on magnetic tape at a level of — 12 db (relative to 0 db = 100% modulation). Thus the non-linear distortion and the tape noise was held below the limit of perceptibility. The disturbing noise of 50 c/s was also reproduced by means of a band filter (width of band: one third) since small components at high frequencies may otherwise have been audible and would have affected the result. Since the sensitivity to the high frequencies is greater than was assumed up to this stage a second series of tests was made with frequencies 3.5, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16 kc/s. In these limits the measurements were made with amplitude modulated tones (wobble frequency 6.25 c/s frequency deviation 100 c/s) because at the high frequencies the bands of thermal noise are too large for a good measurement of the impairment and because with pure sinusoidal tones the frequency characteristic is locally subject to too large a variation.

The amplitude modulated tones were applied via band pass filters of bandwidth one third in order to suppress undesirable sounds (arising from the signal generator) which might appear in the band of frequencies at a higher level than the disturbing source.

The observers were able to adjust the disturbing noises by a regulator StR (see Figure 1) to a value they thought tolerable. The observers were not able to see the amount of attenuation so as not to influence the result.

Preliminary tests have shown that 15 seconds was sufficient time for the adjustment of the level of the disturbing noise. If longer, the concentration of the observers was affected.

2.6 " The level of room noise should correspond to conditions normally encountered in rooms when listening to radio programs : it should have a value in the region of 30 to 50 phons for a quiet or noisy room respectively."

The observations were made in two rooms, one having a normal level of room noise of around 30 phons and the other a higher level of room noise of average 43 phons.

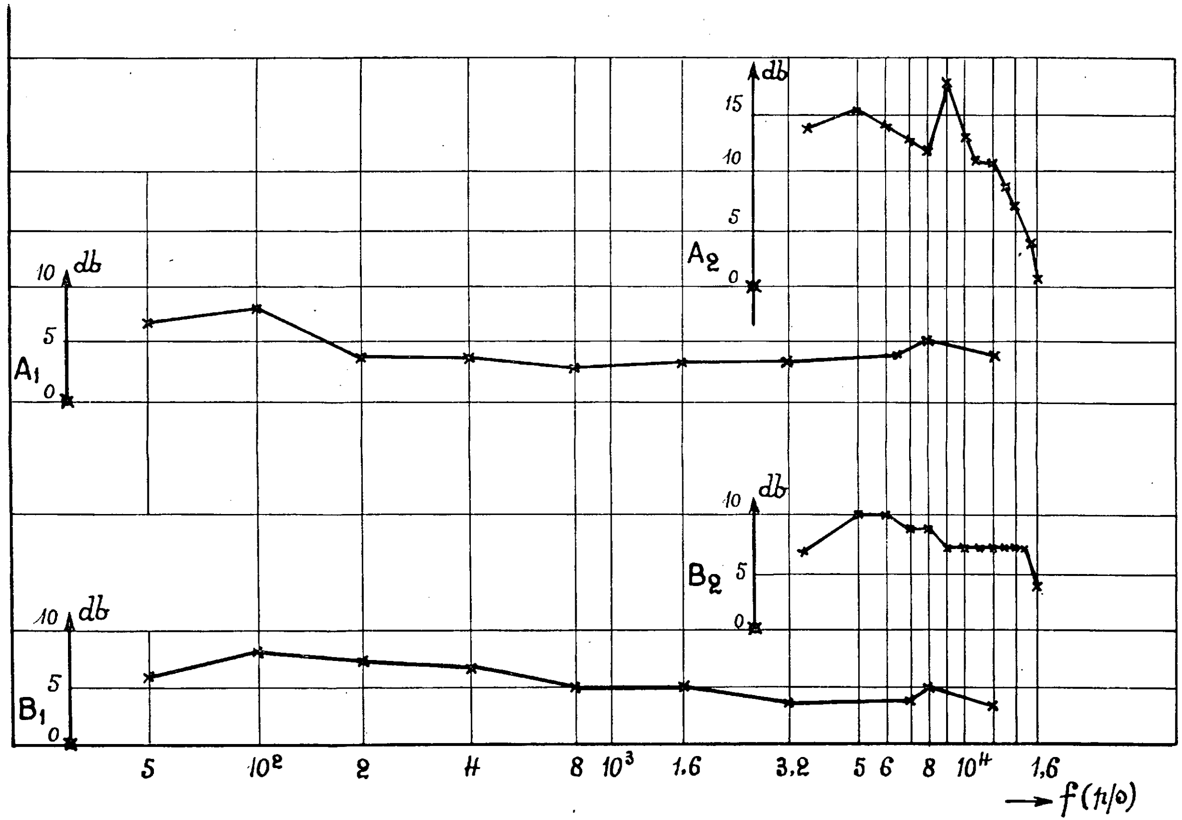
The level of room noise of 50 phons was obtained by means of a second loudspeaker, which was installed at a different angle to the principal loudspeaker and which reproduced street noise with heavy traffic (recorded on magnetic tape). The high frequency band was attenuated electrically corresponding to a reduction in sound with the windows closed.

2.7 " For these measurements about ten observers should be employed of average age (20 to 30 years). People with defective hearing should be excluded. Musical experts only should not be chosen but also amateurs."

The observations were made by 20 people, men and women, 20 to 30 years of age; non musical experts were amongst those chosen. Their audibility curves were first verified by means of an audiometer and those with defective hearing were eliminated. For the high frequencies an audiometer was improvised by a resistance generator and a dynamic receiver. The frequencies used later in the tests (see § 2.5) were used to verify the ear sensitivities.

2.8 *Various.* — It has been stated in the preliminary tests that the observers may not have confidence in what they heard but that they could be considerably influenced by extraneous factors. For example they had a tendency to turn the regulator StR to a position which did not differ much from the preceding setting. The observers were not able to read the amount of attenuation inserted but they were able to judge the angle turned through and tended at the next frequency to adjust to a similar position. This tended to give equal acoustic

* Bandwidth : one third.



A1 Quiet room (30 phons) measured with thermal agitation noise
A2 Quiet room (30 phons) measured with amplitude modulated tones
B1 Noisy room (50 phons) measured with thermal agitation noise
B2 Noisy room (50 phons) measured with amplitude modulated noise

FIGURE 2. — *Acoustic pressure-frequency characteristic at the listening point (average of 6 positions adjacent to the measuring microphone)*

pressure at all frequencies and a flattening of the curve. It was, therefore, necessary to make a preliminary approximate adjustment of the attenuation as known from the existing curve and from preliminary tests and only required the observers to correct these values.

Furthermore it was found that the observers had more tolerance with regard to the first disturbing sounds of an audition than to the disturbing sounds which followed. The same sound occurring at the commencement of an audition could be given about 3 db less attenuation than later in the audition. In order to determine the error the disturbing noises were not always reproduced in the same order.

3. *Results.*

3.1 The results of the tests are reproduced in Figures 3 to 12. In these the ordinates represent the arithmetic mean of the amount of attenuation as adjusted by 20 observers (the curves include a correction to eliminate the frequency characteristics of the testing equipment as chosen in Figure 2).

The scale in decibels refers to the testing apparatus. It should only be read as a relative value and does not represent for example the ratio relative to the level used or to the modulation limit.

3.2 Figure 3 shows the characteristic curve of the psophometer weighting network for thermal agitation noise * and for various forms of signals in a quiet room (30 phons). It will be appreciated that the sensitivity is greater in a silent interval, it is not much less with piano music due to the intervals between different sounds. With organ music, on the contrary, it is much worse and with stringed instruments it is also worse since they both partially mask the disturbing source due to their notes following one another without interval. This effect is particularly noticeable at the middle frequencies which generally contains most of the tones used and in the adjacent higher frequencies. The disturbing effect of the highest and lowest frequencies is not seriously influenced by the program source.

Figure 4 shows for the same test program and disturbing noise the effect of a high room noise (50 phons). The room noise influences in the same way as the disturbing tones, particularly in the absence of disturbing tones or in the case of a " transparent " disturbing source and is much worse than with organ music and stringed instruments which already produce a strong masking effect.

3.3 Figure 5 differs from Figure 3 by the type of disturbing source. This is also the difference between Figure 6 and 4. The effect, known from previous tests and due to the fact that the ear is more sensitive to sinusoidal sounds than to thermal agitation noise is confirmed.

3.4 Figure 7 represents the general average of Figures 3 to 6 for the difference disturbing sources used and for the room noises of 30 to 50 phons.

3.5 The upper frequency band measured with the test program but with an amplitude modulated tone ** as disturbing source is represented in Figure 8 (room noise : 50 phons) and Figure 9 (room noise : 30 phons). Here also the masking effect of room noise is always less as one proceeds to the maximum frequencies.

3.6 In Figure 10 are assembled the curves of Figure 7 (0.05 to 3.2 kc/s) and the average of Figures 8 and 9 (3.5 to 16 kc/s). They have been placed on the ' y ' axis relative to each other so as to be as coincident as possible in the range 3.5 to 12.5 kc/s.

In Figure 10 the characteristic curve of the psophometer weighting network used for measurements on program circuits published by the C.C.I.F. in 1949 (see the *Yellow Book*, Volume IV page 192) is drawn in such a way so as to agree with the other curves. A comparison with the curves obtained in the tests gives satisfactory agreement in the low and mean frequency bands whilst according to the tests the frequencies about 6 kc/s should receive

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* Bandwidth : one third.
** See paragraph 2.5.

a much greater weighting than in the C.C.I.F. curve. For this band of frequencies the shape of the curve would be approximately that indicated by the dotted line. The difference between the two curves might, therefore, be explained as follows :— The old tests (which have served as the basis for the C.C.I.F. curve in 1949) were made by observers having another audibility curve also the transmission quality of the testing apparatus (particularly the loudspeaker systems) might perhaps have been different.

The shape of the curve for the mean and lower frequencies may perhaps be represented with a good approximation by a line with a slope of 6 db per octave.

From the results of the tests the curve represented by the C.C.I.F. in 1949 corresponds in this frequency band to the conditions existing in the silent intervals in a quiet room *, whilst the line shows the effects in the rooms with average noise for music susceptible to disturbance (piano).

3.7 So as to be able to judge the increase in weighting at the higher frequencies, which were represented in the test by thermal agitation noise (white noise) the square of the voltage subjective effect has been plotted as a function of frequency (both linear). The new curve has given a surface which is approximately double, i.e. a noise power greater than 3 db.

3.8 To check the accuracy of the values obtained in the tests the normal error calculations have been used it being understood that one does not mean an " error " in the ordinary sense of the word. The values have been obtained as follows :—

Measurement	Average error (in decibels) in the band of frequencies		
	Lower	Middle	Upper
Single measurements	5.3	6.8	8.0
Average of curves 3 to 6	1.3	1.6	2.2
General average from Figure 10 . . .	0.7	0.8	1.1

Figure 12 shows very approximately the dispersion in the example " piano music " in a quiet room (room noise : 30 phons) with thermal agitation noise of a bandwidth of one third or with amplitude modulated sound.

The sound pressure of the test program having a small amplitude as adjusted by the observers was on the average 54 phons with a standard deviation of 2.4 phons in the quiet room (room noise 30 phons) and 63 phons with a standard deviation of 3 phons in the noisy room (room noise 50 phons).

4. *Conclusions.*

According to the characteristic curve of the psophometer weighting network used for the tests (see Figure 10) the frequency of 10 kc/s should receive a greater weighting of 10 db than that recommended by the C.C.I.F. in 1949. Furthermore the new curve takes into account the frequency band between 10 and 16 kc/s which is not the case with the curve published by the C.C.I.F. in the *Yellow Book*, Volume IV, page 192. If for the frequency band below 3.2 kc/s the shape of the present curve is preserved, the psophometric weighting at 12 kc/s (at 8.5 kc/s in the 1949 curve) is the same as at 1000 c/s. This increased weighting gives twice the power where wideband thermal agitation noise is measured (an increase of 3 db).

The Posts and Telecommunications Administration of the Federal German Republic propose that the results of the tests should form a basis for an examination of the new curve proposed for the psophometer weighting network.

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* The hypothesis (see " Remark " to the Question No. 15) that the 1949 curve did not take into account the disturbing effect during the silent intervals is not, therefore, confirmed by the tests.

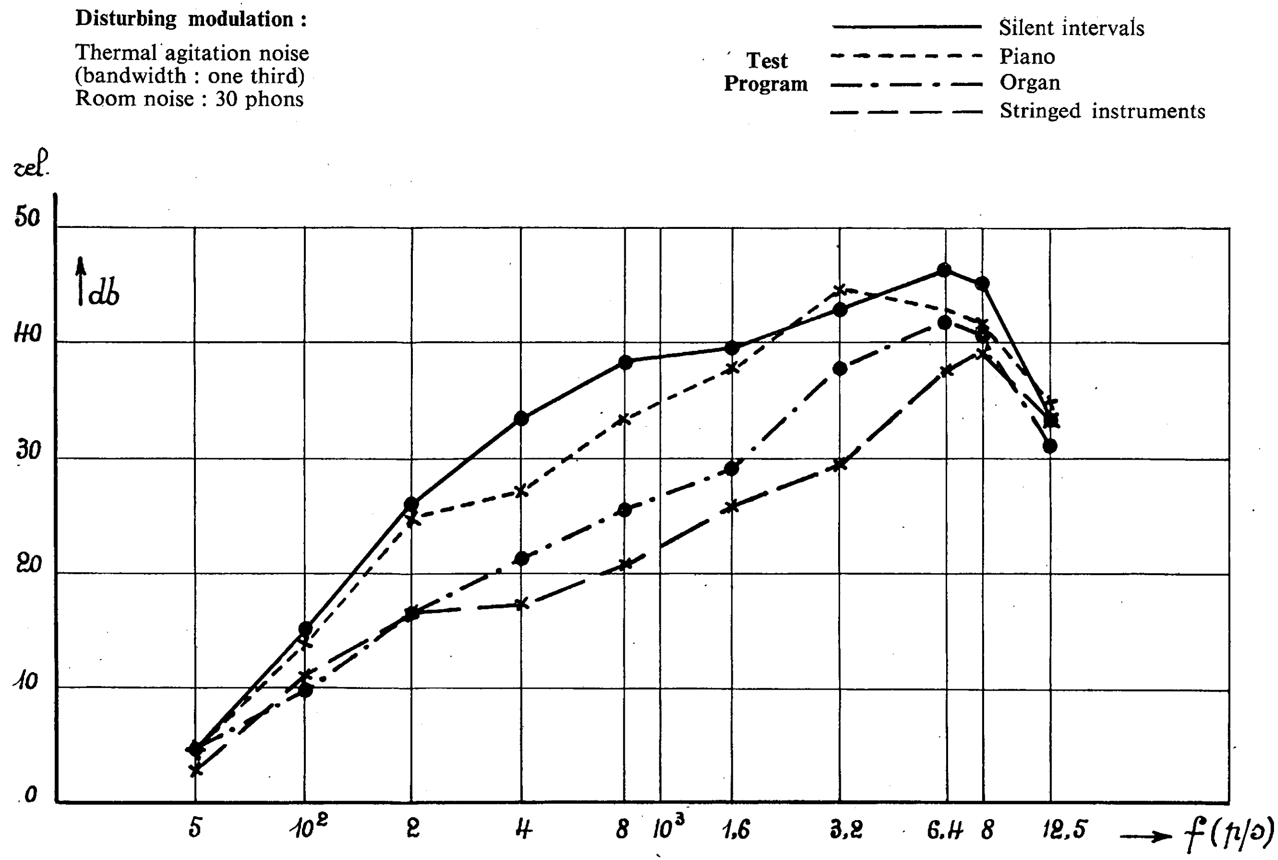


FIGURE 3. — *Characteristic curves pertaining to the psophometer weighting network used for the tests*

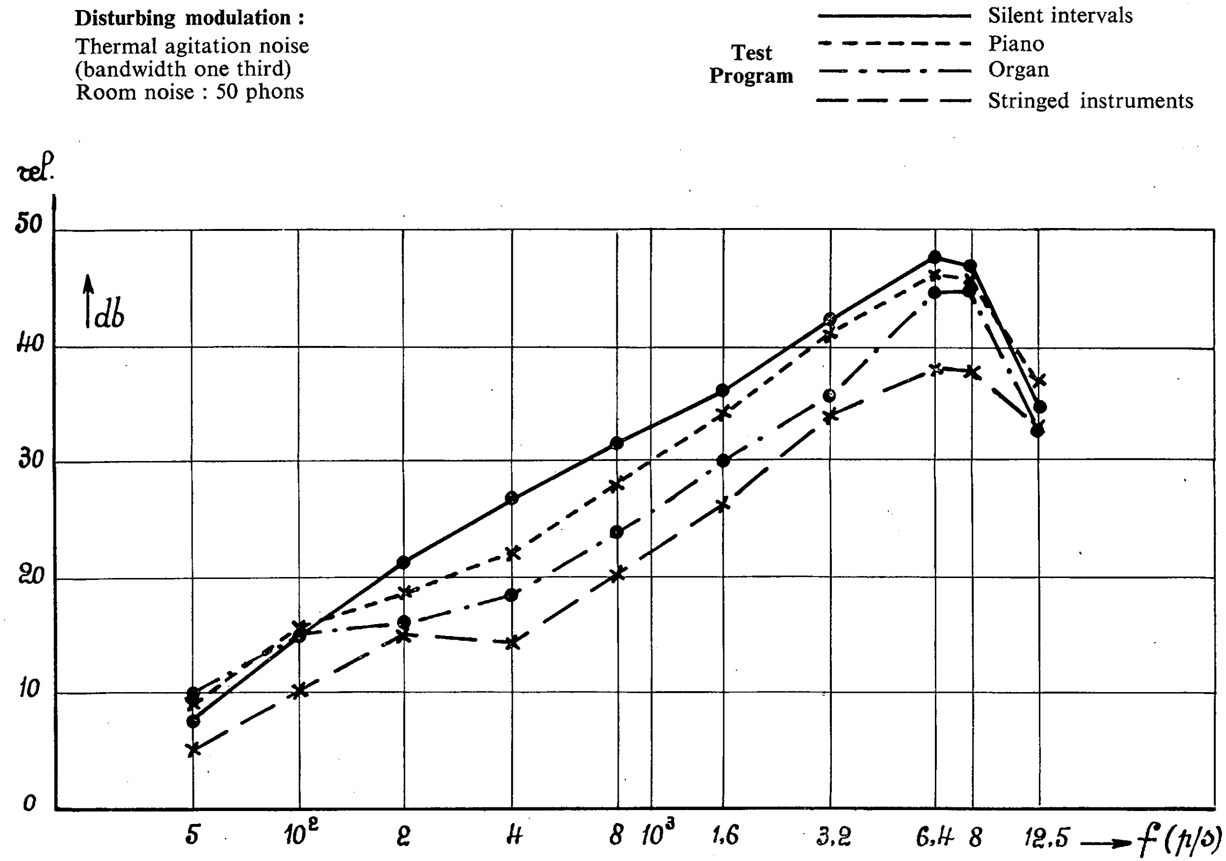


FIGURE 4. — *Characteristic curves pertaining to the psophometer weighting network used for the tests*

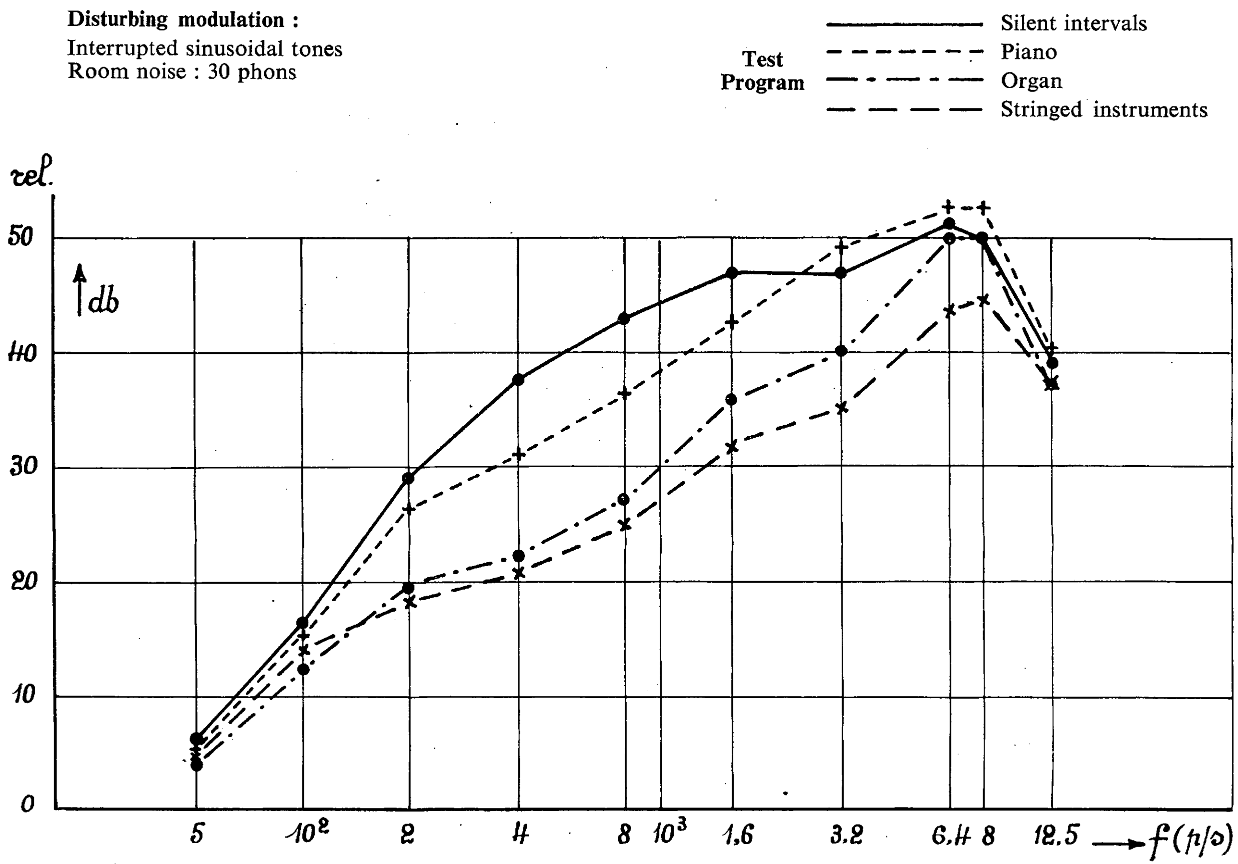


FIGURE 5. — *Characteristic curves pertaining to the psophometer weighting network used for the tests*

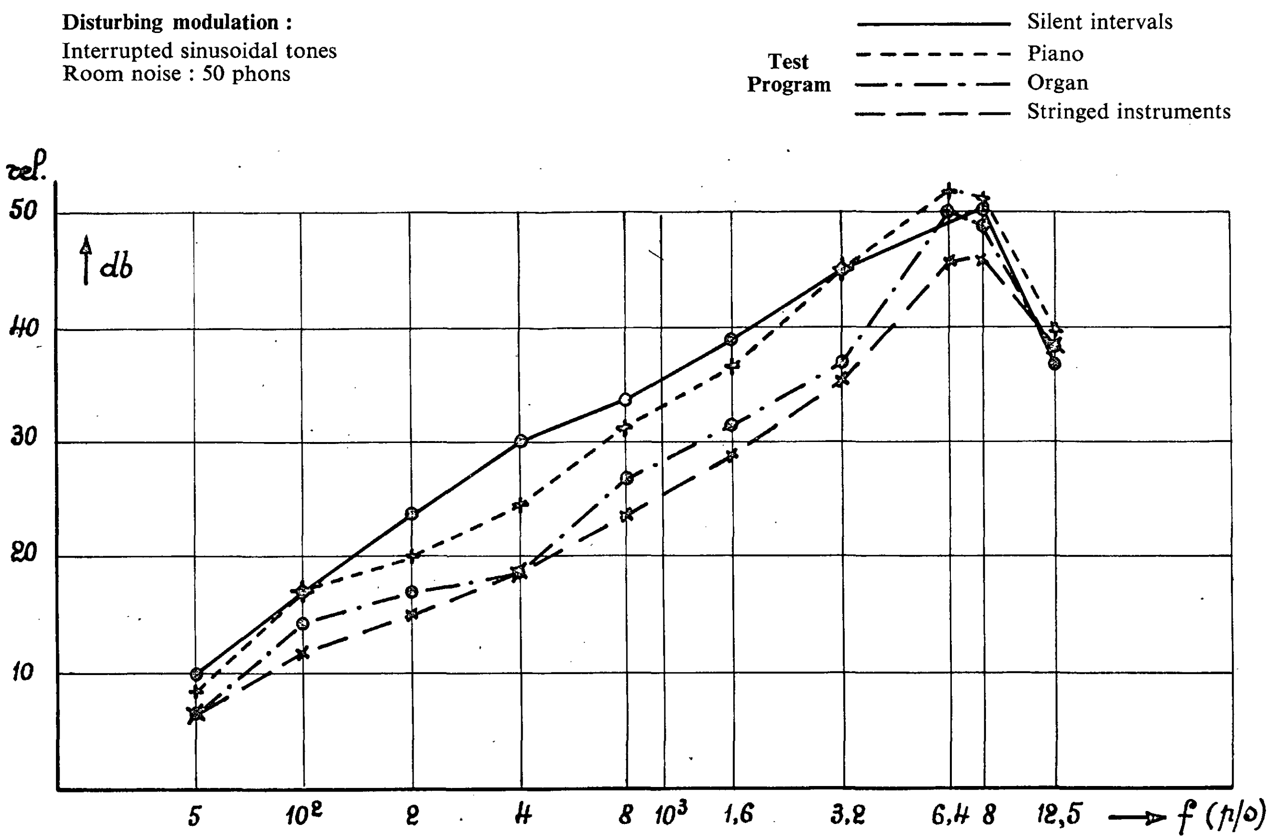


FIGURE 6. — *Characteristic curves pertaining to the psophometer weighting network used for the tests*

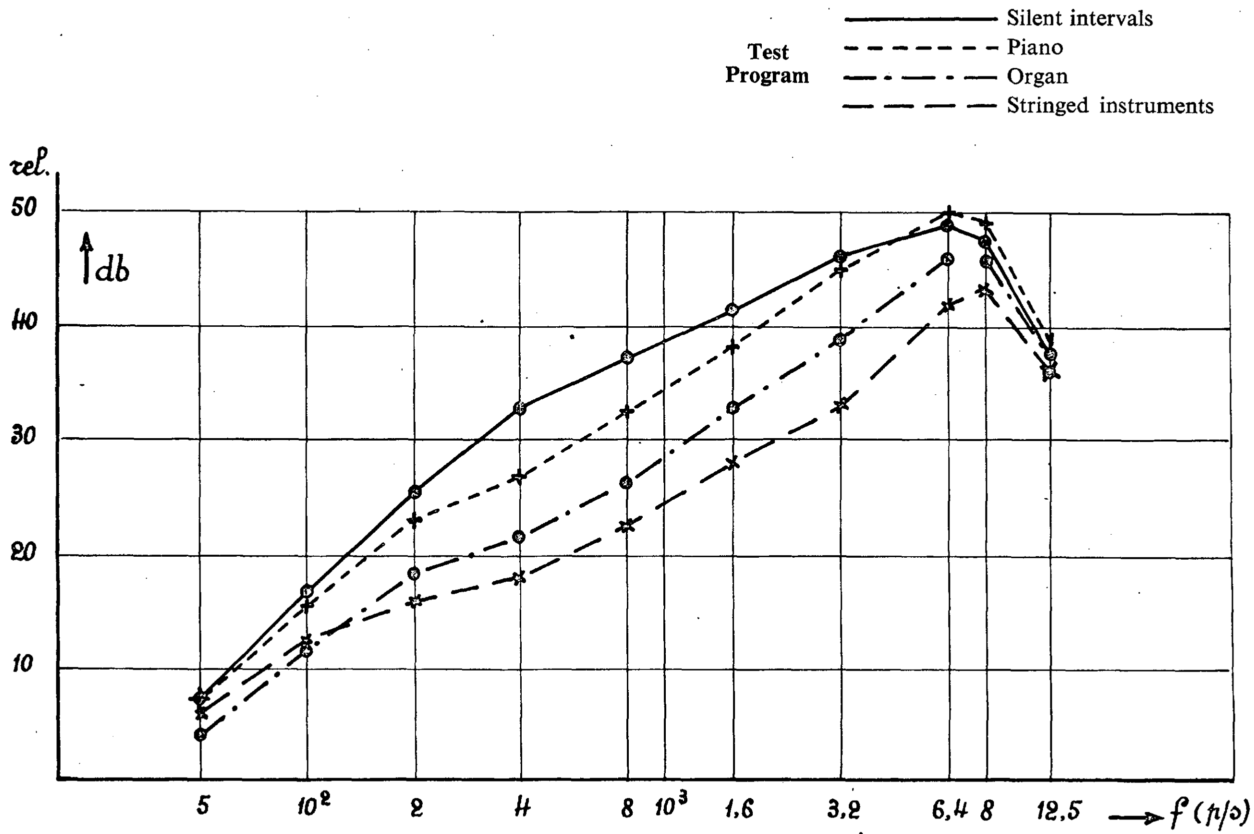


FIGURE 7. — *Curves of average values taken from characteristic curves pertaining to the psophometer weighting network for thermal agitation noise and interrupted sinusoidal tones for room noise 30 and 50 phons*

Characteristic curves pertaining to the psophometer weighting network used for the tests with amplitude modulated tones

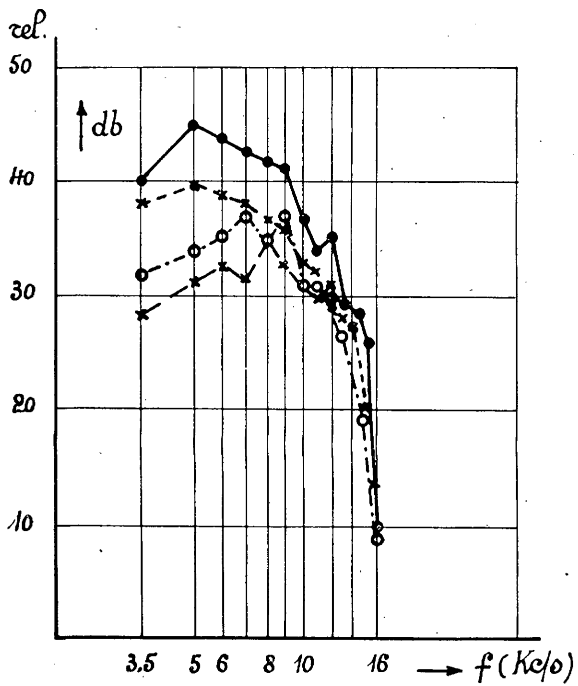


Figure 8. — *Room noise: 50 phons*

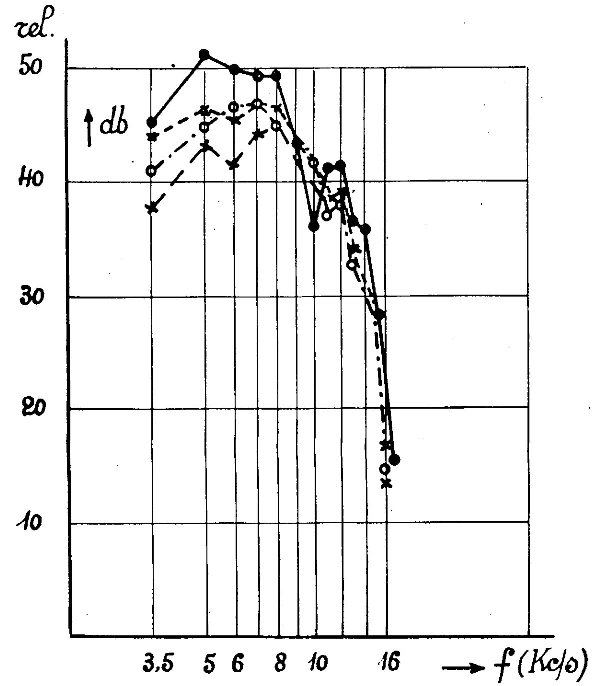
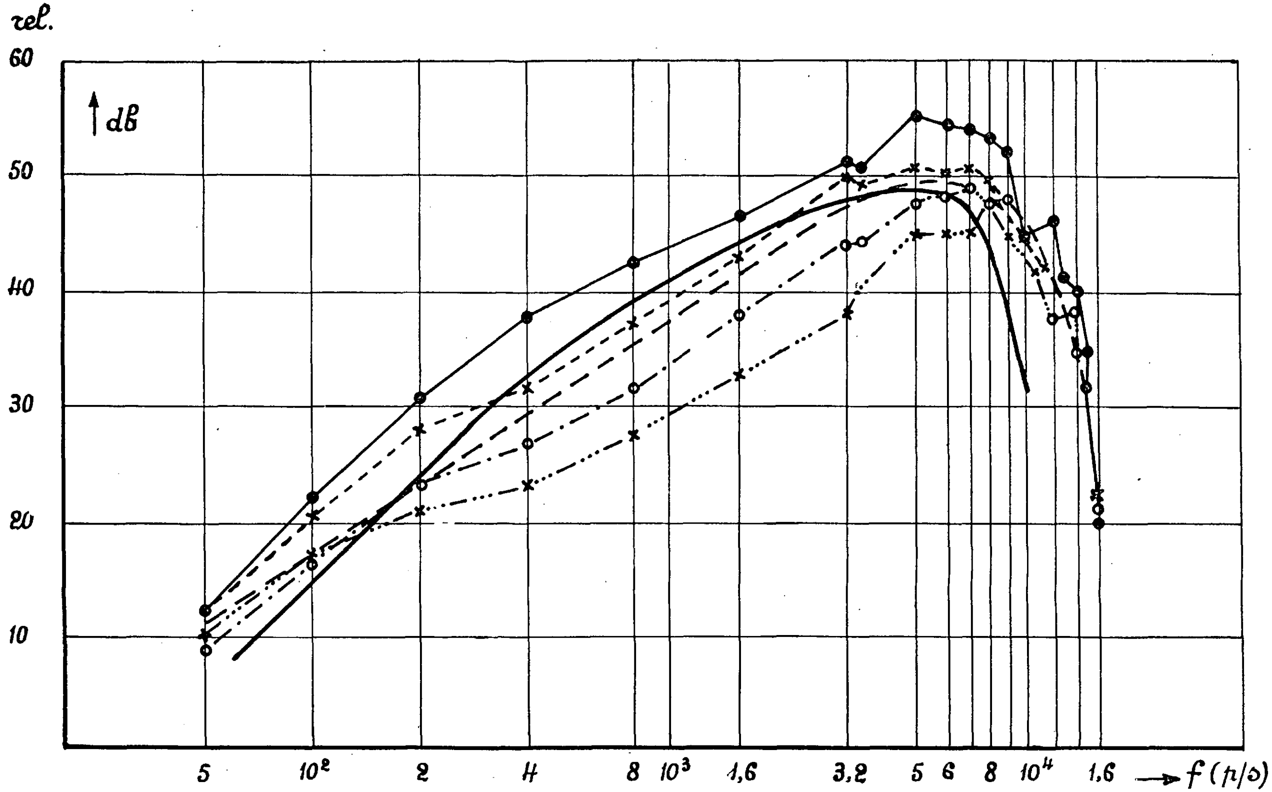


Figure 9. — *Room noise: 30 phons*

Disturbing modulation:
Amplitude modulated tones
(Wobble frequency 6.25 c/s;
deviation frequency of wobble 100 c/s)

Test Program

	Program
————————	Silent intervals
- - - - - - - -	Piano
—— · —— · ——	Organ
—— —— —— ——	Stringed instruments



Test Program

- Silent intervals
- Piano
- Organ
- Stringed instruments

Characteristic curve of the psophometer weighting network used for the measurements on program circuit published by the C.C.I.F.

Curve resulting from the tests

FIGURE 10. — *Curves of average values combining Figure 7 (0.05 to 3.5 kc/s) and Figures 8 and 9 (3.5 to 16 kc/s) compared with the characteristic curve of the psophometer weighting network used for measurements on program circuits published by the C.C.I.F. in 1949*

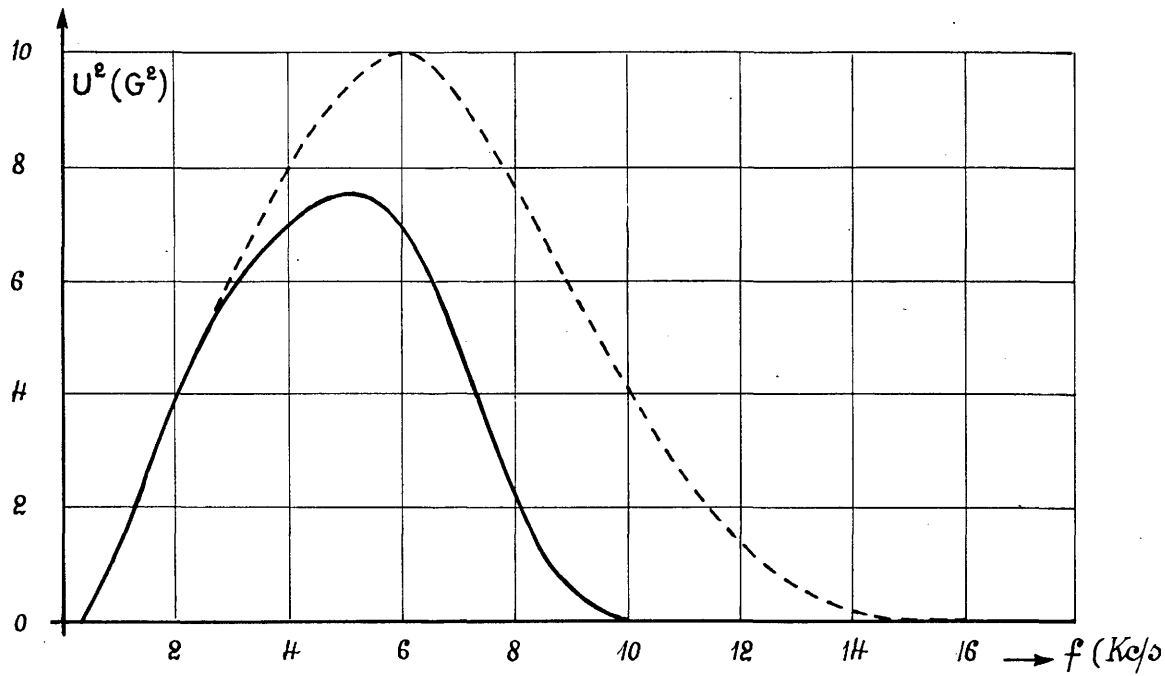


FIGURE 11. — *Linear Graph of $U^2 = F$ (b) for the characteristic curve of the psophometer weighting network used for measurement on program circuits published by the C.C.I.F. in 1949* ——— *and the new curve obtained from the tests* – – – – – –

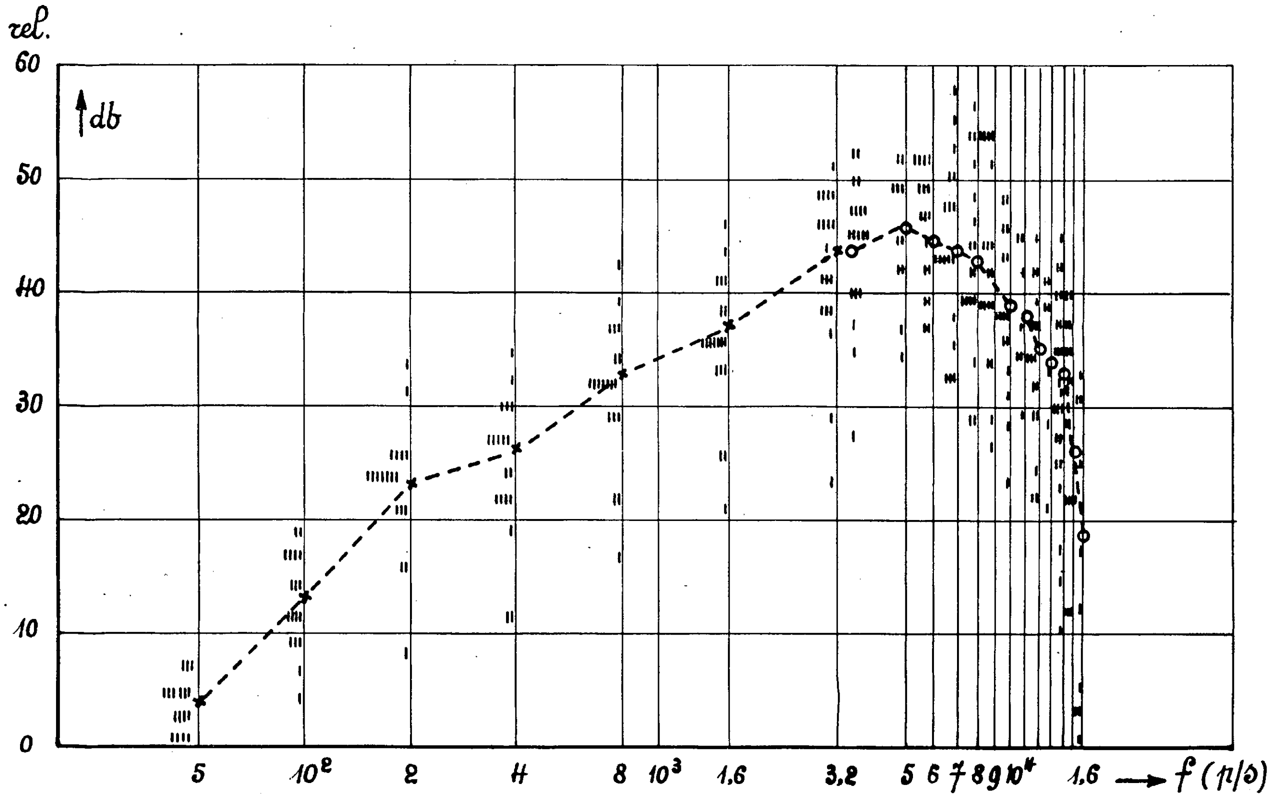


FIGURE 12. — *Measured points and average values for piano music and thermal agitation noise (50 c/s to 3.2 kc/s) or amplitude modulated tones (3.5 to 16 kc/s) for a room noise of 30 phons*

ANNEX 2

(to Question No. 9)

Conditions to be realised in the tests having as their aim the final fixing of the characteristics to be adopted for the psophometer for programme transmissions

It has been decided to adopt the following procedure, in respect of the tests to be undertaken to determine the curve of the filter network to be used in psophometers for programme transmissions :

1. Each observer, seated in a room reproducing the listening conditions of a relatively quiet private house, is asked to imagine that he is listening to a wireless programme. This programme should have a little circuit noise, the volume of which can be varied, and the listener is asked to adjust this noise so that it just fails to interfere with his enjoyment of the programme.

2. Before each test the hearing of each observer should be checked to ensure it is normal, special attention should be given to hearing at high frequencies, because there is a greater variation of people's hearing at high frequencies than at low frequencies.

3. Tests should be made during silent periods of the wireless transmission, or when the amplitude of the transmitted signal is very small.

4. Normal radio programmes should be used or, alternatively, special recordings of equal quality (of voices, music, etc.). All these should, as far as possible, be free from any background noise.

5. Each observer should be able to regulate, to his own liking, the volume of the loud speaker. The values thus fixed for the volume of these sounds should be recorded. The operators should adjust the sound level to that to which they are accustomed when listening on radio programmes.

6. The systems of sound reproduction should be without distortion throughout the frequency band and throughout the whole range of amplitude used during the tests.

7. The disturbing noise should consist of a small frequency band (e.g. sinusoid current periodically interrupted, or a band extracted from thermal agitation noise, etc...). Narrow frequency bands should be used with mean values successively of :— 50, 100, 200, 400, 800, 1600, 3200, 6400, 8000 c/sec.

Other types of noise may be used, but it will be necessary to describe them exactly—for example a noise with a distributed spectrum coresponding to the background noise of carrier systems, and perhaps also intermodulation noise which occurs when there is overloading of a repeater in a multichannel carrier system.

8. The room noise should correspond to the conditions ordinarily met with in rooms used for listening to radio programmes ; it should have values of about 30 or 50 phons, corresponding respectively to the conditions of a quiet or noisy room.

9. For these tests about 10 observers of average age (20 to 30 years) should be used ; persons suffering from hearing disabilities should be eliminated from the tests. Subjects should not be chosen exclusively from the musical experts but also from ordinary music lovers.

Question No. 10.

(Corresponds to study programme No. 75 of the C.C.I.R.) (3rd Study Group of the C.C.I.F. in co-operation with the C.C.I.R.) (Category A 1) [non urgent] (new question)

1. A study of the influence on the quality of a television pictures of the various factors, such as :—

— resolution
— contrast range
— contrast law
— geometry
— colour response
— colour fidelity (where applicable)

and also defects such as :

— noise (random, impulsive, periodic)
— shading
— streaking *(trainage)*
— overshoots
— excessive memory
— colour " crosstalk " }
— colour mis-registration } where applicable
— colour break-up }

2. A study of the methods by which the influence of such factors on the quality of a television picture may be measured objectively.

Question No. 11.

(3rd Study Group in co-operation with the C.C.I.R., I.B.O. and E.B.U.) (Category A 1) [non urgent] (continuation of question No. 16 studied in 1952/1954)

What transmission characteristics should be taken into consideration in the case of a complete circuit intended for television transmissions the circuit being considered between the video terminals, as going from the studio output to the input of the television transmitter ? (See note 1 below).

What are the allowable limits to be recommended for these characteristics ?

Note 1. — According to the C.C.I.R. Study Programme No. 32, an extract of which is given in the annex to this question, the following characteristics, in particular, could be taken into consideration :

A. *Input and output impedances* and

B. *Polarity and continuous component.*

See the provisional C.C.I.F. recommendations given in Annex 2 below.

C. *Amplitude of the signal.*

The C.C.I.F. urgently requests the C.C.I.R. to standardize the value of 1 volt for each of the systems of 405, 625 and 819 lines used in Europe.

This will enable all difficulty in this respect to be avoided at the various video junction points.

D. *Ratio of the picture and synchronizing signals.*

The C.C.I.F. urgently requests the C.C.I.R. to standardize the same nominal value of this ratio for all the systems of 405, 625 and 819 lines used in Europe. *

E. *Non-linear distortion.*

See the Annex 2 to this question and the Question No. 12.

F. *Variation of the equivalent with time.*

See the Annex 2 to this question and the Question No. 13.

G. *Signal to noise ratio.*

See the Annexes 2 and 3 to this question and the Question No. 14.

H. *Phase and amplitude characteristics.*

Specifications in the steady state are still necessary at the present time in connection with the division of responsibility between Administrations. Table 2 of Annex 3 shows the characteristics provisionally proposed for the various television standards used in Europe.

The study of specifications in the transitory state should be continued within the framework of Questions Nos. 17, 18 and 21 below.

ANNEX 1

(to Question No. 11)

Extract from Study Programme No. 32 of the C.C.I.R., entitled " Specifications necessary for the establishment of a long-distance television transmission "

A. *Input and output impedance of the television transmission circuit.*
Value, whether balanced or unbalanced ; tolerance.

B. *Polarity of signal* (at the input to the television circuit).
Polarity and whether A.C. or D.C.

C. *Amplitude of signal.*
Value from peak white to tip of synchronizing.

D. *Ratio of picture signal to synchronizing signal ratio.*
Value to be used for leading into and out of transmission circuit.

E. *Non-linear distorsion.*
Effect of the variation of the input to output characteristic 1° on the picture signal and 2° on the synchronising pulses.

F. *Stability of overall transmission circuit.*
The tolerable change of overall gain at 1 Mc/s (taken as reference frequencies) during the following periods :—

(a) short periods e.g. of 1 second ;
(b) medium periods e.g. of 1 hour ;
(c) long periods e.g. of 1 month ;

* Meanwhile the values which have been proposed for the various television standards will be found in the Annex 3 to this question.

G. *Signal-to-noise rations.*

The tolerable signal-to-noise ratio for :

(a) random uniform noise ;

(a') random non-uniform noise

(b) periodic noise ;

(c) impulsive noise.

In determining this tolerable ratio the effect of noise on the signal and on the synchronising pulses, should be taken into consideration.

In order to simplify the comparison of the results of the tests carried out in the various countries, it is suggested that the ratios should be quoted in db and that the ratio should be :

$$\frac{\text{peak-to peak value of the signal}}{\text{peak-to-peak value of the noise}}$$

and the synchronizing signal should not be considered as being part of the picture signal.

It should be understood that the ratio can be measured in other terms and a suitable correction factor applied ; in this case the correction factor should be stated, for example the crest factor in the case of random uniform noise ;

H. *Attenuation and phase characteristics.*

(a) Attenuation frequency characteristic ;

(b) Differential delay-frequency or group delay-frequency characteristic (specified :—

(α) At low frequencies, the differential delay relative to a linear frequency law.

(β) At high frequencies : the variation of the group delay as a function of frequency).

(c) The transient response.

ANNEX 2

(to Question No. 11)

General Characteristics of an international line circuit for television transmission (provisional recommendation by the C.C.I.F. for all television standards used in Europe) *

Definitions relative to the origins and extremity of a television circuit

The most common television circuit is represented schematically by Figure 1 below:

For the specification of the electrical characteristics of transmission, two cases are to be considered :

— the case of the long distance line

— the case of the television circuit.

(a) *Case of the long-distance line BC*

The long-distance line should be considered individually each time it is a question of setting up or carrying out routine maintenance of this line, which is entirely the responsibility of the telephone Administration. The characteristics of this line are checked by steady state measurements.

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* It is desirable to review all this recommendation in order that it may apply to the " nominal maximum circuit to television transmission " defined in the Question No. 12 below.

Note. — The points B and C may be either in the premises of a telephone or television Administration. The choice is left, on a national plane, to the telephone and television Administrations of the same country. In every case, whatever may be agreed nationally, the terminals B and C are video terminals.

(b) *Case of the television circuit AD*

Specifications of the television circuit are necessary to allow end to end tests to be made before a television transmission. These tests are made by transmitting pulses (see below under IV).

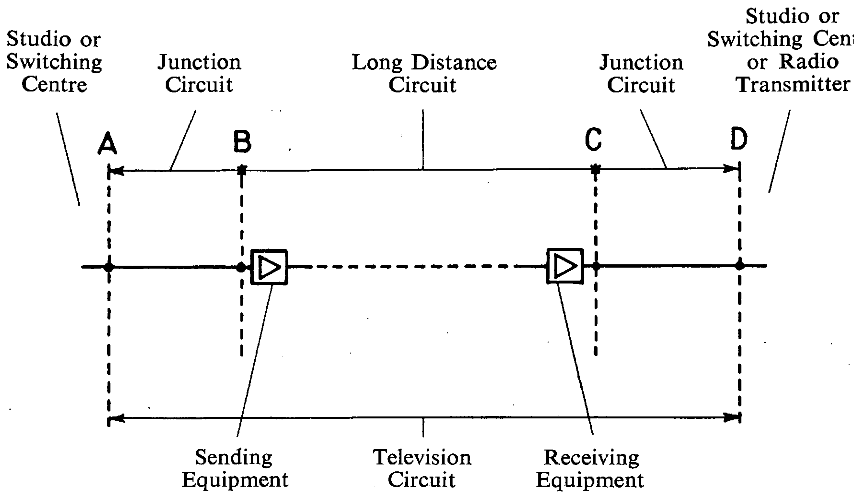


Figure 1

Taking account of these definitions, the C.C.I.F. makes the following provisional recommendations for the general characteristics of the complete circuit AD and the long distance line BC. These characteristics are applicable to the transmission of signals conforming to any of the three television standards (405, 625, and 819 lines) used in Europe.

A. *Input and output impedance*

(a) *Case of the long distance line BC*

The specifications should include two distinct parts :

— specifications from end to end ;
— specifications for connection at international frontiers.

The end to end specifications must, in particular, cover reflections at points B and C, expressed in the form of return loss in the band of frequencies transmitted at these points. The impedances to be considered are, on the one hand those of the sending and receiving equipment, on the other hand the characteristic impedances of junction cables to the studio, to the radio transmitter or to the switching centre.

The specifications for the impedance at terminals B and C should particularly be designed to avoid dispute in the choice of junction cable to the studio, or radio transmitter or to the switching centre.

In all cases the return loss should be more than or equal to 20 db in the frequency band between the lowest to the highest frequencies effectively transmitted. (That is to say, the modulus of the reflection coefficient must be less than or equal to 0.1.) If the junction circuits AB and CD are short, the return loss at points B and C (with respect to 75 ohms) should be more than or equal to 20 db in the frequency band to be transmitted.

(b) *Case of television circuit AD*

At points A and D it is desirable to fix the impedances. This is particularly necessary when circuits have to be switched at this point. The limits should be expressed in the form of return loss in the band of frequencies transmitted at these points. The impedances to be considered are :

In the case of switching:

— The characteristic impedances of the junction cables at the switching point.

In the case of terminal use:

— The impedances of the junction cables and those of the studio apparatus which are connected to these cables.

In all these cases, the return loss should be equal to or greater than 20 db.

However,

(a) If the junction lines AB and CD are short, the return loss at points A and D will be expressed with reference to 75 ohms.

(b) If, furthermore, terminal operation is considered, it can be admitted that, at point A, only the impedance of the circuit as seen from A can be defined.

In the latter case, the conditions to be fulfilled from the point of view of impedance matching, would be as follows :

The input and output terminals are of the coaxial type, i.e. the connection is unbalanced with respect to earth.

Input impedance (impedance of the circuit at A) : 75 ± 2.5 ohms.

The tolerance of 2.5 ohms should be interpreted at the upper limit of the *modulus* of the difference between the actual and nominal values of this impedance.

Characteristics which video signals should show at video junction points at the sending and receiving ends of a long-distance line for telephone transmissions, with a view to specifying the line

The video junction point is any point in a television circuit where the signals appear at video frequency : e.g. :

(a) the junction point between two different systems such as a coaxial cable and a radio relay system ;

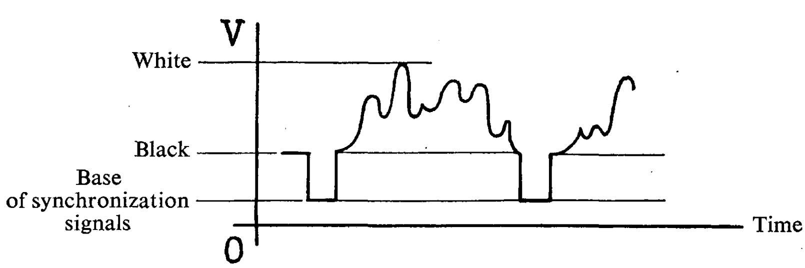
(b) the point of connection of a monitoring device of the television circuit ;

(c) the point of connection of the television circuit and the vision studio.

At these points the video signal must show the characteristics indicated in § B, C and D below.

B. *Polarity and DC component*

The *polarity* of the signals will be positive, that is to say, if the brilliance increases, the potential of the terminal (not earthed) of the input or output impedance also increases.



V = Potential difference between the terminal (not earthed) of the input impedance (or output) and earth (differences of potential are positive towards the top of the diagram).

FIGURE 2

The *useful DC component* (which fixes the average brightness of the image) need not be transmitted. When it is injected at the input of the transmission circuit or reestablished at its output, it should comply with the conditions laid down below for the non-useful DC component.

The *non-useful DC component* (eg due to battery supplies to valves) should be such that it does not dissipate more than 0.5 watt in the input impedance. (This specification is intended to indicate the DC electrical power that the input resistance of 75 ohms should normally be capable of carrying.

When this resistance is disconnected, the voltage should not exceed 60 volts DC in order to limit the voltage to a value which will not be dangerous to staff.)

C. *Amplitude of the signal*

The C.C.I.F. urgently requests the C.C.I.R. to standardize the value of 1 volt for each of the systems of 405, 625 and 819 lines used in Europe.

This will enable all difficulty in this respect to be avoided at the various video junction points.

D. *Ratio of the picture and synchronizing signals*

The C.C.I.F. urgently requests the C.C.I.R. to standardize the same nominal value of this ratio for all the sysem of 405, 625 and 819 lines used in Europe *.

E. *Non-linearity distortion*

(a) *For the complete television circuit between the studio and the transmitter*

The C.C.I.R. has requested that for non-linear distortion of the complete television circuit between the studio and transmitting station, there should be the following clauses :

1. Throughout the range of amplitude of the vision signal, the slope of the amplitude/amplitude curve should not differ by more than ± 10% from its mean value.

2. The amplitude of the synchronisation signals at the output should not differ from that of the same signal at the input by more than ± 3% of the total peak-to-peak amplitude, the transmission circuit being adjusted so that the peak-to-peak amplitude at the input and output are equal.

(b) *For the long distance line*

Study is being made by the C.C.I.F. of the conditions for long-distance lines from the standpoint of non-linearity distortion, with a view to satisfying to the greatest possible extent the desiderata in *(a)*. It is obvious that the telephone Administrations cannot accept any responsibility for the non-linear distortion which would be produced by a system converter located in the installation of the broadcasting Organization and through which the complete television circuit (from studio to radio transmitter) might pass.

F. *Variations in the attenuation with time*

(a) *For the television circuit*

A Study Group of the C.C.I.R. has expressed a desire for the following limits (see the documents of the VIIth Plenary Assembly of the C.C.I.R., London 1953, Volume I, page 268) :

1. Variations of short duration (e.g. 1 second) : ±0.3 db
2. Variations of medium duration (e.g. 1 hour) : ± 1 db

* Meanwhile, the values proposed for the various television standards are given in Table II.

3. Variations of long duration (e.g. 1 month) :
— if the circuit is not monitored, that is to say, is not adjusted each time it is taken into use, the attenuation should not depart from its mean value by more than ± 2 db ;
— if the circuit is permanently monitored, the tolerances in (2) above apply, that is to say, the attenuation should be adjusted every time it varies more than ± 1 db from this nominal value.

(b) *For the long-distance line*

The C.C.I.F. is studying what apparatus is to be used and what arrangements are to be made on long distance lines for television transmissions in order to satisfy desires of the C.C.I.R. Study Group which are indicated in § *(a)* above.

G. *Signal-to-noise ratio for long-distance lines*

After taking note of the desiderata of the C.C.I.R. Study Group with reference to the television circuit, the C.C.I.F. considers that the values indicated below can be recommended for the long-distance line BC between video terminals :
These values of the signal/noise ratio refer to the decibel equivalent of the ratio :

$$\frac{\text{peak to peak amplitude of the vision signal}}{\text{quasi peak to peak amplitude of the noise}}$$

The quasi peak to peak amplitude of the noise does not differ from the peak to peak amplitude of this noise when it is recurrent or impulsive. When the noise is erratic and continuous, the quasi peak to peak amplitude is defined as being equal to 8 times (18 db) the effective amplitude of the noise *.

(a) Erratic continuous " noise " with a uniform spectrum 30 to 35 db according to the television standard concerned **.

(a′) Erratic continuous " noise " with an energy spectrum increasing with the frequency at a rate of 6 db per octave (which corresponds to the case of the ordinary frequency modulation) : 25 to 30 db according to the television standard concerned **.

(b) Recurrent noises ***.
For discontinuous noise of an impulsive character, a very short individual duration and a low repetition rate : signal/noise ratio of the order of 25 db **.

Crosstalk. — In a television transmission crosstalk gives rise to unwanted signals which cause recurrent ****, or continuous random noise according to whether the crosstalk is produced by a carrier current system or a normal audio telephone call. However, this latter type of communication is liable to cause recurrent disturbances during the calling

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* If the instantaneous amplitude of the noise follows a normal distribution law, the quasi peak to peak amplitude is double the instantaneous amplitude of the noise which is exceeded for 5.10^{-5} of the time.

** For further details, see Table 1 of Annex 3 for the values proposed for television standards.

*** See Table 1 of Annex 3 for values recommended by the C.C.I.F. for the 405 line system and for other standards.

**** The British Administration has offered a different recommendation for the 405 line system, based on the following consideration : " The U.K. Administration has not undertaken tests of the effects of crosstalk between two television circuits, but considers that a valuable guide has been given by A.D. Fowler in " Observer Reaction to video crosstalk ", *Journal of the Society of Motion Picture and Television Engineers*, Vol. 57, pp. 46-424. In this paper it is proposed that the minimum permissible signal/crosstalk ratio should be 58 db in the case of " flat " (undistorted) crosstalk. Other figures are proposed for other types of crosstalk characteristic ".

and answering signals. Hence it has been recommended that the logarithmic ratio between the vision signal and the parasitic crosstalk signal, provisionally and only to give an order of magnitude, shall be the same as the limit above for the logarithmic ratio between the vision signal and recurrent noise.

Difference between the picture and sound propagation times. — The difference between the minimum group propagation times of the sound and video components, between cities linked by the television system considered, must not exceed 0.1 second.

Note. — The problem does not arise in cases where the sound and video signals are transmitted in the same channel. If a separate channel, with a high propagation rate is used for the sound signal, the limit of 0.1 second provides so great a margin that no restriction is imposed on the television transmission, even at very long distances. As regards television transmissions over short or medium distances—only types of transmission likely to be used in the near future—the 0.1 second limit will make it possible to use for the sound signal, channels with a relatively low transmission speed.

ANNEX 3

(to Question No. 11)

Values proposed for certain characteristics of a television circuit comprising various television standards in use in Europe

The table 1 below (for information only) contains values for various standards, proposed for certain characteristics of a television circuit. The following data has been used in compiling the table :

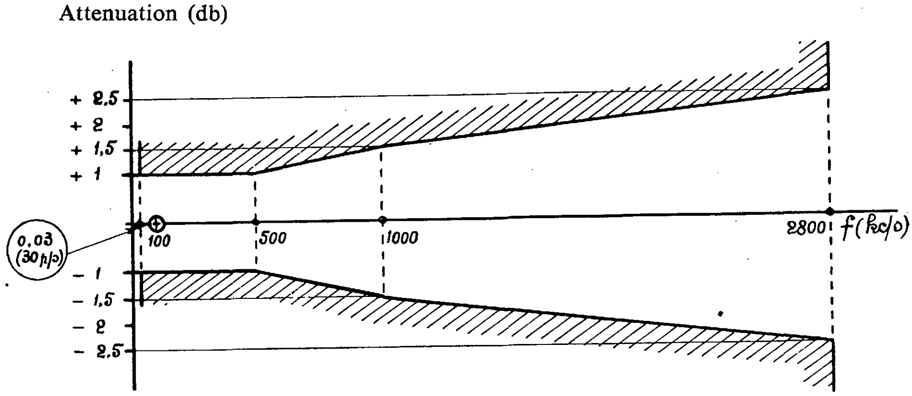
(a) For the 405 line standard, the present provisional recommendations of the C.C.I.F. (*Yellow Book*, Volume III *bis*, pages 167 to 172) brought up to date in accordance with the proposals of the British Administration (C.C.I.F. — 1952/1954 — 3rd S.G. — Doc. No. 16, pages 12 to 14) for a chain of circuits, 800 km. long ;

(b) For the 625 line standard, the proposals of the Administration of the Federal German Republic (C.C.I.F. — 1952/1954 — 3rd S.G. Doc. No. 29, pages 4, 5 and 12) ;

(c) For the 819 line standard, the proposals of the French Administration (C.C.I.F. — 1952/1954 — 3rd S.G. — Doc. No. 17, pages 36 to 41).

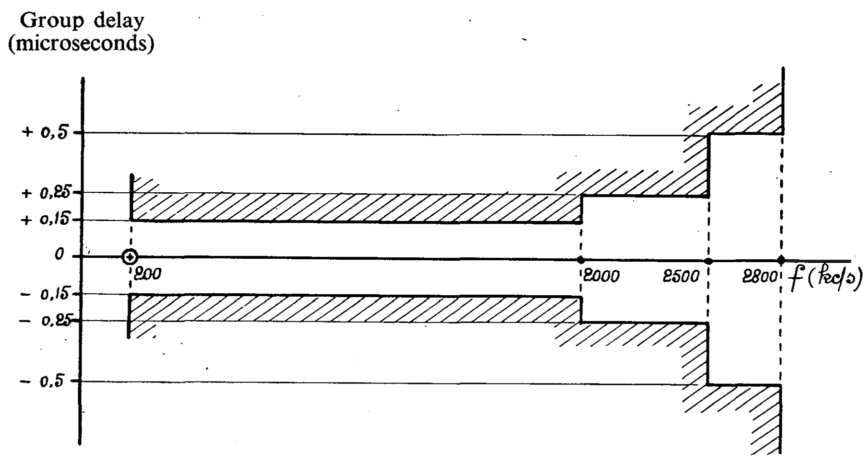
As shown in § D and G of annex 2 above, it may prove possible to establish recommendations for picture signal/synchronising signal ratios and signal/noise ratio, irrespective of the standard used.

The phase and amplitude considerations however, are essentially governed by the standards considered. Provisional proposals submitted to the C.C.I.F. are given in Figs. 1 to 3.



(a) Attenuation Variation as a function of frequency, in relation to the value for 100 kc/s

Note. — The circuit should also transmit, to an appreciable extent the 3000 kc/s frequency.



(b) Variation of Group delay as a function of frequency, in relation to the value for 200 kc/s

Notes. — 1. The " group delay-frequency " characteristic should not show any violent variations within the limits given in this diagram.

2. Moreover, from 30 c/s to 200 kc/s, the " phase change frequency " characteristic should not deviate by more than ± 6° from a straight line with an ordinate origin equal to 0 or to a whole multiple of 360°.

FIGURE 1. — *The amplitude and phase characteristic provisionally proposed (405 line standard), applicable to a circuit 800 km, long, consisting of 4 sections (not necessarily with 3 intermediate video points)*

TABLE 1

Table containing Television Circuit characteristics for which values have been proposed according to the television standard

Characteristics	Television standard		
	405 lines	625 lines	819 lines
Video/synchronising signal ratio	70/30	72/28	70/30 (nominal value)
Signal/noise ratio for various types of noise (Note 1)			
(a) continuous random noise (uniform spectral distribution)	35 db	35 db	40 db (note 1)
(a') continuous random noise (spectral energy increasing with the frequency)	27 db	30 db	
(b) recurrent noise :			
— low frequency	50 db up to 1 Mc/s then decreasing to	50 db at 50 c/s decreasing to	(note 3)
— high frequency	30 db for the highest frequency transmitted (note 2)	30 db for 5 Mc/s	
(c) discontinuous erratic noise :			
— very short pulses, low repetition rate	30 db	25 db	40 db (note 1)
— higher repetition rate		30 db	
Phase and amplitude	see figures 1, 2 and 3		

Notes on Table I.

Note 1. — The signal/noise ratio values given for the 819 line system are for the

$$\frac{\text{peak to peak amplitude of picture signal}}{\text{effective amplitude of noise}}$$

ratio, expressed in decibels.

The values given for the 405 and 625 line systems are for the

$$\frac{\text{peak to peak amplitude of picture signal}}{\text{quasi peak to peak amplitude of noise}}$$

ratio.

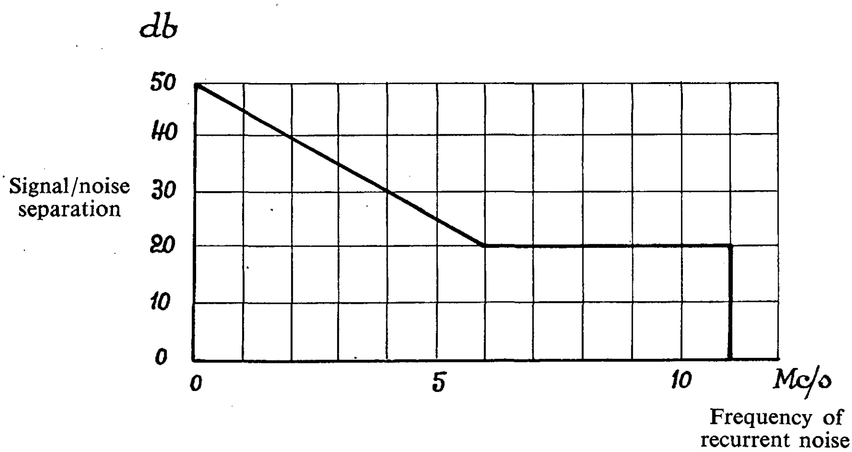
The quasi peak to peak amplitude and the peak to peak amplitude produced by recurrent or impulsive noise are identical. For a continuous random noise with its instantaneous amplitudes distribution according to the normal law, and assuming the quasi peak to peak amplitude A_p to be double the amplitude exceeded (either way) during p% of time, A_p effective amplitude A_{eff} ratios, given below for certain values of p, are obtained :

p %	$\frac{Ap}{A_{eff}}$	$20 \log_{10} \frac{Ap}{A_{eff}}$	Remarks
1	5.1	14	
0.5	5.6	15	Value given for the 625-line system in table above.
0.005	8	18	Value adopted by C.C.I.R. and in § I.G. above

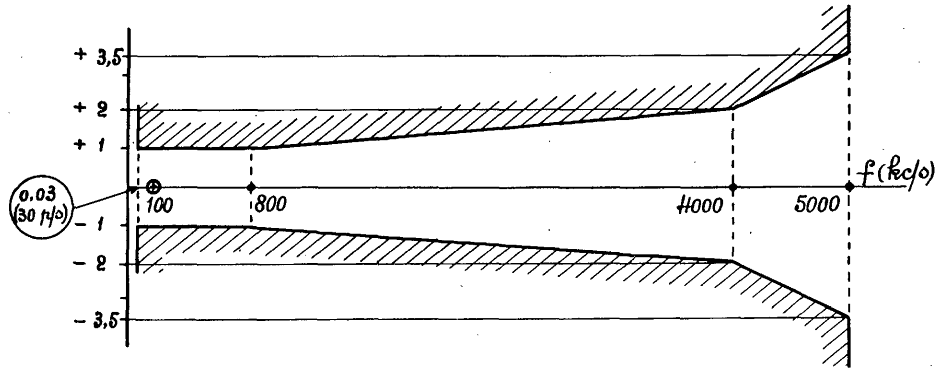
Note 2. — Values recommended by C.C.I.F. (Question 16).

Note 3. — Signal/recurrent noise ratio for the 819-line system.

The French Administration has proposed the curve in Fig. 50, showing the separation to be maintained for at least 90% of the time, between the effective voltage of the noise and the peak-to-peak value of the video signal delivered :

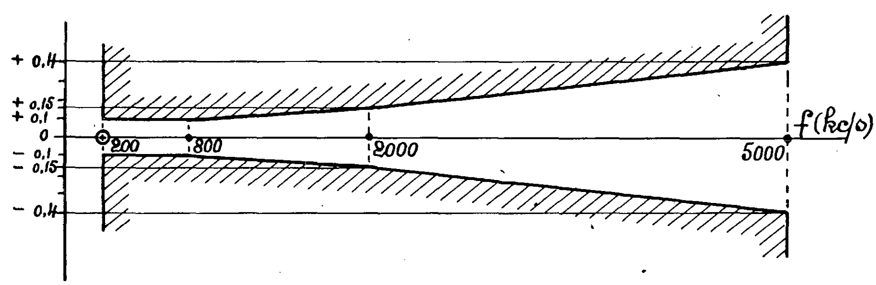


Attenuation (db)



(a) Attenuation variation as a function of frequency, in relation to the value for 100 kc/s

Group delay (microseconds)

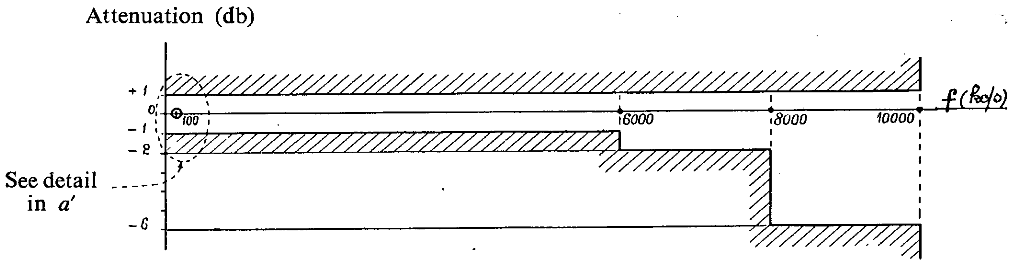


(b) Variation in group delay as a function of frequency, in relation to the value for 200 kc/s

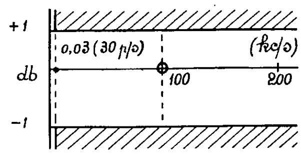
Notes. — 1. Moreover, in an interval of 100 kc/s, the variation should not exceed 0.1 microseconds. The limits for enveloppe delay may appear somewhat wide ; no closer limits can be fixed at present.

2. On the other hand, the " phase change-frequency " characteristic for 30 c/s to 200 kc/s should not deviate by more than $\pm 6°$ from a straight line with an ordinate origin equal to 0 or to a whole multiple of 360°.

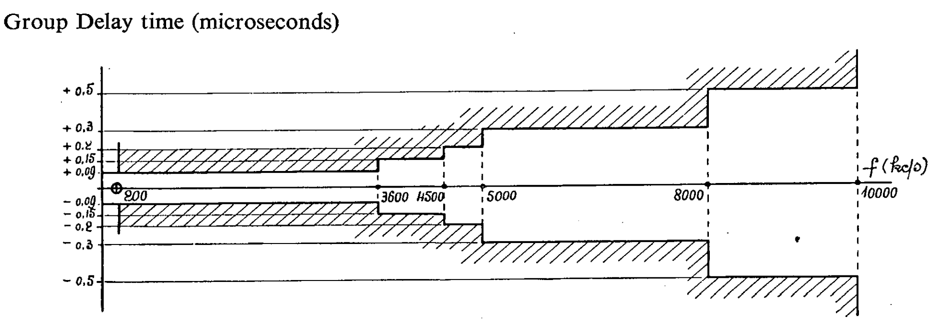
FIGURE 2. — *Amplitude and phase characteristics provisionally proposed for television transmission circuits (625-line system) (for 1000 km circuit with no intermediate video points)*



(a) Attenuation variation as a function of frequency, in relation to the value for 100 kc/s



(a') Detail of diagram *(a)*, 30 c/s to 200 kc/s



(b) Variation in group delays as a function of frequency, in relation to the value for 200 kc/s

FIGURE 3. — *Amplitude and phase characteristics provisionally proposed for television circuits (819-line system)*

(Wishes expressed by Group M of the E.B.U. Tests will be carried out on the Paris-Bordeaux coaxial cable, to determine the length of coaxial pair without intermediate video points, over which the wishes can be met.)

Question No. 12.

(3rd Study Group of the C.C.I.F. in co-operation with the C.C.I.R., I.B.O. and E.B.U.) (Category A2) [urgent] (continuation of questions Nos. 16, part E, and 16 bis *studied in 1952/1954).*

(a) What are the essential characteristics to be determined for the equipment of the " long-distance line " BC for television transmissions * so that, at frontiers and intermediate branching points, coaxial pairs may be interconnected without modulation and demodulation, which are always detrimental to transmission quality ?

(b) What limits are to be fixed for these characteristics ?

Note 1. — The study of this question will be based on the nominal maximum circuit on coaxial pairs for television transmission, used by the 3rd Study Group of the C.C.I.F., in accordance with the following diagram Fig. 1. Its principal characteristics are :

length, 2500 km (or 1600 miles)

4 video junction points : the ends B, C of the " long-distance line " and two intermediate (video-frequency) points MM′

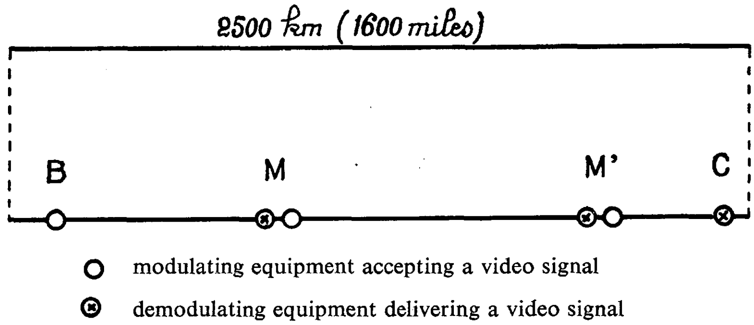


FIGURE 1. — *Nominal maximum circuit on coaxial pairs for television transmission*

Note 2. — Three nominal maximum circuits should be considered as follows :—

1. The nominal maximum circuit entirely on coaxial pairs which has been defined by the 3rd Study Group of the C.C.I.F. (see note 1 above).
2. A nominal maximum circuit entirely on radio links, which will be recommended by the 9th Study Group of the C.C.I.R.
3. A mixed nominal maximum circuit (including sections on coaxial pairs and on radio links) which will be studied later by a working party of the 3rd and 5th Study Groups of the C.C.I.F. with representatives of the C.C.I.R., before the next Plenary Assembly of the C.C.I.R.

* See the definitions given at the beginning of Annex 2 to question No. 11 above.

It is to be understood that each of the three nominal maximum circuits corresponds to the "long-distance line" BC and does not include junction lines (AB, CD) or a television standards convertor.

Question No. 13.

(3rd Study Group of the C.C.I.F. in co-operation with the C.C.I.R., I.B.O. and E.B.U.)
(Category A 2) [urgent] (continuation of Question No. 16, part F, studied in 1952/1954)

As far as the stability of attenuation of an overall television link is concerned, a Study Group of the C.C.I.R. has expressed the following wishes (see the documents of the VIIth Plenary Assembly of the C.C.I.R., London 1953, Volume I, page 268) :—

(a) variations of short duration (e.g. 1 second) . . . . . ± 0.3 db

(b) variations of medium duration (e.g. 1 hour) . . . . . ± 1 db

(c) variations of long duration (e.g. 1 month) :—

— if the circuit is not monitored, that is to say, is not adjusted each time it is taken into use, the attenuation should not depart from its mean value by more than ± 2 db ;

— if the circuit is permanently monitored, the tolerances in *(b)* above apply, that is to say the attenuation should be adjusted every time it varies more than ± 1 db from this nominal value.

What are the devices to be used and the measures to be taken on long-distance lines for television transmission in order to be able to satisfy these requirements ?

Note 1. — Study of this question will be made for the following three cases :

1. A single circuit of 250 kilometes between video terminals ;

2. A long-distance line of 1000 kilometres between video terminals consisting of four sections interconnected at high frequencies.

3. The " nominal maximum circuit on coaxial pairs for television transmission " (see Question No. 12 above).

Note 2. — It is desirable to define what is meant by " attenuation of a circuit for television transmission ". This could be the image attenuation, or the " composite attenuation " or the insertion loss between non-reactive resistors of 75 ohms at a reference frequency to be fixed e.g. 1 Mc/s. At the place where the measurement of the equivalent is to be made there should be a device for separating the signal of this frequency from the synchronisation signals.

Question No. 14.

(To be studied by the C.C.I.R. in co-operation with the 3rd Study Group of the C.C.I.F.)
(continuation of Question No. 16, part G, studied by the 3rd Study Group of the C.C.I.F. in 1952/1954)

Would it be possible to recommend a single value for the signal-to-noise ratio for all types of random noise and for all television systems, by using a curve which gives a " weighting " to each narrow frequency band in the noise spectrum ?

Note. — By way of example, the Cuban Telephone Company has proposed in the following Annex a method which could perhaps allow of the recommendation of a limiting value for the signal-to-noise ratio, and has also given examples of weighting curves for 405 and 625-line pictures. Attention is also drawn to the article by J.M. Barstow and H.N. Christopher reproduced in Annex 2 below.

ANNEX 1

(to Question No. 14)

Weighting Curves for Television Transmission Systems

The Cuban Telephone Company

Introduction. — It is well known that there are many forms of spurious signals (e.g. tones, impulsive noise, echos, etc.) that can cause degradation of a television signal. Only " tandem noise " of a sufficient bandwidth such that no pattern appears on the television screen will be dealt with in these proposals.

Experimental evidence has shewn that viewers describe different noise powers as just observable depending on the frequency spectrum of the noise. Broadly, high-frequency noise can be of very much higher power than low-frequency noise to cause the same degree of picture degradation.

It is thus reasonable to assume that a curve of loss against frequency could be drawn ; such a network, having a response characteristic matching this curve, placed in front of a wideband power measuring set, would enable the noise power indication to be as measure of the television picture degradation, when the combination is connected to a suitable point in a television transmission system. This curve would then be a " videometric weighting network ".

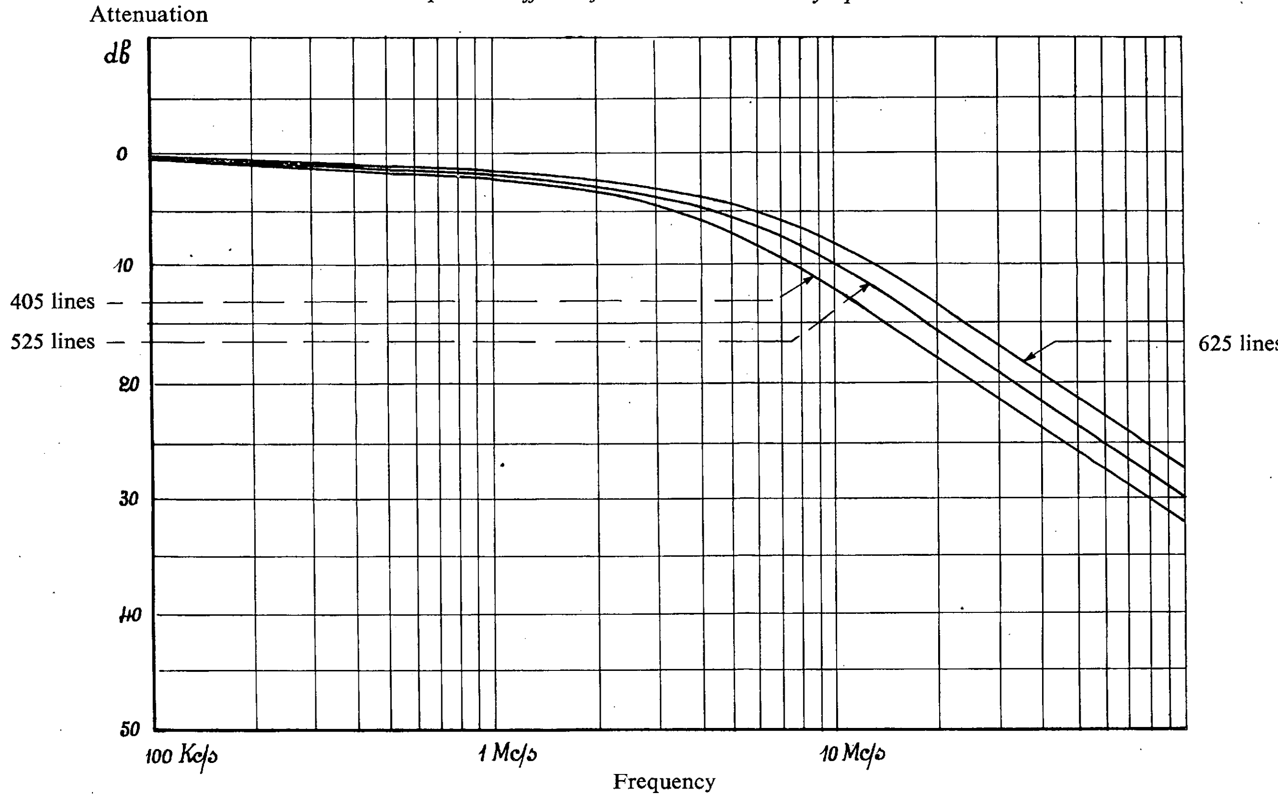
Choice of a Videometric Weighting Network. — It is submitted that the phenomena leading to the observed lack of sensitivity to the higher frequency noise contributions in television pictures can be defined ; and that " videometric noise weighting curves " can be synthesized for any television standard.

The aptness of these synthesized curves can then be checked against experimental evidence.

The phenomena concerned are the aperture effect of the eye, and the aperture effect of the cathode ray spot of the television receiver, which will be referred to as the subjective and objective weighting curves, respectively.

Objective Weighting Curve. — The effect of the television receiver cathode ray spot is a function of the raster employed, and hence is independent of the viewer-thus objective weighting. It is proposed that the spot size should be such that there is the full available

Objective videometric weighting curves.
Aperture effect of receiver cathode ray spot



Cathode spot equivalent to grain size of picture using 3 times the bandwidth of the relevant system

FIGURE 1

range of intensities between two adjacent peak white lines, and that the intensity plotted across any diameter of the spot should describe a " cosine-squared " curve.

Curves showing the " objective weighting " for the British (405), American (525), and European (625) standards are shewn in Figure 1. The shapes of the aperture effect for a spot of " cosine-squared " intensity are obtained from reference 1 *(a)*.

Subjective Weighting Network. — The application of the aperture effect of the eye is fraught with difficulties ; the most obvious being the choice of viewing distance (or angle subtended by the picture at the eye). The alternatives are probably that a line width should subtend a constant angle at the eye, and that this angle should be such that line structure is not visible, or that the angle subtended by the picture height should be such that the whole picture can be inspected without movement of the head—i.e. based on the minimum fatigue. To date, the latter alternative has found most favour, and will probably fit most " family circles " with the larger sizes of cathode ray tube now becoming popular, and also corresponds to the middle of the auditorium of cinemas.

Thus a " subjective weighting network " has been shown in Figure 2 for a viewing distance of four times picture height.

The information for this curve has also been obtained from reference 1 *(b)*.

It will be noted that the " subjective weighting curves " for the British (405) and Continental (625) are identical, having the same number of frames/sec. This is suggested in reference 1 *(c)*. Some points to substantiate this are listed below :—

(a) For a given amount of light from a total picture, the light per line will be inversely proportional to the number of lines.

(b) The area of illumination due to a " noise peak " will be independent of the raster.

(c) For higher frequency noise, within the bandwidth of the lower frequency system, the shapes illuminated by noise peaks are somewhat less easily visible when the number of lines is high than when it is low, as a high number of lines leads to a long thin dot, whereas the low number of lines leads to a more nearly square dot.

Although the evidence is not conclusive on a quantitative basis, on balance it seems reasonable to agree with the conclusions of reference 1 *(c)*.

Videometric Weighting Curve. — By combining the " subjective and objective weighting curves " a " videometric weighting curve " is obtained, Figure 3.

The effect of networks designed to have the loss characteristics defined by the weighting curves on the measurement of " flat " and " triangular noise " is given in Table I.

A comparison of the " videometric weighting curve " proposed with that obtained experimentally by the Bell Laboratories (see Annex 2) is shown in Figure 4.

Application of " Videometric Noise Weighting Curves ". — The application of the " videometric weighting curves " of Figure 3 would give an adequate indication of the picture degradation to be expected on a wide-band monitor tube at the end of a television transmission system. But the picture transmitted is intended for domestic receivers, which must, for reasons of bandwidth economy, have adequate cut-off at the end of the vision band to allow for the transmission of the sound carrier, and it is therefore justifiable to include a cut-off in the videometric noise measuring set that simulates the best filter that can be made to give adequate cut-off at the sound channel, and that this characteristic be defined as part of the videometric noise weighting curve, or as an addition thereto. Figure 5 shows the proposed cut-off characteristic on a normalised frequency basis, where ω is the nominal cut-off according to the television standard.

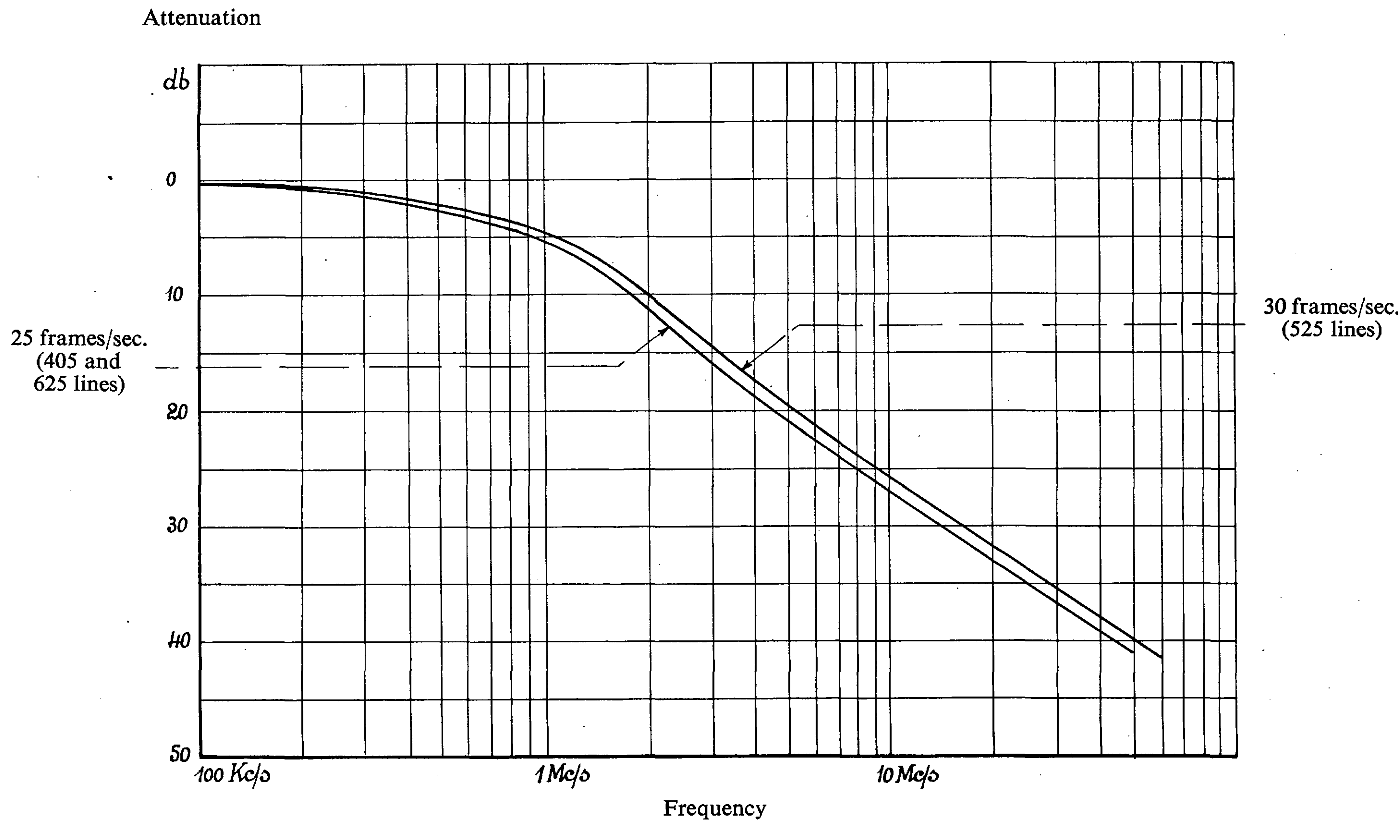


FIGURE 2. — *Television subjective weighting curve due to effect of eye at viewing distance 4 × picture height*

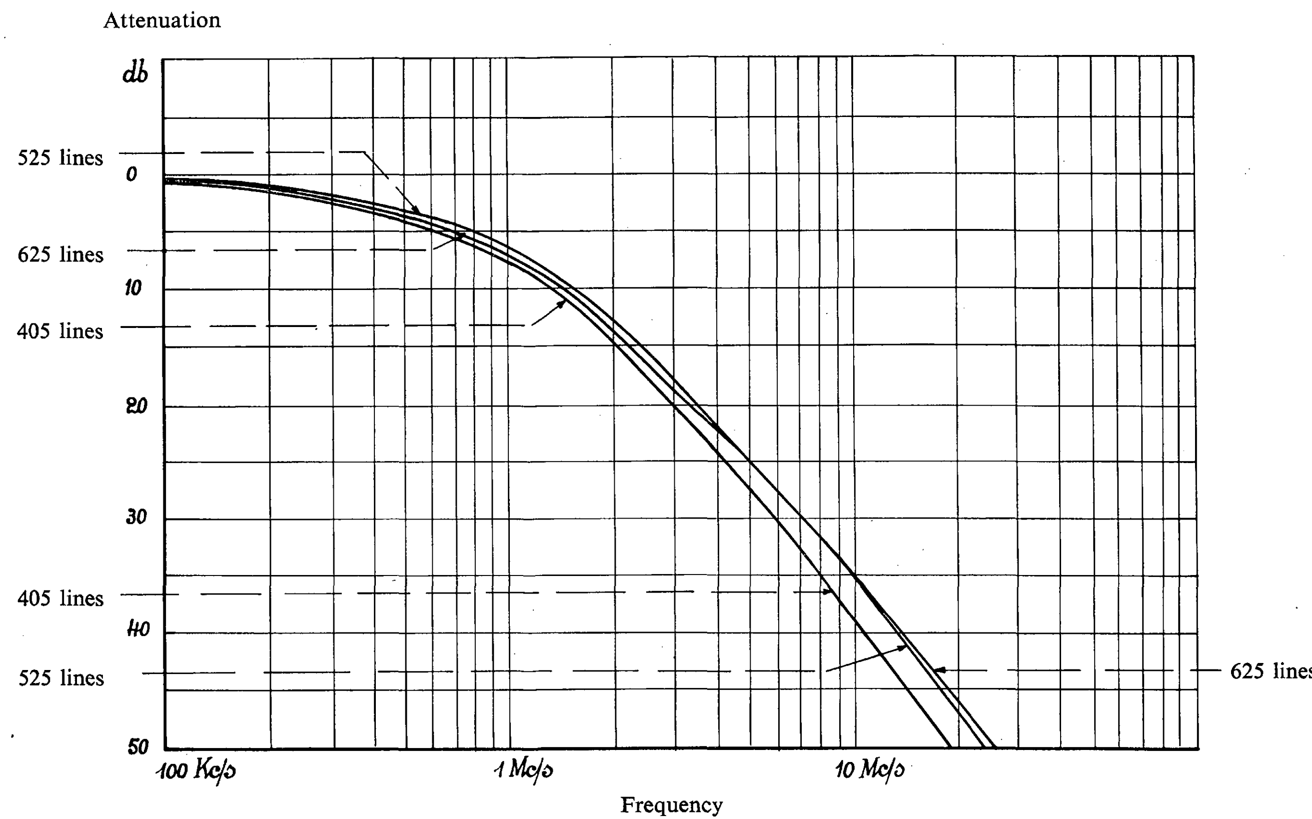


FIGURE 3. — *Proposed videometric weighting curves*

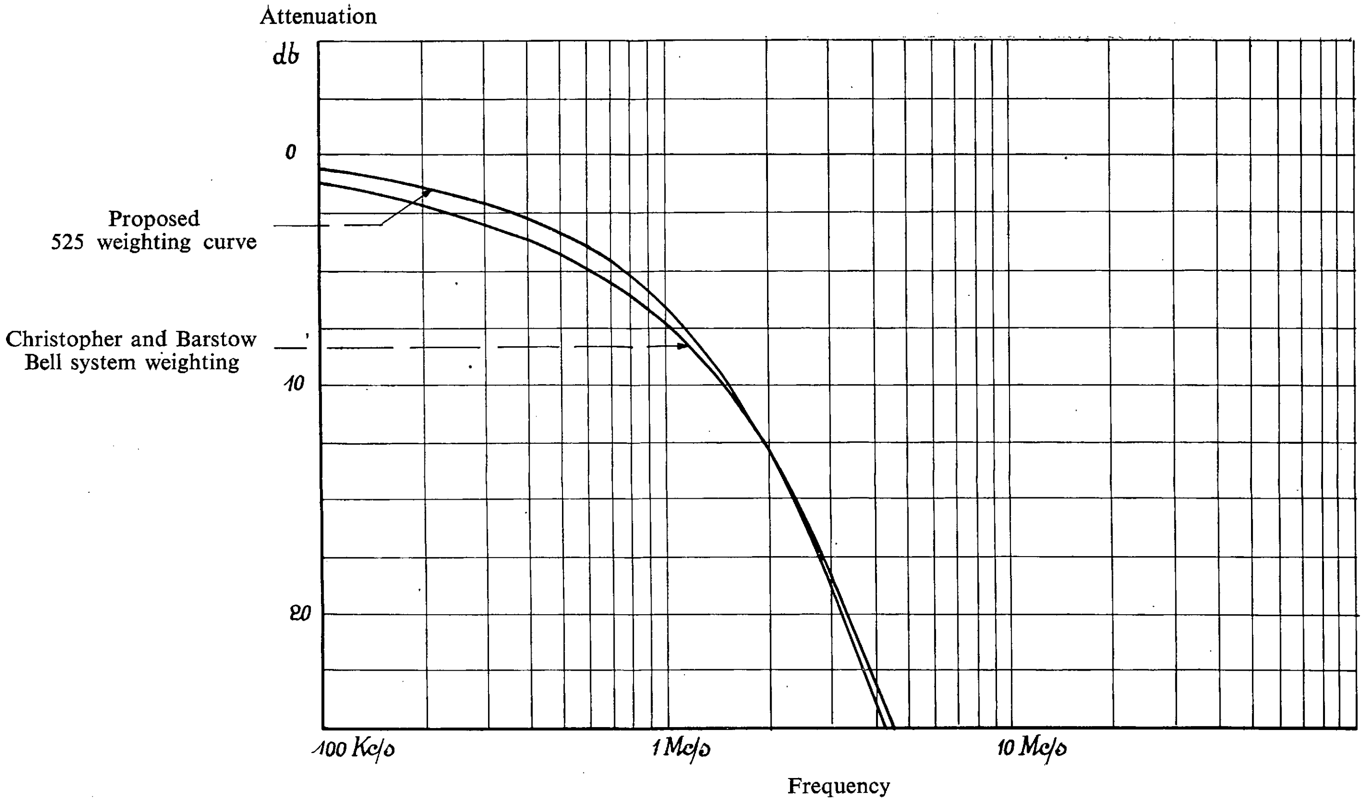


FIGURE 4. — *Comparison of weighting curves 525 lines*

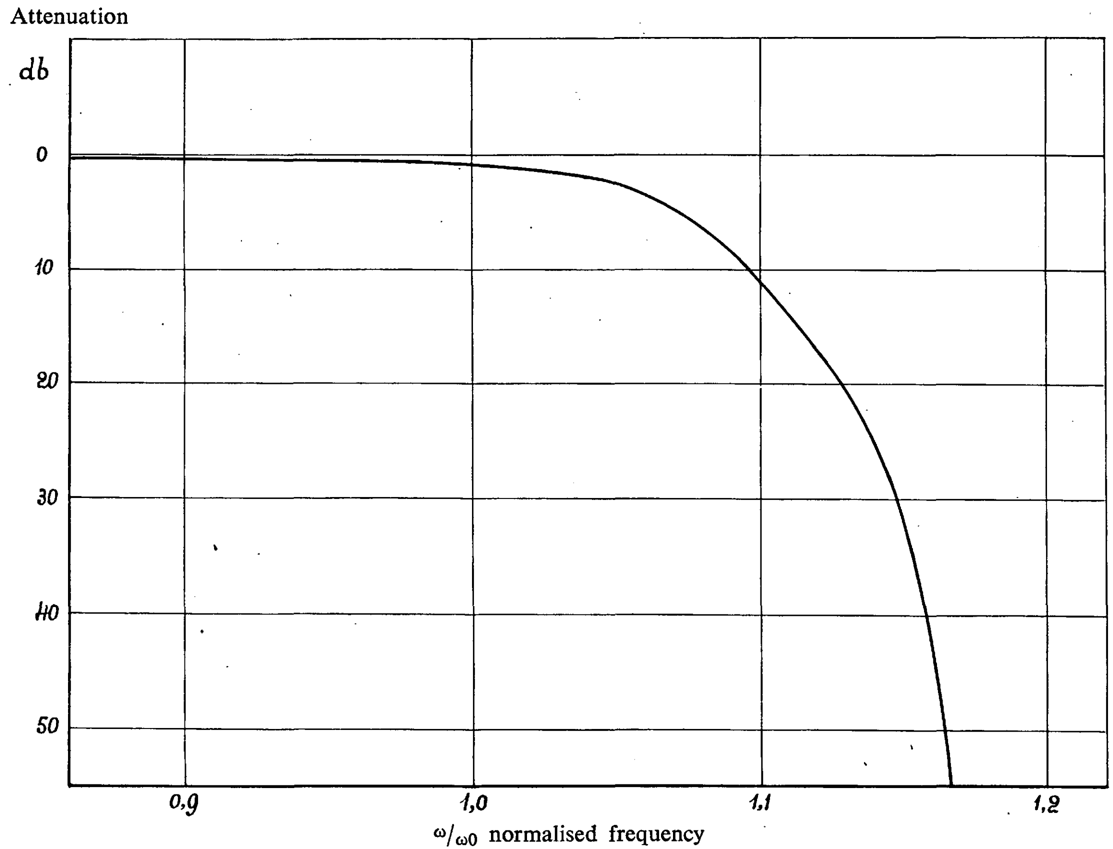


FIGURE 5. — *Proposed normalised cut-off characteristics*

Conclusion. — It is proposed that the measurement of noise at a terminal of a television transmission system should be made using a wide-band power measuring set in front of which is placed a network whose loss characteristic is defined by the "videometric weighting curve" (Figure 3) and a low pass filter defined by Figure 5. For completeness, it is suggested that a peak-to-peak picture signal to v.m.s. noise ratio of 54 db should be obtained for at 1000 km television transmission system (based on the interfering effect of low frequency noise).

Ref. 1 *(a)* "Television Electro-Optical Characteristics", O.H. SCHADE, R.C.A. *Review*, Volume IX,' p. 250.
1 *(b)* *Ibid.*, p. 32.
1 *(c)* *Ibid.*, p. 32 (§ 2).

TABLE 1

System	Type of Noise	Objective Weighting	Subjective Weighting	Total Weighting	Difference
405 lines . . . . . 3 Mc/s . . . . . . 25 f.p.s.	Flat Triangular	3 db 4 db	6 db 10.5 db	9 db 14.5 db	5.5 db
525 lines . . . . . 4 Mc/s . . . . . . 30 f.p.s.	Flat Triangular	3 db 4 db	6.5 db 13 db	9.5 db 17 db	7.5 db
625 lines . . . . . 5 Mc/s . . . . . . 25 f.p.s.	Flat Triangular	3 db 4 db	8 db 15.5 db	11 db 19.5 db	8.5 db

TABLE 2

Weighting Curves

Subjective			Objective			Total		
Frequency Mc/s	405 et 625	525	405	525	625	405	525	625
0.3	1.4	1.1	1.2	1.0	0.8	2.6	2.1	2.2
0.5	2.6	2.1	1.7	1.5	1.3	4.3	3.4	3.9
0.7	3.8	3.3	2.0	1.7	1.4	5.8	4.7	5.2
1.0	5.3	4.6	2.2	2.0	1.8	7.5	6.6	7.1
2.0	11.0	10.0	3.6	3.0	2.6	14.6	13.0	13.6
3.0	15.8	14.2	4.8	4.0	3.5	20.6	18.2	19.3
4.0	18,8	17.6	6.0	5.0	4.0	24.8	22.6	23.0
5.0	21.0	20.0	7.0	5.6	4.7	28.0	25.6	25.7
7.0	24.0	22.8	9.0	7.2	6.0	33.0	30.0	30.0
10.0	27.0	26.0	12.0	9.6	8.0	39.0	35.6	35.0
15.0	30.5	29.4	15.5	13.0	11.0	46.0	42.4	41.5
20.0	33.0	32.0	18.0	15.7	13.6	51.0	47.7	46.6

ANNEX 2

(to Question No. 14)

The Measurement of Random Monochrome Video Interference

by J.M. BARSTOW, member A.I.E.E., and H.N. CHRISTOPHER

One of the important factors in the design and maintenance of television transmission circuits is random interference, sometimes referred to as random noise. Much of this type of interference originates in the input stages of amplifiers but it may also originate in the line or in other parts of the transmission path. These noise components are greatly modified by circuit equalization which may vary from a few decibels (db) to possibly 27 or more db per octave. Thus the transmission engineer is confronted with the problem of evaluating random interference having different energy levels, per cycle, over the television bandwidth. Before noise evaluations can be made, information must be obtained by subjective tests on the interfering effect of broad, narrow, and mixed bands of random noise distributed throughout the television band.

Out of the work associated with such tests comes a reasonable question, " Cannot random interference be measured in such a way that equal measurements will mean approximately equal interfering effect, regardless of the frequency composition of the noise ? "

This question may be reasonably divided into two parts :

1. What is the weighting or relative importance of random interference in different parts of the video spectrum ?

2. Does the human visual mechanism sum up the interference effects of random noise in various parts of the video spectrum in such a way that the over-all effect can be uniquely related to an over-all measurement, made with equipment that is not too complicated ?

Preliminary answers to these questions are given in the following sections of this paper. The answers are called preliminary because it is obvious that they depend to a large extent on the equipment used in making the judgment tests, and this equipment is undergoing constant change as the television art advances. At present, it is believed that a stage has been reached at which results of the type involved will be useful over a sufficiently long period to make publication worth while.

Others have considered this problem and have deduced approximate results by rationalizing a relatively small number of subjective measurements with related work involving photographic reproduction processes [1], [2]. The test results given here, however, are purely experimental and seem sufficient in scope and numbers to warrant conclusions. Although they confirm, in part, the general characteristics of random noise weighting previously estimated, they are independent of any thus far published.

Summary of Results. — The frequency weighting derived from the judgment tests is given in Fig. 1. This weighting is for use with a simple power-summing measuring device.

The general principles derived from the tests may be summarized as follows :

1. Low-frequency noise is judged much more interfering than high-frequency noise of equal power.

2. A given amount of noise power is judged more objectionable if it is concentrated in a narrow band than if it is spread out over a wider band in the same frequency region.

3. Human vision in combination with the present television monitors does not precisely sum weighted noise powers in arriving at an overall assessment of the interfering effect of random noise bands. However, a reasonable compromise can be obtained with weighting applied to a power meter. In the region of 7 db above threshold, average errors of the order of 1 db with maximum errors of 2 db will obtain.

4. At frequencies above 4.5 megacycles (mc) an unexpected effect was observed called sparkle effect. When the total noise power is contained in the region above 4 mc, sharp points of light of very brief duration appear on the raster. It is believed that this effect is the result of the random occurrence of high peak potentials in the random noise which produce the sharp points of light on the raster before the extremely fine-grain noise effect becomes visible. The sparkle effect tends to flatten the weighting above 4 mc.

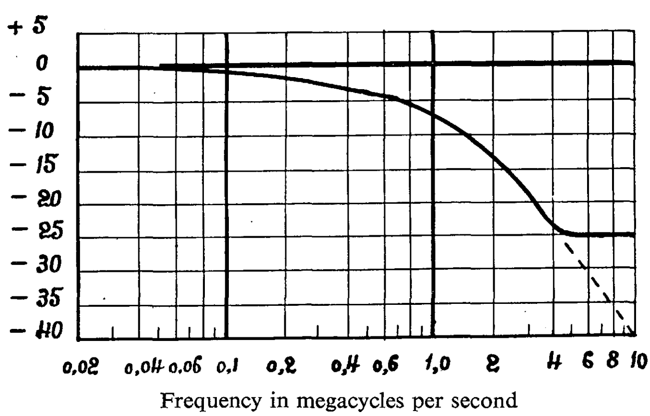
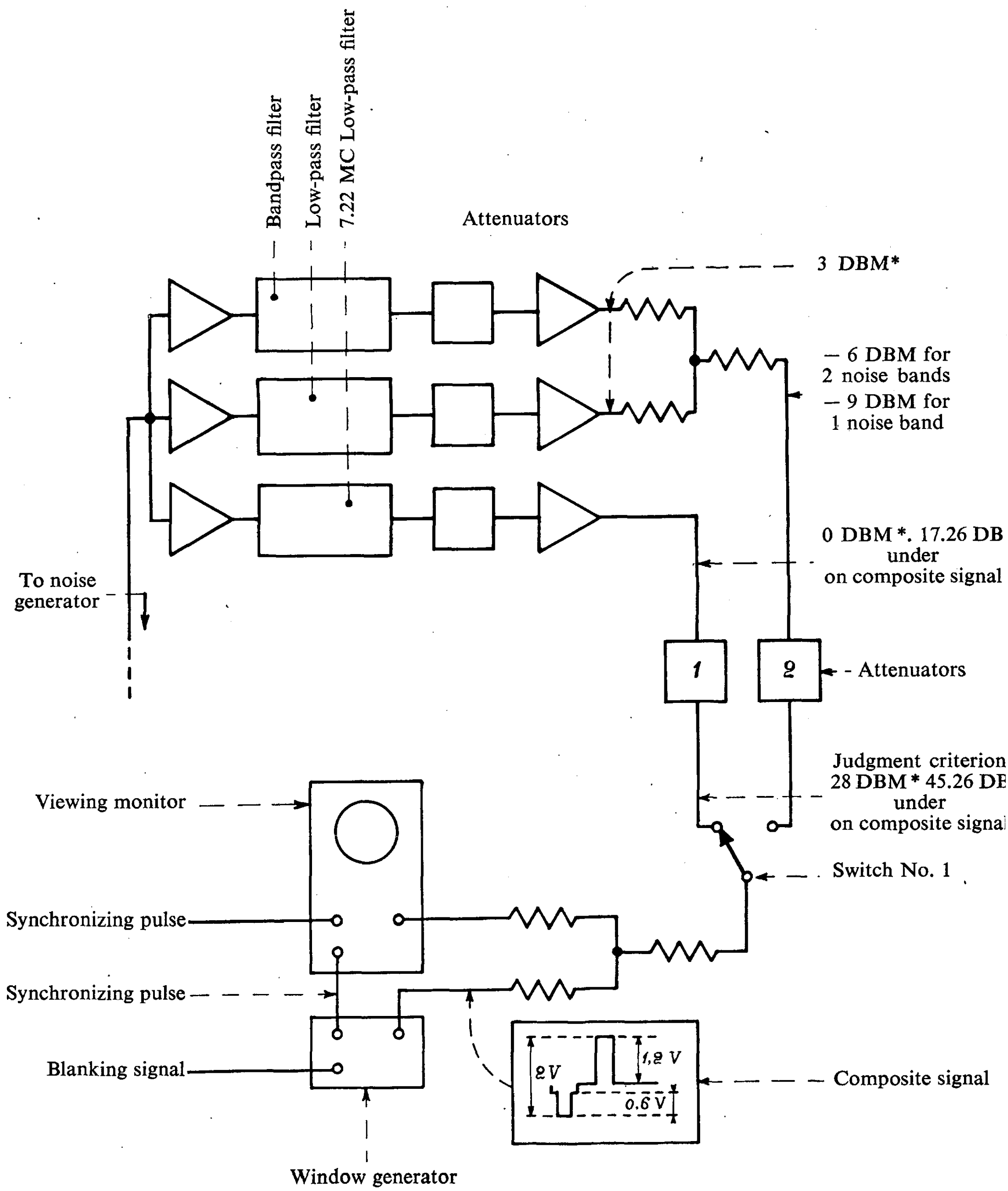


FIGURE 1. — *Random noise weighting for monochrome television*

Subjective Test Conditions. — The objective in setting up the test condition was to simulate somewhat more severe viewing conditions than are usually encountered in the home. The test results were obtained by a jury of observers viewing the raster from a distance of four times the picture height. The raster was adjusted to 6 by 8 inches and was viewed in almost total darkness (ambient about 0.0025-foot lambert). The jurors were subjected one at a time to the test conditions, and for most tests three juries of 10 observers each were employed. The three juries had members in common, there being 14 different jurors used in all.



* DBM signifies r.m.s. noise power referred to 1 milliwatt

FIGURE 2. — *Circuit used to determine the relative interfering effect of discrete bands of random noise*

The test set-up is illustrated schematically in Fig. 2. A test consisted of having the juror compare the judgment criterion (7.22 mc low-pass band of flat noise at about 7 db above the threshold of visibility) with a test noise obtained by passing a wide band of flat noise through either a bandpass or a low-pass filter. The test level of about 7 db above the threshold of visibility (45.26 db below peak-to-peak composite signal) was chosen for the reference condition because it is in the region of a tolerable noise level, and therefore information on methods of measurement which apply to it would be most useful. (Zero db obtain when the ratio of rms noise volts to composite signal voltage, peak to peak = 1.) The observer was permitted to switch (switch 1, Fig. 2) from one condition to the other at will, and was instructed to ask the test operator to raise or lower the level of the test noise as required to obtain interference equality in his judgment. The circuit arrangement of Fig. 2 also permitted the mixing of two noise bands in different parts of the video spectrum for test.

In the early stages of noise tests, picture slides were used as subject material. It was soon observed, however, that the jurors were basing their judgments on the noise in middle gray areas of the picture and check tests were made on wholly gray areas to corroborate this observation. Subsequently the tests were made on wholly gray areas without the picture. This technique permitted the raster to be generated electronically without the use of a scanner, and thus provided essentially a noise-free raster, a feature greatly desired in noise studies.

It was found that about equal results were obtained over a range of gray areas varying in brightness from about 0.3-foot-to 0.6-foot lambert.

The types of random noise tested varied from very wide band noise (7.22-mc reference condition) to narrow bands only 40 kc wide. Although no band used was narrow enough to produce definite line patterns on the raster, some bands wera sufficiently narrow to produce fleeting appearances of herring bone patterns.

The tests on noises having two bands in different parts of the spectrum were made, to obtain additional evidence on the rule of combination of interfering effects as summed up by human vision. Noises typical of those encountered on standard transmission facilities were also included in the tests.

All viewing was on a laboratory monitor equipped with an 1816 P4 kinescope. The kinescope anode was operated at 11 kv and the associated video amplifier was substantially distortionless to above 15 mc. The simulated picture signals were in accordance with the present United States standard of 525 lines, 60 fields per second, 30 frames per second, with alternate field interlace.

The electrical transmission circuits were uniform in their response up to about 8 mc. This means that the monitor was superior to present-day broadcast television receivers in its response in the 0.4.3-mc range, and very much more uniform in response in the range of 4.3-8 mc. The monitor and associated circuits were made good in this high range to permit extension of the information on relative interfering effect toward 8 mc. Hence, it is believed the weighting and measuring methods to be described apply to the present standard monochrome system up to 4.3 mc, and give some indication of the weighting which should be applied to interference on wider circuits used for kinescope recording and wide-band theatre television employing 525-line 15,750-lines per second standards.

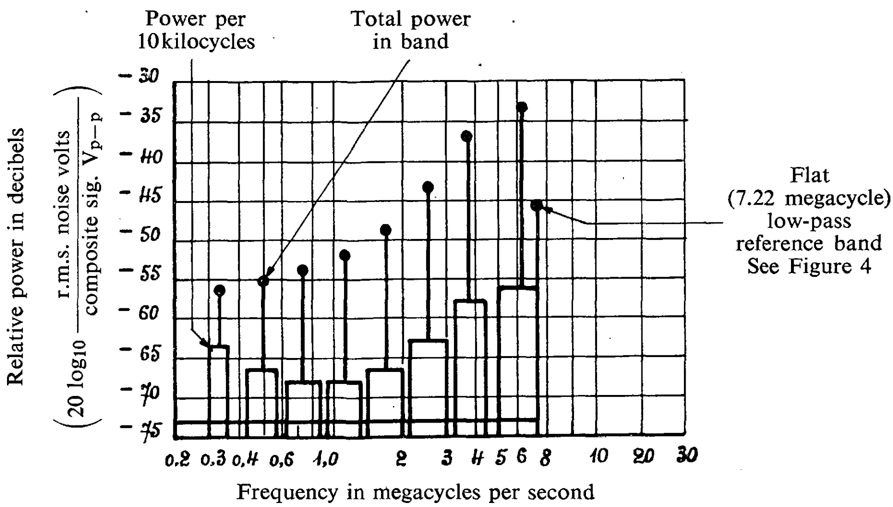


FIGURE 3. — *Powers in bands of noise judged to be equally interfering (30-observer data)*

Discussion of Results. — The results of the tests are shown in Figs. 1, 3, 4, 5 and 6, and Tables I to III. Fig. 3 shows the magnitudes of unweighted noise powers in the bands of noise which were judged to be equally interfering. The bandwidths indicated were selected to be narrow with respect to the full band but not narrow enough to cause bar pattern effects. The total power in each band is shown plotted near the enter of each band. The point representing the total power in each band is the integral of the power per kilocycle over the area defined by the frequency boundaries of each band. For simplicity and ease of computation, the filter characteristics have been idealized. This figure shows that more power is required at high than at low frequencies to produce a given interfering effect. The inverse of the shape revealed by the total power points is very nearly equal to the shape of the weighting given in Fig. 1.

The unweighted power in the low-pass reference band is indicated in Fig. 3 by a point plotted at 7.22 mc, the upper edge of this band. This level is 45.26 db below the peak-to-peak composite signal. Because of the unsymmetrical nature of television video signals, it has become customary to refer to the signal in terms of the peak-to-peak magnitude (picture plus sync) while the noise is expressed in rms magnitudes.

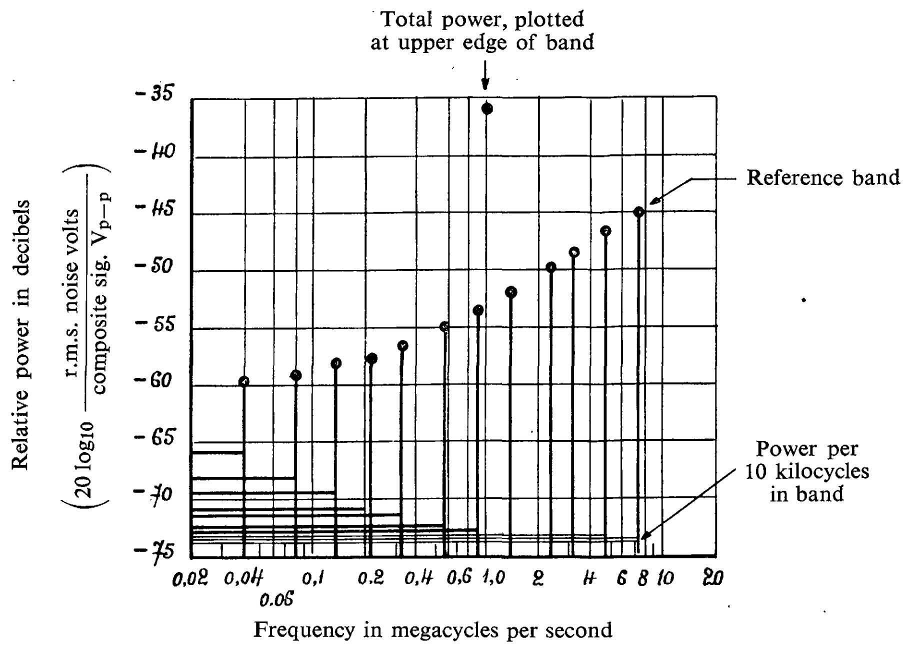


FIGURE 4. — *Powers in low-pass bands of noise judged to be equally interfering (30-observer data)*

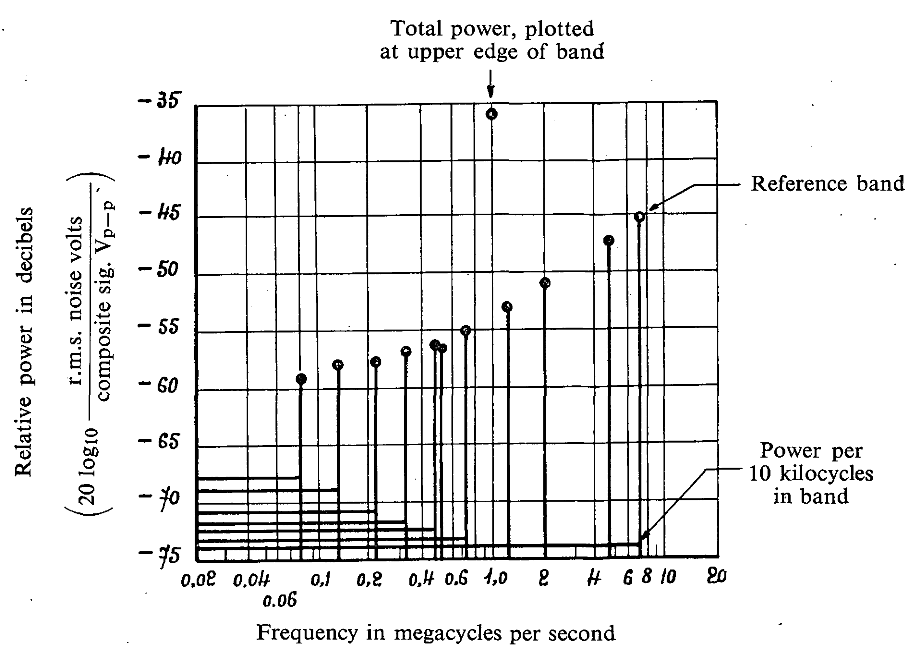


FIGURE 5. — *Powers in low-pass bands of noise judged to be equally interfering (9 observer data)*

Figs. 4 and 5 show the unweighted powers in low-pass noise bands which were judged to be equally interfering. These data were obtained approximately 1 year apart and, although two set-ups and slightly different noise bands were used, the data are in very good agreement. The total unweighted powers are plotted at the upper edge of the low-pass bands in these figures. Considering the rate of increase in the total noise power required to produce the reference interfering effect as the bandwidth is increased, these data show again that on a per-cycle basis, high-frequency noise power does not contribute as much to interfering effect as does low-frequency noise power. In these figures the inverse shape formed by the total power points does not approximate to the best weighting shape. This may be better understood when it is pointed out that in an area where a positive slope of 3 db per octave is attained, the noise powers in that area would be contributing nothing to the interfering effect. This slope is very nearly attained in the 2-to-7-mc region.

The horizontal lines showing the noise power per 10 kc in each band may be used to yield information on weighting also. A negative slope of 3 db in power level indicated by these lines, per octave of total bandwidth would indicate a frequency region in which the weighting is constant. The lower two or three low-pass bands approach such a region.

It is interesting to observe the powers per 10 kc in the low-pass bands having upper edges above 1 mc. These powers per 10 kc are nearly constant, indicating that, in the presence of the low-frequency noise power, the high frequencies are contributing little to the observed interfering effect. In some of the earlier work on the interfering effect of flat random noise, tests were made by starting with a 4 mc band and gradually reducing its width towards 1 mc, maintaining the power-per-kc constant. The observations showed that no appreciable change in interfering effect was produced. The present data of Figs. 4 and 5 are in complete accord with these findings but they also show a marked increase in the interfering effect of noise in the region below 1 mc. The early tests were not carried far enough to divulge this information.

Table 1 shows the magnitude of the unweighted noise powers plotted in Figs. 3, 4, and 5.

Fig. 6 shows three weighting curves, one derived from the bandpass data, another derived from the low-pass data and a third or compromise curve drawn in between the other two. An explanation of the derivation of the top and bottom curves is given in the Appendix.

The uppermost curve, derived from bandpass noises, extends down to only about 300 kc, since adequate data were not taken on bands below this frequency. The bottom curve, derived from low-pass data, is not shown beyond 1.3 mc because in the presence of low-frequency interference, the determination of the position of the high-frequency end of the curve is subject to large errors, and hence there is considerable uncertainty as to its proper level, based on the low-pass data alone.

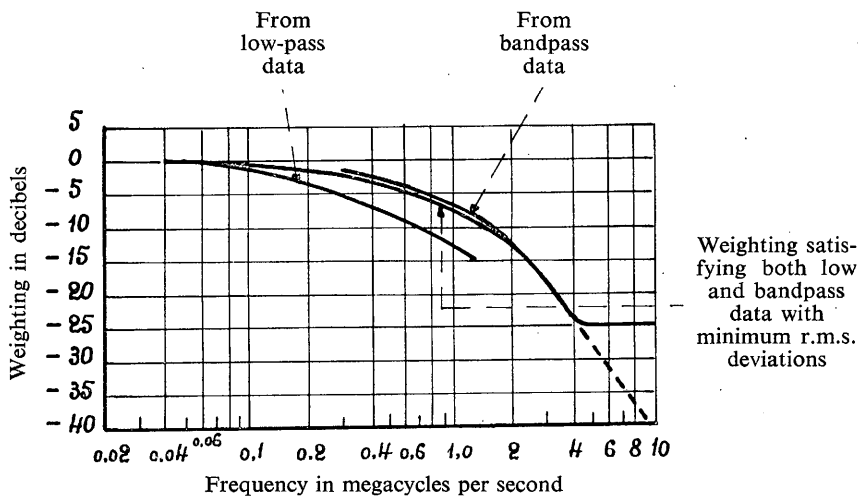


FIGURE 6. — *Weighting shapes derived from judgment tests*

The curves are so placed on the db scale that if the top curve is used for the bandpass noises and the bottom curve for the low-pass noises, computed weighted noise powers turn out to be approximately equal when the interferences were judged to be equal by the jury of observers.

It is obviously impracticable to employ one weighting and calibration for low-pass interference and another weighting and calibration for bandpass interference. Hence, a compromise is necessary if the summation of weighted power is used as an indication of interfering effect.

At this point it should be noted that the different positions of the two curves reveal that for the interference levels tested, human vision does not sum the weighted interference powers over the band in assessing over-all interfering effect. The relative positions of the curves indicate that a given amount of noise power is more interfering if it is concentrated in a narrow band (bandpass data) than if it is spread out over a wider band (low-pass data) in the same frequency region.

Consideration of the interfering effects of narrow- and wide-band noises, having the same power, in the same general frequency region, indicates that the average observer saw something that caused him to rate the narrow bands more interfering. It is a fact that narrow bands tend to produce fleeting patterns not very unlike herringbone effects. If the band could be made progressively narrower until only a single frequency was passed, bar patterns would result. In other words, the narrower the band, the less random the noise effect and hence the more objectionable it becomes. This is apparently one of the causes for the displacement of the two weighting curves, derived for low-pass and bandpass noises, shown in Fig. 6.

Theorizing further on the observations, and noting that they were made at levels only a few db (about 7) above threshold, it appears reasonable that if the noise power in a narrow band at this level were redistributed over a much wider band, the resulting noise power per cycle might easily be so low as to be barely above threshold, or even slightly below threshold. Under these conditions a balance between the interfering effects would be obtained only by raising the power in the wide-band noise relative to that in the narrow-band noise. This reasoning offers a further explanation of the observed results.

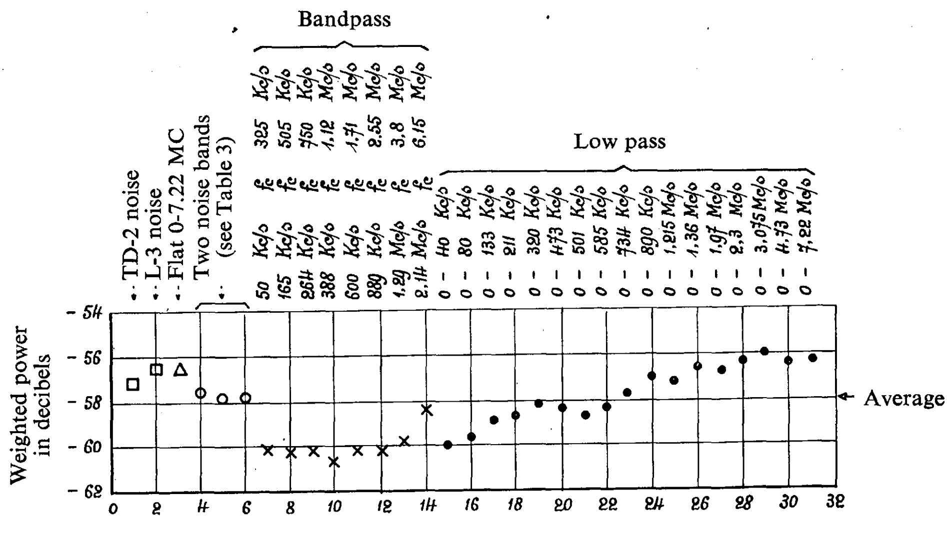


FIGURE 7. — *Weighted powers of noises judged to be equally interfering*

The curve plotted between the two outside curves in Fig. 6 is a compromise weighting which produces nearly constant computed weighted powers when different shapes of random interference are adjusted to be equally interfering by competent jurors. The philosophy involved in drawing this curve between the other two may be described as follows : At low frequencies, where the only evidence available is from noise obtained through low-pass filters, the compromise curve is near the low-pass curve. At high frequencies where the low-pass data gives very poor evidence of what the weighting should be, the compromise curve is drawn near the bandpass curve. This is done not only because the best evidence on what the weighting should be at high frequencies is obtained from the bandpass data, but also because in actual practice most random noises are tipped up to some extent, and therefore approach, in the limit, bandpass noise having high noise power per cycle near the upper edge of the band. It would appear that full weight should be given to high-frequency noise when it occurs in this manner.

Fig. 7 shows the computed interference magnitude for the series of random noises that were used in the course of these experiments. Each position along the abscissa presents a given noise, which is briefly described as regards frequency composition. A more complete description of each noise is given in Table 2, together with numerical magnitudes of the data plotted in Fig. 7. The computed magnitude using the compromise weighting is shown as the ordinate. Since all noises were judged to be equally interfering by jurors, the departure of the respective computed values from a constant average value represents the errors which might be expected from a meter designed to sum the weighted power according to the compromise weighting in Fig. 6.

An examination of Fig. 7 shows that narrow-band noises will in general be underweighted (the meter will read too low), and broad bands will be overweighted (the meter will read too high).

The rms deviation of the db magnitudes shown in Fig. 2 from the average value is 1.42 db. This may be compared to the rms deviation from the mean of all observer judgements on the various noises. The latter figure is 1.45 db. From this it may be seen that the meter error (assuming the mean judgment of the jurors to be correct in every case) is of about the same order of magnitude as the observer deviation.

Sparkle Effect. — Fig. 1 shows two weightings for the area above 4 mc. The lower weighting is an extrapolation of the weighting determined by the judgement tests for frequencies below 4 mc, while the upper weighting more nearly represents the weighting determined by judgement tests on the noise band in the 4-8-mc region.

The appearance of noise as observed on a picture tube varies enormously, depending upon the frequency composition. Very low-frequency noise creates a streaky, nebulous effect that is judged most annoying. As the frequency increases, the disturbance resembles photographic grain in which the individual grains have random motion and become finer and finer as the frequency increases. As the grain becomes finer, the input noise level must be increased to keep the fine grain visible. In the vicinity of 4.5 mc an abrupt change occurs. The face of the picture tube now appears specked with minute points of light that endure for a fleeting instant and then disappear. This sparkling causes the observer evaluation to flatten out above 4.5 mc. It occurs only when the total noise energy is contained in the area above 4.5 mc. This effect appears related to the random occurrence of peak potentials in the random noise source and to the effect of these potentials on the kinescope. The output of the noise generator was examined periodically with an oscilloscope for evidence of clipping. These measurements indicated the output of the noise generator to have a peak factor of 14 db (peak noise volts to rms noise volts) and showed no evidence of clipping.

Overloading of the amplifiers external to the viewing monitor, Fig. 2, tended to change the appearance of the sparkling. The minute bright areas became elongated and more nearly resembled short dashes of light. This change in character made it possible to differentiate between the true sparkle effect and overloading of the amplifiers. Three different 1816 P4 kinescopes showed the sparkle effect. This suggests that the effect is characteristic of the kinescope.

The interpretation of this result on design standards is of importance. If a situation arises in which the expected noise is all in the region above 4 mc, the upper weighting curve should be employed, since the noise cannot be permitted to break through the threshold of the sparkle effect. If the expected noise is spread out over the low as well as the high frequencies, it would be permissible to use the lower curve, since the contribution of the high frequencies (when they are below the threshold of the sparkle effect) is negligibly low and is probably most accurately assessed by application of this weighting. As a practical matter, on general types of noises, it would probably not matter what curve is used, since the sparkle effect begins at levels over 25 db higher than the threshold of interference in the low frequency regions.

Two-Band Noise Tests. — Each 2 band noise was made up of a low-pass band (cut-off low on the frequency scale) and a high-frequency bandpass band. The levels of each were adjusted to be equally interfering. The observations were made in the same manner employed for the 1 band tests described earlier and shown schematically in Fig. 2. Ten observers were employed. Table 3 gives the results of these tests and indicates the weighted power in the 2 band noises were from 1 to 1.4 db smaller than the weighted power in the judgement criterion. These results substantiate the general results presented here as regards the magnitudes of the deviations expected. More specifically, the added bands fall in the category of narrow bands and thus should be underweighted by the compromise weighting, as shown in Figs. 6 and 7, and as is evident in the results.

Conclusion. — The results of the experiments described have indicated that random television interference can be measured with a power meter having frequency weighting with sufficient accuracy to be of value in the design and maintenance of television transmission circuits.

The relationship between the quantity measured and the subjective effect is not precisely unique but the order of magnitude of the errors is about the same for the weighted power meter as were the rms deviations of the observer data. Useful design and maintenance standards can be set up in terms of meter readings at given level points on transmission circuits.

APPENDIX

(to Annex 2)

Weighting from Bandpass and Low-Pass Data

Bandpass Data. — The derivation of a frequency weighting from the bandpass data shown in Fig. 3 is given in Table 4. In the table, column 1 shows the mid-frequencies of the respective bands, and column 2 the full bandwidths. Column 3 gives the total power in each band in db relative to the power in the first band when each noise was adjusted to have the reference interfering effect. In column 4 corrected frequency figures are given. These figures are very nearly the same as the figures in column 1 (mid-band frequencies) but slightly different because, if an appreciable slope in the weighting occurs over one of the given bands of noise, it is apparent that the center-of-interference of that band is not the arithmetic center of the band. Since it was desired to plot the weighting at the center-of-interference of each band, a small frequency correction was calculated whenever the db weighting across the band changed by 2 db or more. The figures in columns 3 and 4, when plotted, give the desired shape of the weighting. This is the shape given in the top curve of Fig. 6. As indicated in the text, the position of the curve on the db scale was determined by adjustment, to produce calculated magnitudes of noise from the bandpass data that were equal to the magnitudes of the low-pass noises calculated from the bottom curve.

Low-Pass Data. — The calculation of weighting from the low-pass data yields results which are considerably more inaccurate than those obtained from the bandpass data, especially in the frequency regions above 500 kc. This is because all the judgments from which weightings may be calculated were made in the presence of low-frequency noise which has been shown to be more interfering, per cycle, than high-frequency noise. Hence, small differences in the opinions of observers in the levels producing equal interfering effects result in very large differences in the estimated weightings for the frequency regions above the very lowest employed.

A very effective method of weighting derivation is the cut-and-try method. This, however, usually involves several unsuccessful attempts and is correspondingly tedious because of the computations involved. Hence, a method of obtaining an initial curve from the data was worked out and a sample is carried out in Table 5 for the data given in Fig. 4.

The principle involved in making the calculation was that each noise should be required, through the application of a calculated weighting, to produce a weighted power sum of unity, since each was judged to be equally interfering. A weighting of 0 db was assumed to apply all across the lowest band (40 kc wide). In the next wider band a 0-db weighting was assumed to hold over that portion common to the lowest band, and a lesser weighting calculated for the remainder of the bandwidth such that the total weighted sum of the power for the noise came out to be unity also.

For the third band the portion common to the second band was effectively treated with the two weightings previously derived and the remainder, in excess over the width of the second noise, was operated upon by a third weighting calculated to make the weighted sum of the powers unity. This method was carried on for bands up to 2.3 mc wide. For wider bands the calculation indicated that practically no contribution to interference was being made by the high frequencies and hence no evidence could be adduced as to where the weightings should be.

In Table 5, column (a) gives the bandwidths of the low-pass noises employed. Column (b) gives the excess bandwidth, for any particular low-pass band, over that of the adjacent lower band. Column (c) gives the frequency factor in db, of the excess bandwidths given in column (b). Column (d) gives the relative powers per 10 kc in db for the bands when they were adjusted in level to produce equal interfering effects. These data are obtained from Fig. 4, making the db figures relative to that for the narrowest band (40 kc). Column (c) gives the weighted power in that portion of any band common to the next lower adjacent band. These are power units and are obtained by reducing unity by the difference between the db figure in column (d) and the corresponding figure in the row immediately above. For example, the figure 0.525 in column (e) corresponds to unity reduced by 2.55 db. Column (f) gives the power figure of unity to which the calculation in each row is directed. Column (g) gives the difference between the figures in columns (e) and (f). Column (h) is the db figure corresponding to the power figures in column (g). Column (i) gives the desired weighting. This figure is obtained by combining the figures in columns (c), (d) and (h) according to the equation $i = h - (d + c)$.

Column (j) gives the frequencies corresponding to the weightings. These frequencies are approximately the mid-frequencies of the portion of a given low-pass band not common to the next adjacent lower band.

The smoothed curve drawn through these points, averaged with a similarly derived smooth curve for the data shown in Fig. 5 gives the shape of the bottom curve shown in Fig. 6.

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1. Pierre Mertz. Data on Random Noise Requirements for Theatre Television. *Journal, Society of Motion Picture and Television Engineers*, New York. N. Y., vol. 57, Aug. 1951, pp. 89-107.

2. Otto H. Schade. Image Gradation Graininess and Sharpness in Television and Motion Picture Systems, Part 2. *Journal, Society of Motion Picture and Television Engineers*, New York, N. Y., vol. 58, March 1952, pp. 181-222.

TABLE 1

Unweighted Noise Powers Judged Equally Interfering *

30-Observer Bandpass Data of May 20, 1952, and July 18, 1950			
Passband, Megacycles (Mc)		Total Power Decibels (db)	Power/10 Kc db
Mid	Full		
0.325	0.050	— 56.8	— 63.8
0.505	0.165	— 55.4	— 66.6
0.750	0.264	— 53.9	— 68.1
1.120	0.388	— 52.3	— 68.1
1.710	0.600	— 48.8	— 66.6
2.55	0.889	— 43.5	— 62.9
3.80	1.29	— 36.9	— 58.0
6.15	2.14	— 33.4	— 56.4

30-Observer Low-Pass Data of May 20, 1952 and July 18, 1950			9-Observer Low-Pass Data of July 18-27, 1952	
Upper Cut-off Mc	Total Power db	Power/10 Kc db	Total Power db	Power/10 Kc db
0.040	— 59.8	— 65.8		
0.080	— 59.3	— 68.4	— 58.8	— 67.8
0.133	— 58.4	— 69.6	— 57.7	— 68.9
0.211	— 57.9	— 71.1	— 57.5	— 70.7
0.320	— 56.5	— 71.5	— 56.6	— 71.7
0.473			— 56.1	— 72.3
0.501			— 56.4	— 73.4
0.585	— 54.9	— 72.6		
0.734			— 54.7	— 73.4
0.890	— 53.4	— 72.9		
1.215			— 53.0	— 73.8
1.360	— 52.1	— 73.4		
1.970			— 50.9	— 73.8
2.300	— 49.8	— 73.4		
3.075	— 48.6	— 73.4		
4.73	— 46.6	— 73.4	— 47.1	— 73.8
7.22	— 45.0	— 73.6	— 45.3	— 73.8
Judgement Criterion	— 45.3	— 73.8	— 45.3	— 73.8

* The indicated powers were judged to have the same interfering effect as the 7.22-mc flat noise band used as a judgment criterion

$$20 \log_{10} \frac{\text{R.m.s. noise volts}}{\text{Peak-to-peak composite signal volt}} = - 45{,}26 \text{ db.}$$

TABLE 2. — *Description of Noises Tested*

Noise Test		Weighted Power db	Deviation from Average db	Deviation Squared db
1.	Simulated *TD* 2, 12 db per octave maximum at 7.22 mc.	57.05	−0.95	0.900
2.	*L*3 noise, down 10 db at 0.5 mc. 10 db at 1 mc. 7 db at 2 mc. 0 at 4.4 mc.	56.45	−1.55	2.400
3.	Flat noise, uniform energy per kc. 0 to 7.22 mc.	56.43	−1.57	2.460
4.	Two noise bands, see Table III	57.47	−0.53	0.281
5.	Two noise bands, see Table III	57.86	−0.14	0.0196
6.	Two noise bands, see Table III	57.76	−0.24	0.0576
7.	Bandpass band centered at 0.325 mc. full band 0.050 mc.	60.00	+2.0	4.000
8.	Bandpass band centered at 0.505 mc. full band 0.165 mc.	60.06	+2.06	4.250
9.	Bandpass band centered at 0.750 mc. full band 0.264 mc.	60.02	+2.02	4.080
10.	Bandpass band centered at 1.120 mc. full band 0.388 mc.	60.52	+2.5	6.250
11.	Bandpass band centered at 1.710 mc. full band 0.600 mc.	60.24	+2.24	5.000
12.	Bandpass band centered at 2.550 mc. full band 0.889 mc.	60.10	+2.1	4.410
13.	Bandpass band centered at 3.800 mc. full band 1.290 mc.	59.28	+1.28	1.640
14.	Bandpass band centered at 6.150 mc. full band 2.140 mc.	58.30	+0.30	0.090
15.	Low pass band 0 to 0.040 mc.	59.80	+1.80	3.250
16.	Low-pass band 0 to 0.080 mc.	59.50	+1.50	2.250
17.	Low-pass band 0 to 0.133 mc.	58.80	+0.80	0.640
18.	Low-pass band 0 to 0.211 mc.	58.60	+0.60	0.360
19.	Low-pass band 0 to 0.320 mc.	58.12	+0.12	0.0144
20.	Low-pass band 0 to 0.473 mc.	58.22	+0.22	0.441
21.	Low-pass band 0 to 0.501 mc.	58.61	+0.61	0.3720
22.	Low-pass band 0 to 0.585 mc.	58.35	+0.35	0.1220
23.	Low-pass band 0 to 0.734 mc.	57.65	−0.35	0.1220
24.	Low-pass band 0 to 0.890 mc.	56.90	−1.10	1.2100
25.	Low-pass band 0 to 1.215 mc.	57.12	−0.88	0.7750
26.	Low-pass band 0 to 1.360 mc.	56.50	−1.50	2.2500
27.	Low-pass band 0 to 1.970 mc.	56.72	−1.28	1.6400
28.	Low-pass band 0 to 2.300 mc.	56.15	−1.85	3.4200
29.	Low-pass band 0 to 3.075 mc.	56.05	−1.93	3.8100
30.	Low-pass band 0 to 4.73 mc.	56.15	−1.85	3.4300
31.	Low-pass band 0 to 7.22 mc.	56.17	−1.83	3.3500
		1801.00		62.8982
		58.00 average		2.03 1.42 db standard deviation

TABLE 3

Results of 2-Band Noise Tests

Observations Made by 10 Observers						
Noise Test No. *	Filter	Passband, Mc		Unweighted Power in Each Band	Weighted Power in Each Band	Total Weighted Power Combined Bands
		Mid	Full	db	db	db
4	Low-pass . . .		0.133	−59.17	−59.77	
	Bandpass . . .	1.12	0.388	−53.06	−61.26	−57.47
5	Low-pass . . .		0.133	−60.06	−60.66	
	Bandpass . . .	3.80	1.29	−38.56	−61.04	−57.86
6	Low-pass . . .		0.211	−59.16	−60.16	
	Bandpass . . .	2.55	0.889	−44.76	−61.36	−57.76
3 Judgment criterion **	Low-pass . . .		7.22	−45.26	−56.43	−56.43

* Test numbers as listed in Table 2.

** The power in the combined bands was judged to equal the interfering effect of the 7.22-mc low-pass band used as a reference or judgment criterion.

TABLE 4

Computation of Weighting from Bandpass Data of Fig. 3

Mid-band Frequency Mc (1)	Full Band-width Mc (2)	Total Relative Power for Equal Interfering Effect db (3)	Corrected Frequency Mc (4)
0.325	0.050	0	0.325
0.505	0.165	1.4	0.505
0.750	0.264	2.9	0.737
1.12	0.388	4.5	1.097
1.71	0.600	8.0	1.644
2.55	0.889	13.3	2.457
3.80	1.29	19.9	3.585
6.15	2.14	23.4	6.15

TABLE 5

Computation of Weighting from Low-Pass Data of Fig. 4

Bandwidth Mc (a)	Bandwidth Excess Over Adjacent Lower Band (b)	10-Log Excess Bandwidth 0.040 (c)	Relative Power per 10 Kc for Equal Interfering Effect db (d)	Weighted Power in Adjacent Lower-Band (e)	Total Weighted Power for Given Interfering Effect (f)	Weighted Power in Bandwidth in Excess of Lower Adjacent Band db (g)	Total Level of Bandwidth in Excess of Lower Adjacent Band db (h)	Weighting for Bandwidth in Excess of Lower Adjacent Band db (i)	Mid-Frequency of Band in excess of Lower Adjacent Band Mc (j)
0.040			0		1.000		0	0	0.020
0.080	0.040	0	−2.55	0.525	1.000	0.475	− 3.2	− 0.65	0.060
0.133	0.053	+ 1.2	−3.77	0.756	1.000	0.244	− 6.1	− 3.53	0.106
0.211	0.078	+ 2.9	−5.27	0.708	1.000	0.292	− 5.3	− 2.93	0.172
0.320	0.111	+ 4.4	−5.72	0.902	1.000	0.098	−10.1	− 8.78	0.266
0.585	0.265	+ 8.2	−6.74	0.791	1.000	0.209	− 6.8	− 8.26	0.452
0.890	0.305	+ 8.8	−7.11	0.918	1.000	0.092	−10.9	−12.59	0.737
1.360	0.470	+10.7	−7.53	0.908	1.000	0.082	−10.4	−13.57	1.125
2.300	0.940	+13.7	−7.56	0.993	1.000	0.007	−21.5	−27.64	1.836
3.075									
4.73									
7.22									

Question No. 15.

(3rd Study Group of the C.C.I.F., in co-operation with the 5th S.G. of the C.C.I.F. and with the C.C.I.R.) (Category A 2) [urgent] (continuation of Question No. 16, part G, studied in 1952/1954)

To allow a recommendation to be formulated for the desirable limit of signal-to-noise for periodic noise in a television transmission, the C.C.I.F. should first give a preliminary indication of the carrier frequencies to be used for the different systems of television described by the C.C.I.R.

A preliminary recommendation exists for the 405-line system ; it remains to establish one for the 625 and 819-line systems.

This being so, the following new (urgent) question should be studied :—

1. For the various television systems recommended by the C.C.I.R., what line carrier frequency should be recommended for the transmission of television signals over long-distance coaxial-pair circuits ?

2. Having regard to :

(a) the line carrier frequency used for the transmission of television signals, for the different systems recommended by the C.C.I.R., over long-distances coaxial-pair circuits, and the types of periodic noise which may result.

(b) the presence of all other periodic noise which may accompany the signal transmitted over the line.

(c) the requirements of the television Broadcasting Organisations concerning the quality of the transmission.

Is it possible to recommend :

(a) a value for the ratio of the signal to periodic noise ?

(b) a graph indicating the weighting to be applied to the amplitude of this noise as a function of frequency ?

(c) an addition law to enable the resultant disturbing effect of a mixture of sinusoidal components to be deduced.

Note. — The C.C.I.R. has drawn attention to the fact that transmission of pilots on coaxial systems can give rise to interference on television transmissions, this interference being similar to periodic noise. It states that this interference is less troublesome if the frequency of the pilots is selected to be approximately an odd multiple of half of the line frequency.

Question No. 16.

(3rd Study Group) (Category A 2) [urgent] (continuation of Question No. 16, part G, studied in 1952/1954)

What characteristics should be recommended for the repeaters of a television circuit on coaxial pairs, for the three television systems used in Europe (405, 625 and 819 lines) ?

Note: Particular consideration will be given to the limits to be imposed so that the signal-to-noise ratios mentioned in § G of Annex 2 to Question No. 11 may be met for the " nominal maximum circuit on coaxial pairs for television transmission ".

Question No. 17.

(3rd Study Group in co-operation with the C.C.I.R., the I.B.O. and the E.B.U.) (Category B) [non-urgent] (continuation of Question No. 17 studied in 1952/1954)

(a) Can the transient response of a transmission circuit to a given signal be deduced from the transient responses of the different parts of the circuit to the same signal without having to use spectral analysis ?

Note. — According to the initial results given by the study of this question it is possible to deduce the transient response of a transmission circuit to a given signal from the transient response of different parts of the circuit to the same signal without having to use spectral analysis provided that the signal has a limited bandwidth and if as is generally the case in practice, the impedances at each junction point in the circuit are much the same. There are two practical methods of making the calculations (see the " note of the French and British Administrations on the methods of calculation in the transient state ", on pages 389 and 393 of Volume III *bis* of the *Yellow Book*). The annex below indicates the relationships between these two methods. In particular it is necessary to study what will be the optimum value of the parameter τ defined in this note. It is also essential to agree on the method of defining the function $Y(2\pi jf)$ introduced in this annex, in order that all users will employ the same values of the parameters t_k in their calculations.

(b) In the spirit of part *(a)* of this question, can a method be recommended for synthesizing a network having given transient characteristics with the object, for example, of correcting the residual distortion of a transmission system without having to make a detailed examination of the make-up of different sections of the system ?

ANNEX

(to Question No. 17)

Reply by the French Administration to Question No. 17 studied in 1952/1954 by the 3rd Study Group

Part (a). — The theoretical studies in the bibliography given on pages 393 and 394 of Tome III *bis* of the C.C.I.F. *Yellow Book* have indicated that the problem is possible in the case where the transmission circuits to be studied have a limited spectrum.

The French and British Administrations have proposed two methods described in the note on pages 389 to 393 of Volume III *bis* of the *Yellow Book.* The two methods have the same starting point.

Let $(-f_u, +f_u)$ be the band of frequencies for which it is desired to know the transient response of a television circuit. In the two methods a pulse I (t), of spectrum limited to the band $(-f_o, +f_o)$, wider than the useful band required $(f_o > f_u)$, is applied to the circuit.

(In practice, the two Administrations propose a pulse of the sine-squared (raised-cosine) form of half-amplitude width $\frac{1}{2f_u}$ and whose spectrum is limited to the band $(-2f_u, +2f_u)$ but this choice is by no means imperative).

Let $R(t)$ be the response of the circuit to this signal.

Both Administrations calculate, starting from $R(t)$, a series of coefficients characterising the circuit.

The French Administration proposes to place $R(t)$ in the form :

$$R(t) = \Sigma\, \alpha_n\, \mathrm{I}\,(t - n\,\tau) \qquad \tau = \frac{1}{2f_o}$$

(In the appendix a method is given for rapidly calculating α_n knowing $r_n = R(n\,\tau)$).

The British Administration for its part proposes to define the circuit by letting the series β_n represent the response of the circuit to a " filtered impulse " limited to the band $(-f_u, +f_u)$.

This signifies that if $J(t)$ is the filtered impulse and $S(t)$ the response of the circuit to this filtered impulse, $S(t)$ is in the form

$$S(t) = \Sigma\, \beta_n\, J\left(t - \frac{n}{2f_u}\right)$$

The method for calculating β_n is the following :—

(a) the spectrum of $R(t)$ is limited to the band $(-f_u, +f_u)$ so that the series is given by $r'_n = R\left(n\,\frac{\tau'}{2}\right)$ with $\tau' = \frac{1}{2f_u}$

The values of r''_n are calculated from an expression of the form :

$$r''_n = \Sigma\, H_{m,n}\, r'_n$$

The new interval is $\tau' = \frac{1}{2f_u}$

The coefficients $H_{m,n}$ have a simple form because the time series of r''_n (interval $\frac{1}{2f_u}$) is related in a simple manner to the time series of r'_n (interval $\frac{1}{4f_u}$) ;

(b) To the spectrum of $R(t)$ is applied a correction factor which is the inverse of the pulse $\mathrm{I}(t)$ in the interval $(-f_u, +f_u)$ and zero beyond, an operation performed by convolution of r''_n with a known series.

The series β_n is thus the series of ordinates of the pulse response of the circuit at the instants $n\,\tau'$, when this circuit is followed by an ideal low-pass filter of cut-off frequency f_u.

In practice, the second method has the advantages over the first of yielding a shorter series in the case where the frequency f_u is greatly attenuated by the circuit. If this frequency is not greatly attenuated, the number of terms of the series increases and might then exceed those of the terms of the series α_n. This arises from the fact that the density of the energy spectrum is indeterminate in the filtered impulse $J(t)$ in the vicinity of f_u.

The second method on the other hand has the disadvantages of limiting information to the band f_u and requiring the presence of a low-pass filter of effective cut-off f_u in all experimental verification.

The essential difference between the two methods appears in the convolution of the circuits. In the French method the convolution for α_n is made relative to the different circuits, the series α_n is calculated relative to the overall circuit and then, if one seeks to minimise the number of coefficients characterising the overall circuit, can be changed to β_n. In the British method β_n is calculated for the individual circuits and then β_n for the overall circuit is obtained by convolution.

The remark in the text of Question No. 17 concerns the annex published in the *Yellow Book*, Volume III *bis*, pages 389 to 393. The conclusion (pages 392 and 393) remains valid with the following new explanation. The French Administration is prepared to translate the series of interval $\frac{1}{4f_u}$ according to its method into a series of interval $\frac{1}{2f_u}$ corresponding to that obtained by the British method. But it is useless for one Administration to take $\frac{1}{2f_u}$ as the interval and the other $\frac{1}{4f_u}$ in order to make the results transferable if it is not the same f_u in each case. An acceptable provisional proposition is to take for (f_u) one of the terms of following series:

3 Mc/s (for example, the standard for 405 lines)
6 Mc/s (for example, the standard for 625 lines)
12 Mc/s (for example, the standard for 819 lines)

The users should also define the function $Y(2\pi jf)$, that is to say, specify:

(1) Between what points the function $Y(2\pi jf)$ is taken;

(2) To what signal the function $Y(2\pi jf)$ applies and at what reference level.

Regarding this the French Administration proposes the following :—

(1) $Y(2\pi jf)$ may be taken between the input of the long-distance line and the junction point between the two international circuits. If the junction is made by a radio link, the transmitter belonging to one Administration and the receiver to another, by agreement a junction point should be chosen on one side or the other of the radio link.

(2) As is well known, $Y(2\pi jf)$ the transmission factor in the band $(-f_u, +f_u)$ should be defined with respect to a given origin and level. It is recommended to take $Y(2\pi jf)$ such that the significant coefficients A_k (see Volume III *bis*, page 389, formula 3) should be as few as possible (the term " significant " is taken as " not negligible " in the numerical calculation).

$Y(2\pi jf)$ will be placed in the form

$$Y(2\pi jf) = Ke^{-2\pi jft_o} \Sigma A_k e^{-2\pi jf\frac{k}{2f_u}}$$

t_o and K being chosen so that the number of significant terms A_k is as small as possible and the greatest of the terms A_k is equal to unity.

The choice of K and of t_o is mainly a question of convenience. It will be left to the discretion of Administrations.

As regards the quality and the order of magnitude of A_k (see Volume III *bis*, page 393, 5th line) the question remains for study on the assumption that it will have three limitations:

(a) for the values of A_k with small index;

(b) for the values of A_k with high index and small value;

(c) for the values of A_k with high index and large value.

Part (b). — The method to be recommended for the synthesis of networks is based upon the theory of inversion of the time series given in an article by Thomson (*Proceedings of the Institution of Electrical Engineers*, Vol. 99, Part IV, p. 397, December, 1952) and in " *l'étude No. 257 T du Service des Recherches et du contrôle techniques de l'administration française* ".

In this theory the inversion of a series X is defined as the operation which produces a series Y such that the convolution of X and Y gives a " unit " series, that is to say only possessing one non-zero term.

It may be shown that this operation is identical to the inversion of the spectrum of the function represented by the series and that it is possible if this spectrum is not zero anywhere in the interval $(-f, +f)$ where $f = \frac{1}{2\tau}$.

This being so, the operation is not directly applicable to the series α_n given by the method of the French Administration. The spectrum should first be limited to that of $-f_u$, $+f_u$. The result of this limitation obviously restores the series β_n given directly by the method of the British Administration.

The inversion of this series gives the filtered impulse response, limited to $(-f_u, +f_u)$, of the network which corrects the distortion of the circuit in this band.

In practice, it is easy to provide this correcting network by means of a delay line on which taps are arranged adjustable at intervals separated by $\tau = \frac{1}{2 f_u}$.

It is then possible to effect the inversion (or the correction) by the adjustment of the apparatus without calculation.

For this purpose use is made of a pulse generator $I(t)$ followed by a low-pass filter of cut-off frequency f_u and an oscilloscope.

The object is to obtain the same pulse shape on the oscilloscope by direct transmission and by transmission through the circuit followed by the correcting network (see Figures 1 and 2).

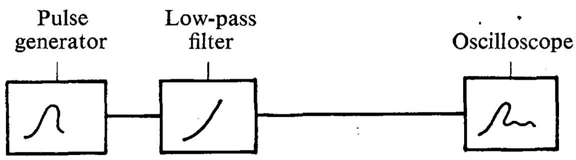


FIGURE 1

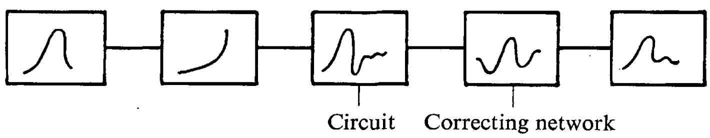


FIGURE 2

The presence of the low-pass filter of effective cut-off $f_u = \frac{1}{2\tau}$ is absolutely necessary but it is not important at what point in the circuit it is placed.

APPENDIX

(to the annex)

Calculation of the coefficients α_n

This calculation serves to solve the system of equations :

$$r_n = \frac{1}{2}\alpha_{n-1} + \alpha_n + \frac{1}{2}\alpha_{n+1} \tag{1}$$

These equations have exact solutions when the following conditions are fulfilled :—

$$\sum_n (-1)^n r_n = 0 \tag{2}$$

$$\sum_n (-1)^n n r_n = 0 \tag{3}$$

These conditions indicate that the spectrum of the signal R_n, and also its derivative, is zero for the frequency $f_o = \frac{1}{2\tau}$.

They are in no way artificial and correspond to physical reality : the network studied should not specially favour the frequencies in the neighbourhood of $\frac{1}{2\tau}$ if it is desired to test it with the chosen pulse.

Therefore, the resolution of the system results in the following series of operations :—

(a) multiply the terms of the series r_n by $(-1)^n$

(b) form the series $b_n = \sum\limits_{o}^{n} (-1)^p \, a_p$

(c) form the series $c_n = \sum\limits_{o}^{n} b_p$

(d) multiply the terms of c_n by $(-1)^n$

Example

Let the series

$$\overset{\tau}{\longleftrightarrow}$$
$$0 \quad 1 \quad 5 \quad 11 \quad 14 \quad 11 \quad 5 \quad 1 \quad 0$$

which represents the response of a network cutting off at $0.75\,f_o$ to a cosine-squared pulse of half-amplitude $\frac{1}{f_o}$ and of spectrum from $(-f_o, \ +f_o)$ $\left(f_o = \frac{1}{2\tau}\right)$

(a) multiply by $(-1)^n$

$$0 \quad \bar{1} \quad 5 \quad \overline{11} \quad 14 \quad \overline{11} \quad 5 \quad \bar{1} \quad 0$$

(b) form $b_n = \sum\limits_{o}^{n} (-1)^p \, a_p$

$$0 \quad \bar{1} \quad 4 \quad \bar{7} \quad 7 \quad \bar{4} \quad 1 \quad 0$$

(c) form $c_n = \sum\limits_{o}^{n} b_p$

$$0 \quad \bar{1} \quad 3 \quad \bar{4} \quad 3 \quad \bar{1} \quad 0$$

(d) multiply by $(-1)^n$

$$0 \quad 1 \quad 3 \quad 4 \quad 3 \quad 1 \quad 0$$

The answer is immediate and gives the following table.

$$\begin{array}{ccccccc} \underbrace{0\ \ 1} & \underbrace{\ 3\ } & \underbrace{\ 4\ } & \underbrace{\ 3\ } & \underbrace{\ 1\ } & \underbrace{\ 0\ } & \\ \underbrace{0\ \ 1} & \underbrace{\ 4\ } & \underbrace{\ 7\ } & \underbrace{\ 7\ } & \underbrace{\ 4\ } & \underbrace{\ 1\ } & \underbrace{\ 0\ } \\ 1 & 5 & 11 & 14 & 11 & 5 & 1 \end{array}$$

Question No. 18.

(3rd Study Group in co-operation with the C.C.I.R., I.B.O. and E.B.U.) (Category B) [non-urgent] (new question)

When an international television circuit includes several links belonging to countries having different television standards, the study of each link in the time domain has to be made, in accordance with the needs of the country to which the link belongs, with the aid of one or more test signals of the sine-squared (or raised-cosine) type.

(a) Is it possible to recommend, for the maximum effective frequencies of these test signals and for the time-series intervals used in the analysis of the cor-

responding waveform responses, one or more groups of values such that the quality of the circuit for the intended transmissions can be deduced, with sufficient precision for practical needs, from the results of the studies of each of the links ?

(b) If so, what method should be recommended for combining these results so that the overall characteristics of the circuit for the intended transmission can be deduced therefrom ?

(c) If not, what supplementary tests should be considered ?

Note. — The following annex gives some preliminary considerations on the subject of this question.

ANNEX

(to Question 18)

Reply of the French Telephone Administration to Question 17 of the 3rd Study Group in September, 1954

From the individual responses of two linear networks to the same signal, it is possible to determine the response, to the same signal, of the tandem connection of the two networks.

When the signal considered has a limited frequency spectrum and does not contain any frequency exceeding f_o the above operation may be performed by means of the ordinates obtained from analysis of the signal and the responses taken with a maximum spacing of $\frac{1}{2} f_o$.

With reference to the testing of television circuits by a test signal, and the combination of the test results of the different links of an international circuit, by the rules inspired by the methods outlined above, the French Administration recommends :—

1. One of the test signals should be a sine-squared (raised cosine) pulse having a half-amplitude duration equal to a half-cycle of f_u, the upper frequency of the band tested (e.g. 3 Mc/s for the British 405-line system). In the tests discussed in Question No. 17, the precise form of the signal is of secondary importance because allowance may be made for the imperfections of the generator by an appropriate correction of the time series representing the transmission performance of a link. It should be noted that the imperfections of the signal used must be avoided as far as possible, in a manner which does not unnecessarily complicate the calculations, and particularly in order to prevent the spectrum of the signal used spreading beyond the spectrum of the theoretical sine-squared pulse, conditions which would spoil the selection proposed in 2 below.

2. The response of a link to the proposed test signal will be measured by selecting ordinates at intervals not greater than $\frac{1}{4} f_u$. When, in accordance with 3, the object of the calculation will be to define the response in the band $(-f_u, +f_u)$, the interval should be $\frac{1}{4} f_u$. When an Administration having a link defined by f_u has to put this link at the disposal of an Administration which uses only a band $f'_u < f_u$, the first Administration, always using a test signal corresponding to f_u, i.e. suitable for its own link, would be advised to take an interval which may be smaller than $\frac{1}{4} f_u$ and which at the same time is an integral sub-multiple of $\frac{1}{4} f'_u$, in a way which will facilitate the transformations described in 5.

In certain cases listed below in 5, however, the test signal corresponding to f_u may in practice give insufficient information in the band f'_u.

3. The calculation beginning with a series of interval $\frac{1}{4} f_u$, as mentioned in 2, will lead by means of the now classical methods of calculation to a time series of interval $\frac{1}{2} f_u$, which will express the quality of a circuit by methods which are being studied.

4. The choice of the frequency f_u for the 625 and 819-line systems is left to the competent authorities ; it is probable that for the 625-line system, the choice will be 5 Mc/s.

5. The method recommended for combining the relative results of the different links of an international television circuit passing through countries which will eventually have different standards, is still under study. It is to be hoped that each Administration will make known the value of the frequency f_u appropriate to its own circuits, so that the intervals mentioned in 2 may be known when an Administration tests one of these circuits. A single test, yielding several intervals should thus satisfy not only national but also international requirements.

For such international television circuits, practical considerations may make it necessary to proceed with these tests on the overall circuit and on the national links using only one test signal, which would be the signal adopted, in the sense specified in 1, to the band of frequencies corresponding to the definition to be transmitted.

For this reason the French Administration has proposed the new question, the text of which is given above.

Question No. 19.

(Category A 1) [urgent] (continuation of Question No. 18 studied in 1950/1951)

What parameters and method of specification should be recommended to define the impedance regularity of a repeater section of coaxial cable (excluding the repeaters), the section being intended to form part of an international circuit for television transmission ?

Note. — Annexes 1, 2, 3 and 4 below indicate the manner in which various Administrations specify the impedance regularity of a coaxial pair section. Another factor is being studied under Question No. 20 which is of importance in connection with the overall impedance regularity of a circuit (the repeaters included) ; this factor being the impedance matching between the repeaters and the line.

Later, when these two questions have been studied, consideration will be given to the conditions to be laid down for the various parts of a television circuit in order that the impedance regularity along the length of the circuit shall be satisfactory.

ANNEX 1

(to Question No. 19)

Method followed by the American Telephone and Telegraph Company for the specification of the impedance regularity of a repeater section on a coaxial-pair cable

The criterion for impedance regularity cannot be stated simply because it is only one of several factors that affect the echoes that will be experienced. Whereas a quite definite decision can be made as to the worst overall echo condition that will be tolerated, the balancing of the various factors that contribute to echoes is a matter of engineering judgement. In the Bell System it is the present practice to make the impedance regularity of the cable itself good enough so that it contributes very little to the overall echo level. It is kept in mind that the cable, once installed, cannot be modified in light of changing future requirements.

So far no definite value has been specified for repeater section impedance regularity and, in fact, except in special cases, this quantity is not measured even for completion test purposes. Almost complete reliance rests with strict manufacturing control methods and tests and with careful installation practices. One requirement for the L3 carrier system is that it be applicable to cables already laid for L1 carrier, so that this new system is not expected to affect requirements or practices.

The application of factory control tests and requirements is on a " test section " basis, where " test section " relates to all cable reel lengths consecutively manufactured for installation in an 8-mile section of cable. In addition to tests and limits for coaxial units before these are stranded to form cable, requirements are specified for the following quantities in completed reel lengths :

(a) The average Z_t of all coaxial paires in all lengths of cable within any test section (Z_t being the average of the impedances measured at the inner and outer ends of any given coaxial pair in a reel).

(b) The r.m.s. deviation of Z_t from average of any coaxial pair assigned to a given position in all reels in a test section.

(c) The r.m.s. of the differences between inner-end impedance of one reel and the outer-end impedance of the next manufactured reel for all coaxial pairs occupying the same position in all reels in a test section.

(d) The average of the worst internal echoes per reel in the coaxial pairs in the test section.

The results of such manufacturing control have tended to minimize the need for special installation procedures, such as the allocation of individual reels to specific places in the route and the stocking of reels tagged for use in specific repeater sections in case of subsequent troubles requiring cable replacements. The principal special installation procedures now followed are :

(a) The reel lengths of any " test section " are installed in an 8-mile section of route but may be placed in any order in this section.

(b) Throughout the route the coaxial pair occupying the same position in the lay up of the individual reels are spliced together. Apart from the effect on impedance matching this procedure facilitates the identification of individual coaxial pairs in the event of subsequent sheath openings for trouble clearing purposes.

ANNEX 2

(to Question No. 19)

Method used by the French Administration for the measurement and specification of the impedance regularity of a coaxial cable.

In the new specification, now being produced, the regularity of impedance of a repeater section is defined by the response of the cable to a pulse of given duration and form. The attenuation to which the pulse is subjected in its passage up to the point of reflection and back is automatically corrected so that the energy of the echo caused by a given irregularity, is the same irrespective of its position in the cable (so called " correction for energy ").

Transient measurements on a repeater section of coaxial cable 2.6/9.5 mm.

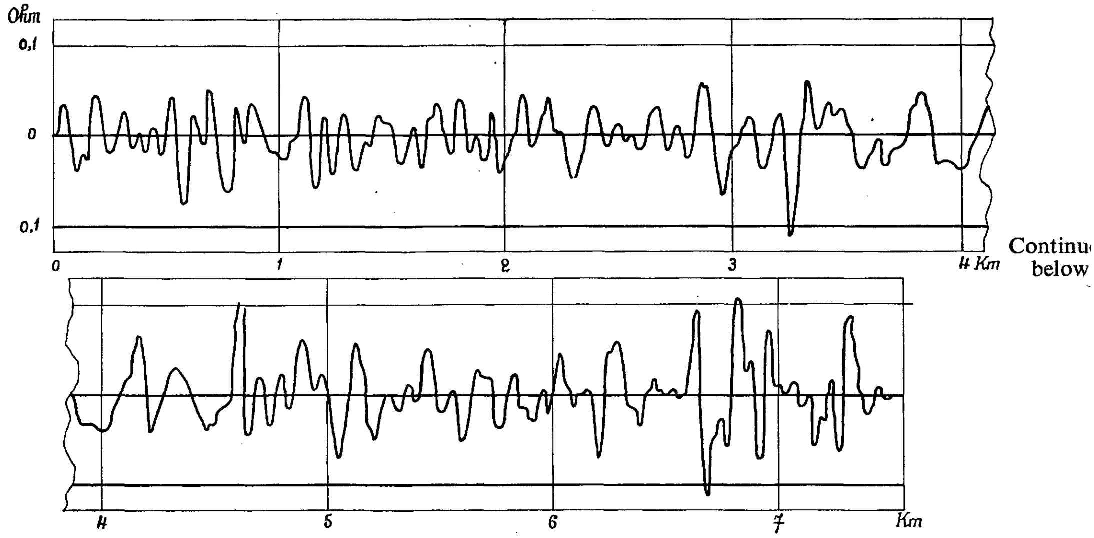


FIGURE 1. — *Echo characteristic*

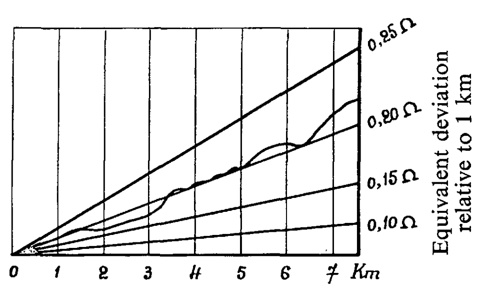


FIGURE 2. — *Energy characteristic*

In the apparatus now adopted by the French Administration a sime-squared (raised-sinusoidal) pulse with a half-amplitude width of 0.17 microseconds repeated at a frequency of 4 kc/s is used.

The provisional limits in the specification for standard 2.6/9.5 coaxial cables based on the technique of measurement in the transient state are :—

(a) As regards the maximum amplitude of the echo (peak value) : 0.5 ohms. This limit should be observed both for the echoes originating near the origin and those produced by more distant faults as it is the view of the French Administration that, in television transmission, a given irregularity causes the same distortion whatever its position in the repeater section.

(b) As regards the energy reflected by the cable, the equivalent deviation for a kilometre of coaxial pair should be less than 1 ohm. It is recalled that the equivalent deviation is defined by the value of a single irregularity placed at the origin of the cable and causing the same reflected energy.

The test results obtained up to the present time show that the above clauses are in general respected.

As an exemple, the attached figure gives the curve of the echo relative to a repeater section in a coaxial and also the curve of reflected energy from the same cable as a function of its length. These curves have been obtained by uniting the oscillograms obtained at the two ends of a section and each corresponding to one half section.

The measurement of the impedance irregularities of coaxial pairs (necessary for the evolution of the pulse tail affecting television transmissions), already rendered more accurate by " energy correction " has been improved again recently by methods using full correction of amplitude and phase. It permits account to be taken of the attenuation distortion and phase distortion affecting the echo signal, whatever the position of the irregularities along the line. The method permits correction up to a distance of 4.5 km for a 2.6/9.5 mm coaxial pair, the test of a repeater section of coaxial pair being made from the two ends with a pulse of 0.17 μs.

For record purposes we give as an appendix an article entitled " *Correcteur d'amplitude phase pour échomètres à impulsions destinés au contrôle des câbles électriques à grande distance* " by MM. Comte and Bouderlique, of the Telecommunications Laboratory of " *Câbles de Lyon* ".

We indicate, moreover, the contribution on a pulse test set (echometer) for factory use made by MM. Fuchs and Fenouillet of the " *Société Anonyme de Télécommunication* " to a " Colloquy on pulse theory and techniques, 5-10/10/53 " under the title " *Essais en régime transitoire des câbles coaxiaux après pose* ". A summary of this meeting has appeared in a pamphlet devoted to this Conference.

APPENDIX

(to Annex 2)

Amplitude and phase corrector for pulse test sets (echometers) for the control of long distance electric cables

by Georges Comte, Engineer E.S.E. and Max Bouderlique
of the Telecommunications Laboratories of " Cables de Lyon "

1. *Introduction.*

The use of pulse test sets (echometers) is a matter of convenience, speed of operation and flexibility, for the investigation of faults and impedance irregularities affecting long lengths of electric cables [1] [2].

This investigation is always handicapped by the dispersion of the echo signals which become increasingly reduced in amplitude and extended in time as the points at which they arise become further from the origin of the line. The various component frequencies comprising frequency spectrum of these echoes, which may be obtained by expansion as a Fourier series, undergo different attenuations dependent upon their frequencies, and are not propagated at the same speed. In others words the frequency component f of the echo produced by a fault at a distance x from the origin is multiplied by the propagation factor $e^{-2\gamma x}$, in which $\gamma = \alpha + j\beta$, the complex propagation coefficient of the line which is a function of the frequency.

This dispersion greatly reduces the precision of the pulse testing method of localisation, on telecommunication cables as much as on power lines and certainly represents a fundamental obstacle to their use [3] [4].

Considering, for example, the case of lines intended for television transmission, it is very difficult to predict the significance of the pulse tail phenomenon, because the calculation of the current resulting from multiple reflection must take account of the distance between the points at which echoes occur and not their absolute position on the line; whereas the attenuation seen on an echometer is a function of this absolute position [5].

The authors have sought a remedy for the effect of this selective dispersion in the form of an amplifier of which the gain is variable as a function of the distance travelled by the echo currents and of the various frequencies which together constitute them, this amplifier being in series with a normal receiving amplifier of a standard type pulse test set (echometer).

It is evident that such an arrangement can be used only if the band of frequencies is limited, but it is known that the frequency spectrum of realisable pulses of duration τ and of repetition frequency f_1 is substantially contained in a band of frequencies f_1 f_2, f_2 being equal to $\frac{1}{\tau}$ [6].

2. *Choice of method of correction.*

In the case of coaxial cables for carrier working and television transmission, which have been particularly considered, the term γ is given with sufficient accuracy by the expression :—

$$\gamma = mp + K\sqrt{p} \qquad (\text{with } p = j\omega = 2j\pi f) \text{ [7] (Figure 1 refers)}$$

and the effect of attenuation and phase distortion is limited to the factor $e - 2kx\sqrt{p}$, which is analogous to the transfer coefficient of a large number of elementary resistance-capacitance (RC) sections forming a ladder network (Fig. 2). The factor $e^{-2\,mpx}$ represents the outward and return path over a perfect cable (without attenuation or phase distortion) ; a practical line (which is not a minimum-phase network) may be defined by the addition of a minimum-phase network to a perfect line. The effects of this network may be compensated by an amplifier which may also be a minimum-phase type provided that the transfer coefficient of this amplifier reproduces the quantity $e^{2kx}\sqrt{p}$ over a frequency band greater than the interval $f_1\ f_2$.

Standard 2.6/9.5 coaxial cable

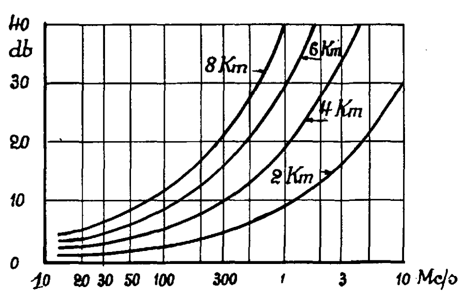


FIGURE 1. — *Variation of attenuation as a function of frequency*

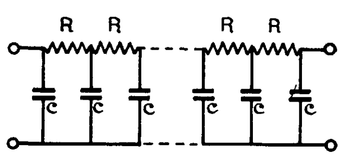


FIGURE 2. — *RC ladder network*

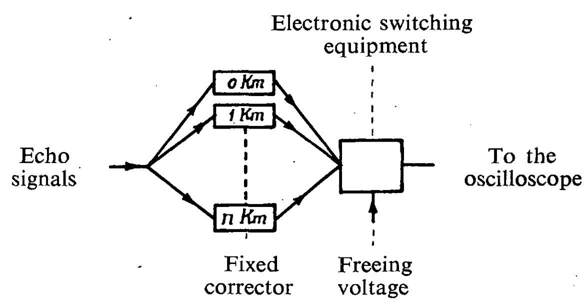


FIGURE 3. — *Corrector with parallel paths*

If x is considered independent of time, the question reduces to the following standard problem : to determine an amplifier compensating the attenuation of a line of fixed length $2x$. The solution may be obtained in two ways :

1. By the juxtaposition of an amplifier with flat (constant with frequency) gain and of passive correctors [8].

2. By the use of an amplifier of which the gain varies as a function of frequency following the law that it is desired to obtain ; this variation is usually obtained by the insertion of an appropriate network in the feedback path of the amplifier [9].

The case where x is a function of time is only an extension of the above case.

A first practical solution is perhaps provided by the use of several amplification paths fed in parallel by the echo signals, each path being designed to compensate the distortion of n kilometres of cable, the voltages amplified being received successively over the different paths and mixed by means of an electronic switch synchronised with respect to the transmission of the cable (Figure 3).

A possible varient uses compensation paths connected in series.

These two methods seemed, however, handicapped by the switching difficulties and we have not continued their study.

Another solution is supplied by the use of only one correction path formed by several stages of amplification connected in tandem and with gain/frequency characteristics varied in synchronism with the pulse generator of the pulse test set (echometer). The use of a large amount of negative feedback permits the insertion of gain control elements in the feedback loop of the amplifier [10]; these elements must therefore constitute impedances which are variable as a function of time following a predetermined law, which is known to be realisable readily by means of electronic valves, for example by frequency modulation and in compandor systems used in telephony. For this reason we have chosen this solution.

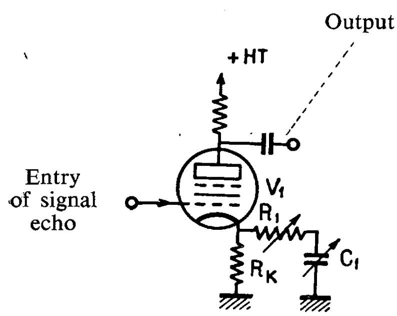


FIGURE 4. — *Principle of a corrector stage*

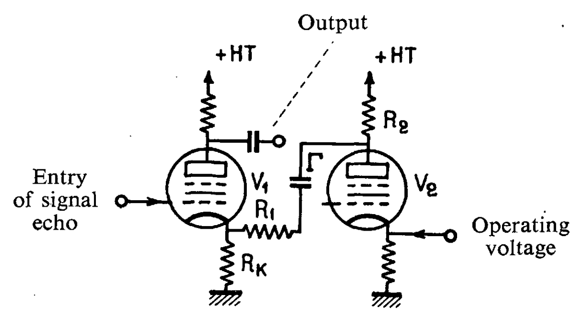


FIGURE 5. — *Schematic of a corrector stage*

3. *Outline of the principles of an amplitude and phase corrector.*

A single feedback path over the whole amplifier seemed attractive from the start and for reasons of stability it was necessary to use a return loop for each stage of correction, this loop being applied in a low impedance circuit in order to reduce the disturbing effect of stray capacitance and self-inductance at high frequencies.

Each stage of amplification consists of a resistance-capacitance valve amplifier with the negative feedback network in the cathode circuit. This network consists of a resistor R_1 and a variable capacitor C_1 connected in series, the combination being connected in parallel with a fixed resistor R_K. The modulus of the gain of such a stage is given by the expression :—

$$g = \frac{S R_p}{(1 + S R_k)} \frac{\sqrt{1 + C_1^2 \omega^2 (R_K + R_1)^2}}{\sqrt{1 + C_1^2 \omega^2 \dfrac{[R_K + R_1 (1 + S R_K)]^2}{(1 + S R_K)^2}}}$$

in which S represents the slope of the valve (which is assumed to have an infinite internal resistance) R_p is the load resistance and $\omega = 2\pi f$ is the angular frequency corresponding to the frequency f.

The realisation of components R_1 and C_1 does not present any very great problems: a resistance variable between several hundreds and several thousands of ohms may be obtained by the space charge effect of a triode valve by varying the potential of the grid. On the other hand, the input impedance of a pentode valve of slope S_a and load impedance R_a provided with a capacitor of reactance T connected between control grid and anode, is given by :—

$$Z_E = \frac{R_a - \dfrac{j}{\Gamma\omega}}{1 + S_a R_a}$$

equivalent to the series circuit of a resistance and of a capacitance the value of which may be varied by means of the slope or the load resistance; in particular by selection of R_a the capacitance C_1 will be practically the only variable element. If this phenomenon is used it will be possible to combine the characteristics of n stages of amplification in such a way that, for a value determined by the capacitors C_1, the overall gain/frequency characteristic of the corrector compensates the distortion resulting from propagation over a length of twice that of the line; it will suffice to vary the capacitors C_1 proportionally to the square of the distance traversed by the echo signals in order that the compensation may be realised automatically.

The practical realization is, in fact, more complicated for the following reasons :—

(a) because the compensation of the attenuation of the cable must be translated into an equalization, related to the time of propagation [11], which cannot be perfect because the number of correction stages and the band of frequencies corrected is finite.

(b) it is necessary to compensate for the effects of the parasitic cathode-heater capacitance of valve V_1 which prevents all action at high frequencies.

4. *Description of a practical realization.*

An experimental amplitude and phase corrector has been constructed in the telecommunication laboratories of "*Câbles de Lyon*" for the examination of repeater sections of standard 2.6/9.5 coaxial cable.

This corrector contains :

(a) a pre-amplifier intended to improve the signal-to-noise ratio of echo signals.

(b) ten stages of controlled gain connected in cascade, each stage being in accordance with Figure 5.

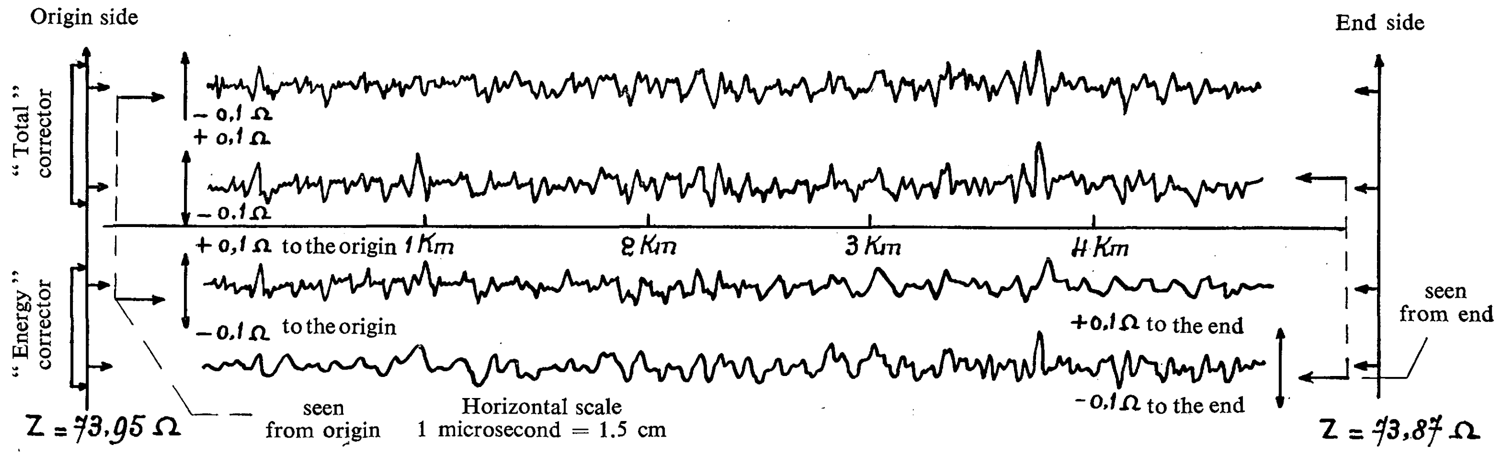
The successive stages of amplification differ from one another by the values of R_1, R_2 and Γ.

(c) a control voltage generator synchronised with the pulse generator of the pulse test set (echometer); this voltage is in the form of a symmetrical saw tooth and the correction law is obtained by the curvature of the characteristics of the control valves.

Each stage of amplification provides correction for a particular band of frequencies $f_j\ f_k$ at a given instant of time. As a first approximation the control voltage varies the gain/frequency characteristic of the band $f_j f_k$ according to the arrival time of the echoes in such a way that echoes produced by faults farther from the origin of the line undergo greater amplification at the higher frequencies.

The use of symmetrical corrector network configurations enables the control voltage and its harmonics to be kept separate from the signal to be amplified.

The adjustment of the different stages is facilitated by the use of standard oscillatory circuits, excited by pulses, the decrement of which corresponds to the attenuation of the various frequencies concerned. A positive verification is effected by producing successive reflections over a length of several hundreds of metres of concentric pair, which shows at what point the dispersion is effectively corrected.



The test its made with an 0.17 μs pulse cable viewed from each end with a " total " corrector (amplitude and phase) and an " energy " corrector

FIGURE 6. — *Comparative test on a 2.6/9.5 cable of length = 4.703 km with a factory-type pulse test set (echometer)*

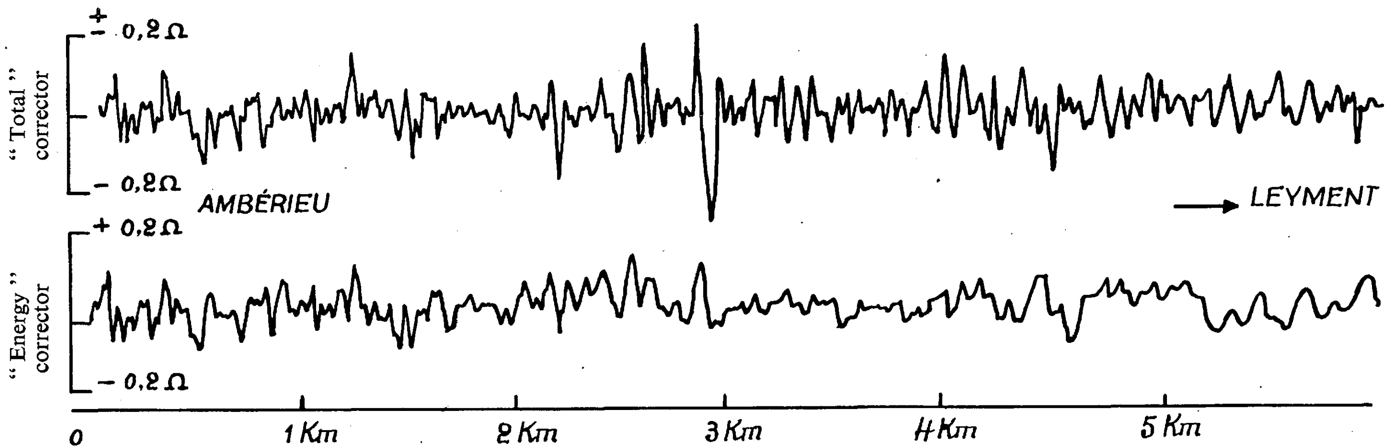


FIGURE 7. — *Lyon-Ambérieu cable, Leyment-Ambérieu section. Measuring point: Ambérieu. Measurements by pulse test set (echometer) with correctors. Pulse 0.17 μs. Pair I $Z_0 = 73{,}81\ \Omega$*

The assembly of apparatus, contained in three boxes, is mounted in a test vehicle and the necessary power supply, as well as that for the pulse test set (echometer) is provided by a 2 kW generator.

5. *Results obtained.*

After correction of the amplitude and phase, the echo resulting from a pulse of 0.17 μs at an impedance discontinuity situated 5 km from the origin of a standard 2.6/9.5 coaxial cable only has a residual widening and reduction of amplitude of less than 10% whereas without correction the amplitude of the echo is reduced in the ratio 10 to 1 and its duration is multiplied by four. The precision of the echo trace is thus increased and greatly improved and the curves taken at the two ends of a length of 5 km may almost be superimposed (Figure 6).

This apparatus is actually used for the control of the regularity of the repeater sections of concentric cables laid by " *Câbles de Lyon* " ; Figure 7 is an example of the trace that can be obtained.

6. *Conclusion.*

The principle of correction of amplitude and phase seems applicable to all types of line. However, if the main emphasis is to increase the maximum distance of effective compensation, the number of stages of amplification must be increased and the basic noise rapidly becomes the limiting factor ; however the range of such a corrector may be improved by the integration of echo signals over a large number of periods and making use of the method of autocorrelation which appears to be a very promising tool in research on faults affecting very long lines and, in particular, submarine cables.

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ANNEX 3
(to Question No. 19)

Method used by the Italian Administration for the measurement and specification of the impedance regularity of a coaxial cable

In the specification for the provision of a repeater section of coaxial cable of the type standardised by the C.C.I.F., the Italian Administration has included the following clauses for the regularity of impedance :

1. Specification for the factory lengths in a section of circuit used for television transmissions (length of 4.5 kilometers).

The deviation between the " terminal pulse impedances " at the junction point of two manufacturing lengths should not exceed 0.25 ohms in the first kilometer from the ends and 0.40 ohms in the remaining part.

The root-mean-square value of the deviations in a section should not exceed 0.225 ohms (this value will probably be reduced to 0.20 ohms).

The maximum deviation between the " terminal pulse impedances " of all the manufacturing lengths of the coaxial cable within a section should not exceed 0.60 ohms. The " terminal pulse impedance " is the impedance measured in the factory, at the input of each length, by means of a pulse echometer with a raised-cosine (sine-squared) pulse of duration equal to 0.05 microseconds.

2. Specification for the repeater section of a circuit for television transmissions. At each end of all the repeater sections a graphical record is made of the echo oscillogram obtained with a raised-cosine pulse of 0.2 microseconds duration ; note is taken of the values of the echos whose levels are less than 70 db below the sent pulse, and the distance of the irregularity from the beginning of the section is also noted. Following this the value of echos obtained with a pulse of 0.05 microsecond duration is noted. The following limits should not be exceeded :—

the worst echo	54 db
the worst echo corrected for attenuation	48 db
root-mean-square of the three worst echos corrected for attenuation . .	51 db

These limits hold for the echos obtained with each of the two pulse durations.

On 10% of the repeater sections for circuits for television transmissions the impedance-frequency curve from 60 kc/s to 10 Mc/s is also taken.

The deviations of the measured curve from that of a regular mean curve (obtained from a theoretical curve) should not exceed $\pm 2\%$.

The 2.5 Mc/s ordinate of the regular mean curve should be between 74.4 and 75.6 ohms.

3. Specification for a repeater section for telephony (9 km).

Two consecutive television repeater sections are joined together to form a repeater section for telephony.

On all the telephony sections readings are taken, at one end, of the echo oscillogram with a pulse duration of 0.2 microseconds in order to check the central junction. On 10% of the telephony sections a curve of " impedance-frequency " is traced with the conditions specified above.

All the limits in the present specification naturally should not be considered as final since constant modifications are being made to them as well as to the specification for the manufacture of the coaxial cable. The limits above have, in general, been well observed up to the present.

ANNEX 4
(to Question No. 19)

Method used by the British Telephone Administration to measure the regularity of impedance of a coaxial cable

The present procedure for testing a repeater section of coaxial cable is as follows :—

1. Impedance-frequency tests (as described in tome III *bis*, pages 237 and 238) are taken over the frequency range of 60 kc/s to 4.5 Mc/s from each end of the repeater section. In practice it is found that the maximum deviation does not exceed 1.0 ohms.

2. Pulse tests are taken from each end of the repeater section. Using pulses of the order of 0.1 microseconds it is found that from the worst reflection the ratio between the sent and received pulses does not exceed 60 db after correction for the attenuation of the line.

3. When considered desirable, similar pulse measurements are made during the installation of the cable, on each length of 1830 metres, after it has been laid in the ground and jointed. The same values as given in § 2 above are obtained in practice.
The advantages of taking tests on the relative short lengths of cable when it is laid are :

(a) Any irregularities which may occur during the process of installation are immediately brought to notice and can easily be located and rectified.

(b) If a joint has been incorrectly assembled or has been damaged, the oscillogram will immediately show its location by the characteristic double reflection which occurs from a short irregularity.

(c) In illustration of the above, the attenuation of a 0.1 microsecond pulse to and from the centre of a 1830 metre section of the 0.375 inch type of cable is only about 6.0db. These tests therefore ensure that a record is made of all impedance irregularities or changes in impedance level which exceed 0.1%. Thus adequate routine control is kept of the regularity of the cable impedance during installation.

4. The tests described in § 3 above, by ensuring the regularity of the relatively short sections of cable, enable the overall tests described in § 1 and 2 above to be regarded with confidence as a measure of the regularity of the whole repeater section.

5. The United Kingdom has under study other methods of ensuring that the regularity of impedance throughout a repeater section is maintained at the necessary high value.

Question No. 20.

(Category A 1) [urgent] (continuation of Question No. 20 studied in 1952/1954)

What are the conditions to be recommended for matching (at various frequencies) the impedance of the repeaters to that of the line (taking into account the internal impedance irregularities of the cable between two adjacent repeaters) as regards the resultant echo at the end of an international television circuit on a coaxial cable of the type standardized by the C.C.I.F. for telephony ?

Note. — Annex 1 below indicates a method of calculation which may be employed for the study of the question. Annexes 2 to 4 give the various proposals presented in 1953.

ANNEX 1
(to Question No. 20)

Note by the French Telephone Administration

In Figure 1 is represented the schematic of a repeater section of coaxial cable between two adjacent repeaters.

R_1 and R_2 are the reflection coefficients between cables and repeaters.

$r_x, \ldots r_y$ are the reflection coefficients at the points of abscissae $x, \ldots \ldots y$ y of the cable ; these reflections may be produced within a manufacturing length (l = 230 m) or at a junction point between two lengths.

It is known that, by double reflections, a parasitic wave, called the pulse tail, accompanies the useful signal. Thus, if two irregularities (x) and (y) are considered their contribution to the pulse tail will be

$$-r_x\, r_y\, e^{-2\alpha(y-x)} \qquad \text{(with } y > x\text{)}$$

and this signal will arrive at the instant $\theta = \dfrac{2\,(y-x)}{v}$ after the main signal.

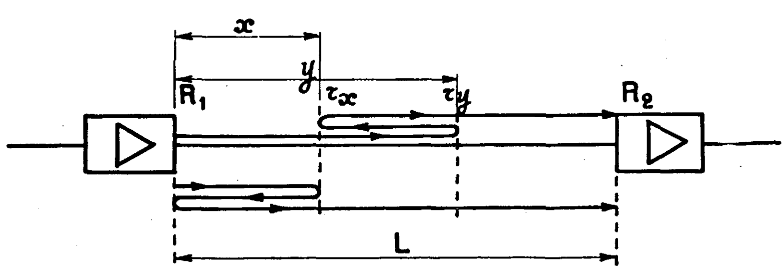


FIGURE 1

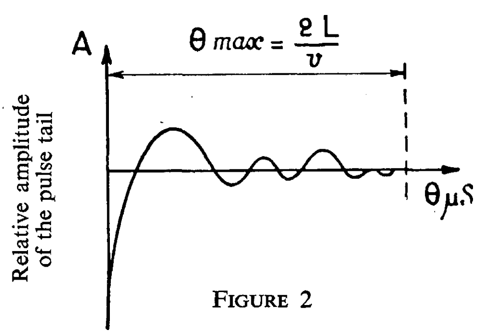


FIGURE 2

It is assumed that it is possible to determine a linear attenuation α and a group velocity v and that the amplitude of the main signal at the receiving end of a repeater section is unity.

In the pulse tail, three groups of terms of different origin may be recognised ;

(1) double reflection between the equipments

$$q_1 (\theta_{max}) = -R_1 R_2 e^{-2\alpha L} \qquad \left(\theta_{max} = \frac{2L}{v}\right)$$

(2) double reflection in the cable

$$q_2 (\theta) = - \sum_{y-x=\frac{v\theta}{2}} r_x r_y e^{-2\alpha (y-x)} \qquad \left(\text{summed over the values of } y-x = \frac{v\theta}{2}\right)$$

(3) interaction between the cable and the repeaters

$$q_3 (\theta) = - R_1 r_x e^{-2\alpha x} - R_2 r_y e^{-2\alpha(L-y)} \qquad \left(x \text{ and } y \text{ being such that } x = L - y = \frac{v\theta}{2}\right)$$

The C.C.I.F. has already proposed a provisional limit for the first term.

Let an attempt be made to evaluate the second term (contribution of the cable alone) and the third term (interaction) and to compare the two.

Experience has shown that on a manufacturing length (230 metres) the pulse tail q_2 is of the order of 2.10^{-6}.

For a repeater section of 9 km there are approximately 40 manufacturing lengths, and in the most unfavourable case one would have, without counting possible reflections at the joints :—

$$q_2 = 80.10^{-6}$$

In estimating the term q_3, the maximum value of the reflection coefficient observed on the cables should be substituted for r_x ; it is of the order of 2×10^{-3}.

Consider finally the reflection at the output of a repeater. In order that the interaction term be not greater than that due to the cable alone

it is necessary that : $R_{max} \times 2.10^{-3} < 80.10^{-6}$

whence : $R_{max} < 4\%$.

If, on the contrary, it is supposed that the mismatch is complete $|R| = 1$, the interaction term becomes equal to 2×10^{-3} ; it is thus 25 times greater than the term q_2 which characterises the intrinsic quality of the coaxial pair.

The effect is even more important if both the input and the output of the repeaters are mis-matched.

Note. — The preceding calculation does not claim to be exhaustive, but only indicates a possible method of calculation.

The numerical results that are found are only indicative and are not put forward as a proposition even provisionally.

The two considerations which follow indicate nevertheless the direction of study which should be pursued :

(a) the hypothesis to render equal the distortion due to internal irregularities of the cable and that due to the interaction between the input (or the output) of the repeater and any irregularity of the cable should be reviewed.

(b) the hypothesis of reflection coefficient which is real and constant with respect to frequency should be abandoned to take into account the variation with frequency of this coefficient which is not necessarily real.

ANNEX 2

(to Question No. 20)

Reply of the Cuban Telephone Company to Question No. 20 in 1953

1. It has already been recommended on page 173 of Volume III *bis* of the *Yellow Book* of the C.C.I.F. that the factor N (equal to twice the attenuation of a repeater section of line plus the return loss between the input and output impedances of the repeaters and the line) should be of the order of 70 db at frequencies in the region of the virtual carrier frequency used for the transmission over the line.

There is little probability that the lowest carrier frequency used will be less than about 800 kc/s and at this frequency the line attenuation is about 20 db so that to obtain a value of 70 db for the factor N, the sum of the return losses between the input and output impedances of a repeater and the line should be not lower than 30 db. It is possible to maintain a return loss of 30 db between, for example, the repeater input and the line, but it will probably be easier to maintain a return loss of 15 db at both the input and output.

2. The Cuban Telephone Company recalls that in the reply it made to Question No. 18 studied in 1951 (see " C.C.I.F. — 1950/1951 — 3rd S.G. — Document No. 18, page 17), it was indicated that one would anticipate that an impedance irregularity in the line of $\pm$ 1 ohm relative to 75 ohms produces a parasitic signal, due to multiple echos, of about 50 db below the level of the vision signal, for a repeater section, for the case where the output impedance of the repeater was not matched to the impedance of the cable. If, nevertheless, a return loss of 15 db is maintained at the repeater output, the ratio between the signal and the parasitic signal will be 69 db, or, if one adds on a random law, 66 db if the repeater input has also a return loss of 15 db.

For a system consisting of 100 repeater sections, it might be expected that the level of the parasitic signal should be about 46 db below the vision signal and this value should be satisfactory.

It is therefore suggested that the input and output impedances of the repeater should be such that the return loss relative to the impedance of the line should be in the two cases greater than 15 db in the region of the virtual carrier frequency. A value slightly below this would probably be satisfactory for the higher frequencies transmitted on the line.

ANNEX 3

(to Question No. 20)

Reply by the American Telephone and Telegraph Company (United States of America) to Question No. 20 in 1953

Mismatch between line and repeater impedances is only one of the contributors to the overall echo level. The permissible magnitude of this mismatch depends on the degree of control of the other contributions (see response to Question 18) and on the particular design of the transmission system, for mismatch may be deliberately introduced to facilitate equalization.

In the American type L3 coaxial system it is considered desirable to match the impedance of the repeater to the impedance of the line as perfectly as can be done, within economic limitations. Special attention is paid to obtaining a good match at the frequency of the television carrier. At the present stage of development of the L3 system, the objective is for the reflection coefficient between line and repeater not to exceed about 5 to 7% over most of the frequency range used and about 10 to 14% at the upper end of the band.

ANNEX 4

(to Question No. 20)

Reply by the French Telephone Administration to Question No. 20 in 1953

To get an idea of the conditions to be recommended regarding the matching of the impedance of the repeaters to that of the line for an international television circuit on standard coaxial cable 2.6/9.5 mm, the French Telephone Administration has taken as a basis the evaluation of the pulse tail at the end of a circuit 1000 km long, the coaxial pairs of which are of the technical quality obtained in present manufacture and are equipped with repeaters standardized by the French Administration.

1. *The reflection coefficients at the input and output of the repeater*, respectively R_E and R_S. These coefficients have been obtained by direct measurements with an apparatus of which the pulse duration is 0.2 microseconds. They are referred to a resistance of 75 ohms and are respectively equal to

$$R_S \simeq 120.10^{-3} \text{ (output)}$$
$$R_E \simeq 70.10^{-3} \text{ (input)}$$

2. *The internal irregularities of the pairs.* — These have been measured on a number of repeater sections by examining the echo curves. Their order of magnitude (peak maximum) is 1.10^{-3}.

3. *The irregularities at the junction of two manufacturing lengths (joints).* — The maximum value of such a reflection coefficient may be taken as 2.10^{-3}.

The evaluation of the pulse tail, taking the above values as a basis, gives for the tail of the signal an amplitude of 0.3 %. This value does not seem to give rise to noticeable distortion in the television transmission.

The C.C.I.F. has not fixed the admissible limit for the pulse tail. The C.C.I.F. has proposed a provisional limit for the term $R_1 R_2 e^{-2\alpha L}$ (α = the attenuation coefficient, L = the length of a repeater section). This limit is 300.10^{-6} in the region of the carrier frequency. The French equipments under the same conditions give 100.10^{-6} and are therefore well below this limit. The internal irregularities of the cables could be limited to conform to the criterion given in the reply of the French Administration to question No. 18. The peak maxima of the reflection coefficients at the junction of the cable lengths should be limited to twice the value allowed for the internal irregularities of the cable.

This being so, there would seen no point in imposing a limitation of the pulse tail for circuits intended initially for telephony and of which the quality in the present state of technique would appear adequate for television transmission.

There is given in the appendices the detailed calculation of the pulse tail and the echo curves used to determine the reflection coefficients of the repeaters.

APPENDIX 1

(to Annex 4)

Evaluation of the pulse tail on a connection by coaxial cable 2.6/9 mm

1. *Statement of the problem.*

It is proposed to evaluate, by following the method described in the annex to question No. 20 of the C.C.I.F. the pulse tail of a pulse (0.20 microseconds at mid-height) over a connection of 1000 km on coaxial cable 2.6/9.5 millimetres. The figures used in this calculation correspond to the characteristics of current French coaxial cables and equipment.

2. *Summary of the annex to question No. 20 (Yellow Book,* Volume I *ter*, page 297).

Figure 1 represents a repeater section of coaxial cable between two adjacent amplifiers.

R_1 and R_2 are the reflection coefficients between cables and equipments.

$r_x \ldots\ldots r_y$ are the reflection coefficients at the points of abscissae $x \ldots\ldots y$ of the cable, corresponding to the internal irregularities.

r_n is the reflection coefficient at the junction of the $(n + 1)$th and the nth factory length of cable.

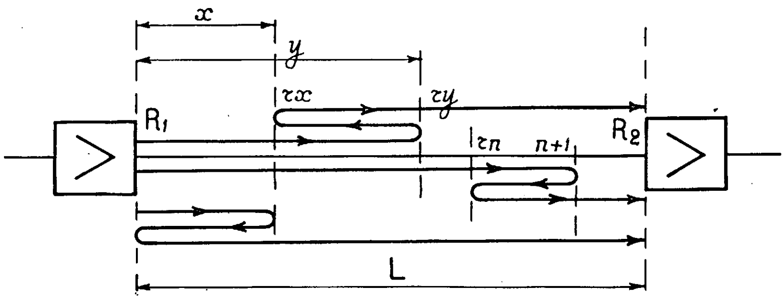


FIGURE 1

If it is admitted that it is possible to define a linear attenuation α and a group velocity v and one takes the amplitude of the main signal at the receiving end of a repeater section as unity, the contribution to the pulse tail of two irregularities x and y will be :—

$$-r_x \, r_y \, e^{-2\alpha(y-x)}$$

and this signal will arrive at the instant $\theta = 2\dfrac{y-x}{v}$ after the main pulse.

When θ varies from 0 to 0.2 microsecond, the pulse tail can be neglected in comparison with the attenuation due to the reflection losses $\left[\sum r_x\right]$.

We will examine below the pulse tail corresponding to $\theta \geqslant$ *0.20 microseconds.*

The pulse tail disturbs the signals adjacent to the impulse considered; it plays the role of a noise.

3. *Order of magnitude of the reflection coefficients.*

3.1 *Equipment.*

From measurements made on a repeater for coaxial cables, standardised type 51740 of the French Administration (see the Appendix 2 attached) the order of magnitude of the coefficient R_1 and R_2 is :

$$R_1 \text{ (reflection at output)} \simeq 120 \times 10^{-3}$$
$$R_2 \text{ (reflection at input)} \simeq 70 \times 10^{-3}$$

3.2 *Internal irregularities.*

An examination of the curves of echo taken on a large number of repeater sections, according to the method given in the French reply to Question No. 18, indicates that the magnitude of the maxima of the peak is 1×10^{-3}.

3.3 *Reflection between adjacent manufacturing lengths.*

The maxima of the reflection coefficients at the junction of two manufacturing lengths are greater. The order of magnitude of the maximum r_n will be taken as 2×10^{-3}.

4. *Evaluation of the pulse tail.*

The contributions of the different signals composing the pulse tail may be estimated in the following manner :

4.1 *Double reflection between the equipments.*

4.1.1 *Repeater section.*

$$q_1 \ (\theta \max) = - R_1 \, R_2 \, e^{-2\alpha L}$$

$$\theta \max = \frac{2L}{v} \simeq \frac{2 \times 8}{0.28 \, . \, 10^6} \simeq 60 \ \mu s$$

The C.C.I.F. has proposed a provisional limit for this term : 300×10^{-6} in the region of the carrier frequency.

For present French equipment :

$$R_1 R_2 \simeq 84.10^{-4}$$

If, for example, the frequency of 1 Mc/s is considered the total attenuation is

$$2 \alpha L = 2 \times 0.27 \times 8 = 4.3 \, N$$

and

$$R_1 R_2 e^{-2\alpha L} \simeq 100 \times 10^{-6}.$$

4.1.2 *Connection 1000 km long* (125 repeater sections).

The reflections between cable and equipment are of a systematic character ; less than 20% of the sections have the same length within 60 m (distance occupied by the pulse in the cable), the total effect should reach a maximum :

$$q_1 = 125 \times 20 \times 10^{-6} \simeq 0.25\%$$

4.2 *Double reflections between internal irregularities of the cable*

4.2.1 *Repeater section.*

q_2 (θ) is of the order of 1×10^{-6} on manufacturing lengths, but the signal is random and the summation as a function of length is made on a root-mean square law.

This gives

$$1 \times \sqrt{20} \times 10^{-6} \simeq 4.5 \times 10^{-6}$$

for a repeater section.

4.2.2 *For a connection 1000 km long*

$$q_2 (\theta) \simeq 4.5 \sqrt{125} \times 10^{-6} \simeq 50.10^{-6}$$

4.3 *Double reflections between joints.*

The corresponding pulse tail occurs at the times 3, 6, 9 .... microseconds. By adopting the value of $r_r = 2 \times 10^{-3}$, but admitting the law of summation of $\sqrt{n}$, this gives :

$$q_3 = 4 \times \sqrt{2500} \times 10^{-6} \simeq 200 \times 10^{-6}$$

for a connection of 1000 km.

4,4 *Double reflections between a joint and an internal irregularity.*

To assess this effect the maximum values of r_n and r_x are taken but with any sign. For 1000 km, taking account that the reflection at a joint should be combined with two reflections situated, one before and the other after the junction but at equal distances from it

$$q_4 = 2 \times \sqrt{2} \sqrt{2500} \, 10^{-6} \simeq 150 \times 10^{-6}$$

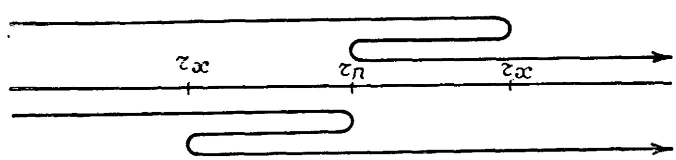


FIGURE 2

4.5 *Double reflections between equipment and internal irregularity.*

The most important term is obtained for a reflection from a maximum irregularity near the ends, for example a joint.

4.5.1 *Repeater section.*

In considering the reflection at the input one has

$$q_5 = 2 \times 70 \times 10^{-6} \simeq 140 \times 10^{-6}$$

For the reflection at the output one has

$$q_5 = 2 \times 120 \times 10^{-6} \simeq 240 \times 10^{-6}$$

In combining the two components of the pulse tail quadratically one has for a repeater section 280×10^{-6}.

4.5.2 *Connection of 1000 km.*

The above value is multiplied by 125 and gives

$$q_5 \simeq 280 \sqrt{125} \times 10^{-6} \simeq 3000.10^{-6}$$

5. *Recapitulation.*

Now take q_1, q_2, q_3, q_4 and q_5 together.

q_1 is separated in time from the other components of the pulse tail and has a maximum value of 0.25%.

q_2, q_3, q_4, q_5 should be combined quadratically and q_5 being predominant gives the order of magnitude of the pulse tail thus :

$$\sqrt{q_2^2 + q_3^2 + q_4^2 + q_5^2} \simeq 0{,}3\,\%$$

Even though the allowable limit of the pulse tail has not yet been fixed by the C.C.I.F., it is reasonable that the value of 0.3% does not produce appreciable disturbance in the transmission television pictures.

APPENDIX 2

(to Annex 4)

Determination in the transitory state of the reflection coefficients of a coaxial cable repeater

The reflection coefficients of a standardised coaxial repeater have been determined in the transitory state by pulse echometer of the *Société anonyme des Télécommunications* (S.A.T.), using a pulse of 0.2 microseconds.

These coefficients are referred to a resistance of 75 ohms. In Figure 3 is shown the reflection by 70 ohms which was used for calibrating the apparatus.

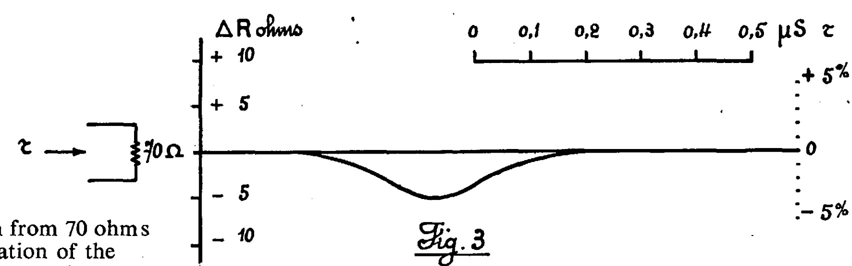
Figure 4. — Reflection at the input (R_2).

Figure 5. — Reflection at the output (R_1).

Figure 6 and 7. — Reflection by the elements of the repeater which contribute to a large part of the mismatch.

REFLECTIONS MEASURED ON " S.A.T. " PULSE ECHOMETER

Pulses of 0.20 μs duration at mid-height



Reflection from 70 ohms (calibration of the apparatus)

Fig. 3

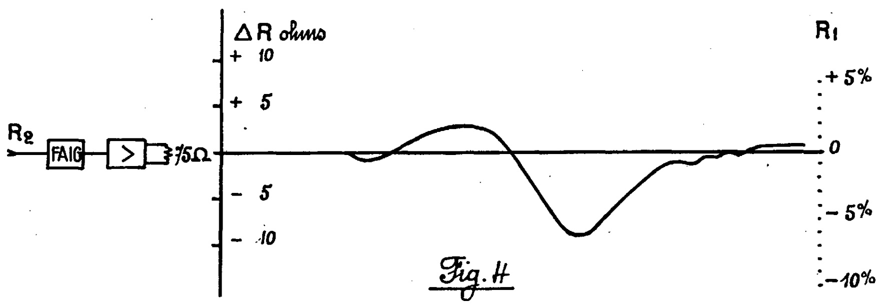


Fig. 4

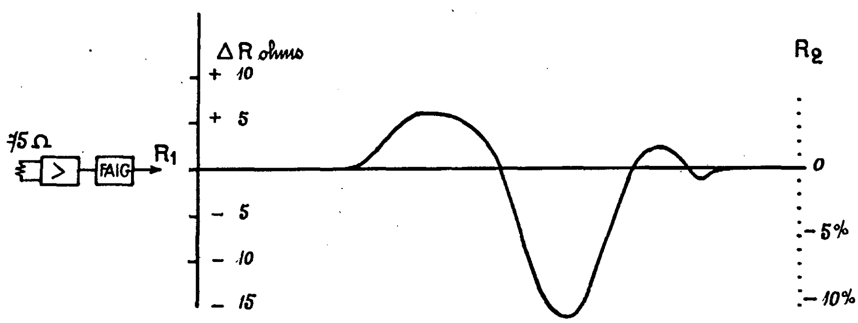


Fig. 5

REFLECTIONS MEASURED ON " S.A.T. " PULSE ECHOMETER

Pulse of 0.20, μs duration at mid-height

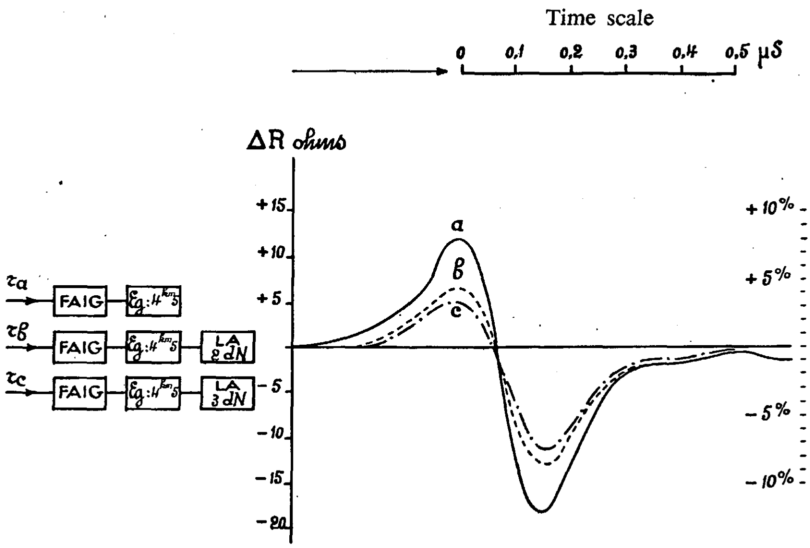


FIGURE 6

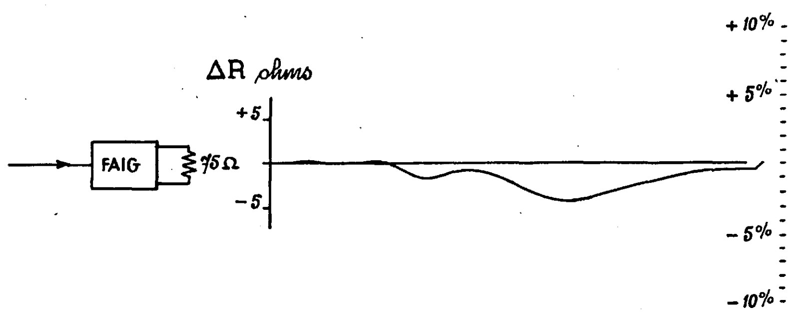


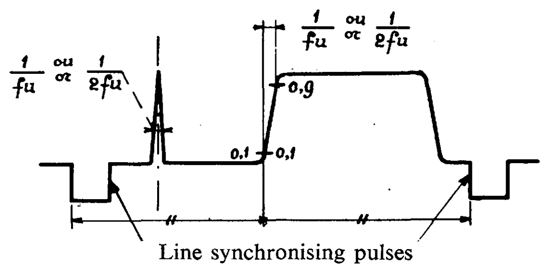
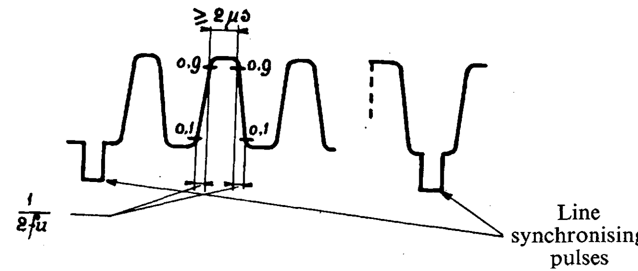
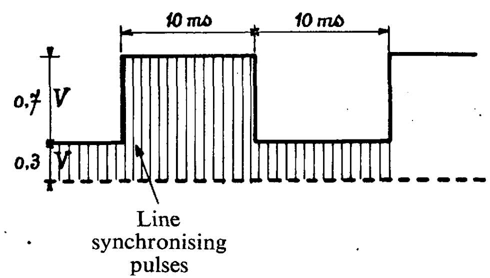
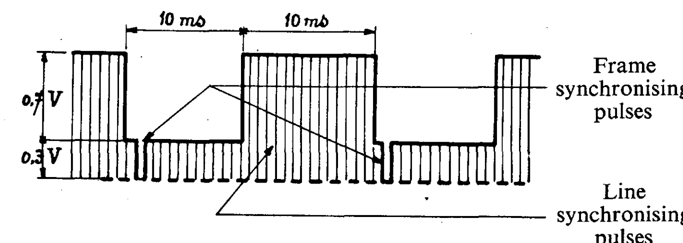
FIGURE 7

Question No. 21.

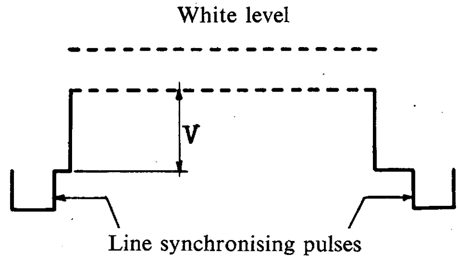
(3rd Study Group in co-operation with the 9th S.G. of the C.C.I.F. and with the C.C.I.R., I.B.O. and E.B.U.) (Category A 2) [urgent] (continuation of Questions Nos. 19 bis *and 21 studied in 1952/1954)*

(a) What test signals are to be recommended for checking the ability of an international television circuit to transmit motion pictures correctly ?

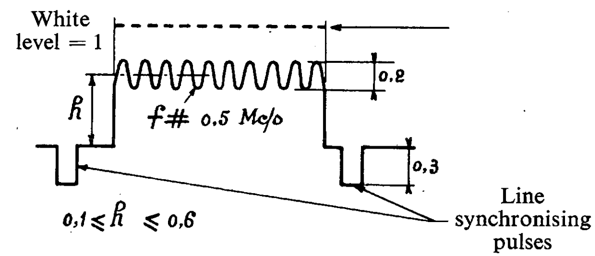
(b) What are the permissible distortions of these test signals during transmission over the long-distance line BC, which should conform to the definition of the " nominal maximum circuit on coaxial pairs for television transmission " (see Question No. 12 above) ?

	FEDERAL GERMAN REPUBLIC AND THE UNITED KINGDOM	FRANCE
I_A	 *PULSE-AND-BAR (cos² ωt pulse and square wave)*	 *HF Test signal*
I_B	 *50-c/s SQUARE WAVE*	 *LF Test signal*

II_A

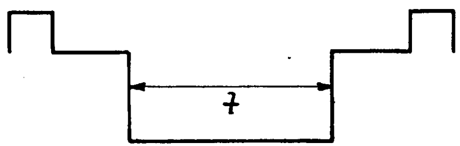


VARIABLE LIFT (grey of intensity which is variable between black and white)



Modulated, variable grey

II_B



t variable $2\frac{1}{2} - 80$ µs

EXPANDING BAR
(square wave of variable width)

f_u nominal upper video frequency

Note. — The build-up times indicated in the column headed " France " take account of the generator characteristics as well as the characteristics of the oscilloscope : these are the times measured on the oscilloscope when it is directly connected to the output of the generator.

Note 1. — By way of information, the signals described in the following Annex are used or contemplated by the Administrations of the Federal German Republic, France and the United Kingdom of Great Britain and Northern Ireland.

Note 2. — Consideration should be given to the paper by N.W. Lewis in Proceedings of the Institution of Electrical Engineers, Vol. 101, part. III, pages 258-290, July 1954.

ANNEX

Test signals used, or to be used, by the Administrations of France, the Federal German Republic and the United Kingdom

The tests signals used for checking the ability of a coaxial-pair circuit to transmit television pictures satisfactorily should permit of assessments concerning :

I. The transient response of the circuit. It is to be noted that several signals will be necessary for a precise analysis over the whole video-frequency band (see signals I_A and I_B below).

II. Non-linear distortions (see signals II_A and II_B).

III. Noise and interference ; at present, Administrations have available only oscilloscopes for this purpose.

IV. Stability of characteristics with time : slow variations of the characteristics can be determined by observing the changes of the amplitude and shape of test-signal responses ; for rapid variations, measuring apparatus is still being studied.

It is not possible at present to make detailed recommandations on these various points. The table below gives, only by way of information, various test signals which are or should be used by certain Administrations in the different cases.

Question No. 22.

(3rd Study Group in co-operation with the 5th S.G.) (Category A 2) [urgent] (new question)

The 7th Study Group of the C.C.I.F. is studying, under the heading of its Question No. 7, the fixation of tariffs to be applied to occasional television transmissions or to the leasing of circuits for television transmissions. With the object of supplying the necessary technical information the 3rd and 5th Study Groups of the C.C.I.F. should study the following points :

A — *Coaxial pairs.*

(a) What, at least approximately, is the ratio between the net cost of a telephone conversation exchanged from end to end on a telephone circuit in a coaxial system on the one hand and the net cost of a television transmission in one direction only over a coaxial system *without modification of the cable and the repeaters,* on the other ?

(b) In view of the fact that for good quality television transmissions, it is necessary to have terminal equipment different from that for telephony and,

moreover, to modify the repeaters in order to realise a supplementary phase compensation, what supplement is envisaged to the above-mentioned ratio in order to take account of these modifications ?

B — *Radio relay links.*

(c) What, at least approximately, is the ratio between the net cost of a telephone conversation exchanged from end to end over a carrier current telephone system on a broad-band relay system on the one hand, and the net cost of a television transmission, in one direction only, over a broad-band radio relay system without modification of the relay stations, on the other ?

(d) In view of the fact that for good-quality television transmissions, it is necessary to have terminal equipment different from that for telephony and, moreover, to modify the relay stations in broad-band radio relay systems, what supplement should be envisaged to the above-mentioned ratio in order to take account of these modifications ?

Note 1. — The questions posed will be studied for the three television standards envisaged in Europe (405, 625 and 819 lines) on the basis of the replies of the C.C.I.R. to its study programme No. 32 (corresponding to Question No. 11 of the 3rd Study Group of the C.C.I.F.).

Note 2. — When the above mentioned information requested of the 3rd and 5th Study Groups of the C.C.I.F. becomes available, the International Telephone Tariff Committee will establish a detailed questionnaire in order to study the net cost of television transmissions.

Question No. 23.

(3rd Study Group in co-operation with the 5th and 4th S.G., Question No. 6 of the 4th and 5th S.G.) (Category A 2) [urgent] (continuation of Question E ter *studied in 1952/1954, corresponds to Question No. 112 of the C.C.I.R.)*

What is the variation (as a function of time) of the ratio between signal and noise which may be allowed on an international telephone communication ?

Note 1. — It would be desirable to bring into line the specifications concerning total noise for carrier systems or on coaxial pairs, symmetrical pairs and radio relay links (see Question No. 24 below). On the other hand, administrations are asked to forward to the C.C.I.F. Secretariat the results of observations made on each of the systems as regards the variation of noise as a function of time.

In particular, it would be useful to discover whether the noises conform to a normal or to a log-normal distribution (i.e. one which is normal if the psophometric power is expressed in decibels or nepers).

Note 2. — The C.C.I.F. Laboratory will carry out articulation tests under the following conditions. The Laboratory has already at its disposal recordings of typical noise produced at the end of a radio relay link in the absence of all telephone conversation. Administrations and private operating countries are asked to send as soon as possible to the Laboratory recordings on magnetic tape of the total noise, during the busy hour, on a telephone circuit on which there is no telephone conversation. This circuit should be routed over one of the carrier systems of the following types :—

1. A system with a very large number of telephone circuits (e.g. 600 circuits) on coaxial pairs.

2. A system of 60 circuits on symmetrical pairs.

The equivalent of the telephone circuit should be adjusted to the value 0.8 nepers or 7 decibels. These recordings are to be sent to the C.C.I.F. Laboratory together with all the necessary information and will serve as a source of noise in the tests to be carried out.

To allow an adjustment of the mean intensity of these noises (before the tests are made in the Laboratory) the recordings should include (before and after the section of tape to be used for the articulation tests) a recording of a sine wave at 800 c/s having an absolute power level of — 40 db at the point where the recording has been carried out. This recording of 800 c/s will allow, if it is necessary, the study, at a later date, of the behaviour of the variations as a function of time, of these noises.

The C.C.I.F. Laboratory will study by means of tests at *constant speech power* the reduction in the articulation produced by such noises for various values of the reference equivalent of the total connection between two subscribers. It will also determine the transmission impairment corresponding to these variable noises and thereby the impairment corresponding to a variation of the signal-to-noise ratio.

Question No. 24.

(3rd Study Group in co-operation with the 5th S.G. of the C.C.I.F., the C.C.I.R. and with the C.C.I.T., Question No. 7 of the 5th S.G.) (Category A 2) [urgent] (new question)

Will it be possible to have a recommendation concerning total noise, common to all wideband carrier systems (carrier systems on coaxial cable, on symmetrical pair cable or on radio relay links) ?

Note 1. — There exists at present a C.C.I.F. recommendation concerning the total noise that can normally be admitted for 99% of the time on a carrier system over coaxial pairs in cable. This recommendation was established to enable each Administration, independently of other Administrations, to make plans for the section crossing its own territory on an international carrier system over coaxial pairs.

The establishment of similar recommendations is the subject of Question No. 34 below for systems on symmetrical pairs in cable *.

Finally, in the case of radio relay systems, it is necessary to take note of the propositions of the C.C.I.F. on the question of clauses concerning noise, which

* Question No. 38 concerns a similar problem for 12-circuit carrier telephone systems on open wire lines, which are not studied within the framework of the present question.

it expects to establish, based on a nominal maximum circuit on radio relay systems as defined in Annex 1 below.

Note 2. — On the other hand, the note at the end of Question No. 23 above asks Administrations to observe the variation as a function of time of the total noise existing on the different types of systems. The study of the results of these observations will make it possible to see if the noises observed have characteristics sufficiently similar for it to be possible to have, for this total noise, a clause common to all types of system, and if so, attention is drawn to the suggestion of the Cuban Telephone Company in Annex 2 below.

ANNEX 1
(to Question No. 24)

Document No 66 (revised) of the C.C.I.R.
(Geneva, 1954)

DRAFT RECOMMENDATION

Nominal maximum circuit for frequency-division multiplex radio-relay systems with maximum capacity of sixty telephone channels or more

The C.C.I.R.,

considering :—

(a) that it is desirable to establish nominal maximum circuits for radio-relay systems in order to afford guidance to the designers of equipment and systems for use in international telecommunications networks ;

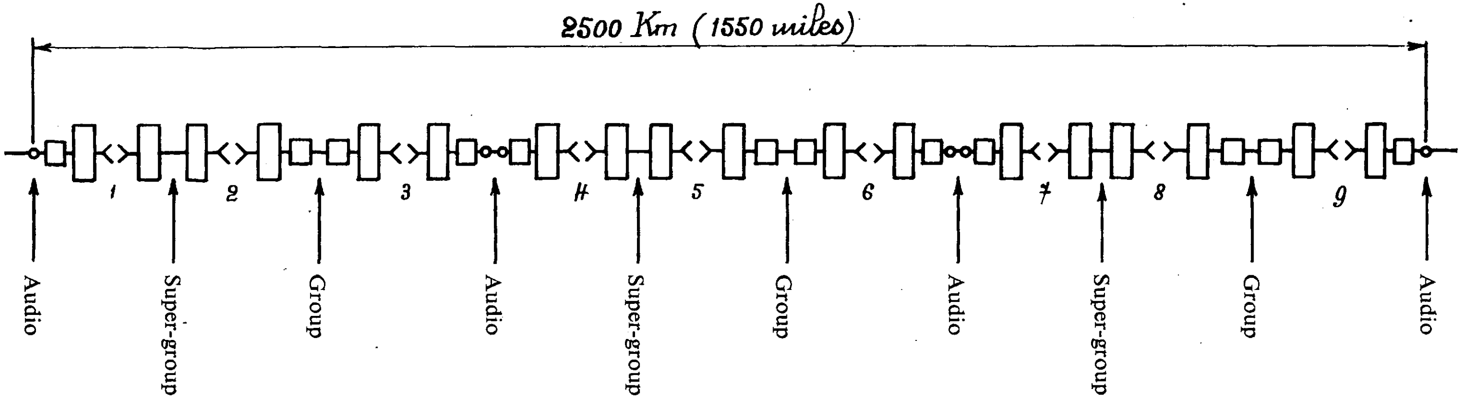
(b) that occasionally tropospheric conditions may give rise to brief periods of fading on radio-relay systems, with consequent increases in noise ;

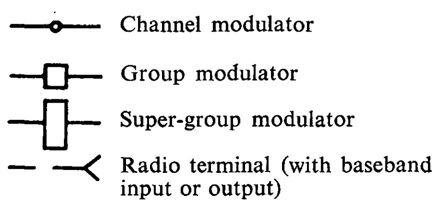
(c) that these transient increases in noise, which are quite unrelated to intermodulation associated with the busy hour, and will not generally coincide with it, must be allowed for in specifying the noise that may be permitted ;

recommends:

1. That a nominal maximum circuit should be established for F.D.M. (frequency-division-multiplex) radio-relay systems with a maximum capacity of sixty or more telephone channels per radio frequency channel ;
2. That this circuit should be 2500 km long ;
3. That this circuit should include the following sets of F.D.M. modulators : 3 sets of channel modulators, 6 sets of group modulators, 9 sets of supergroup modulators, it being understood that a " set of modulators " comprises a modulator and a demodulator ;
4. That the circuit should include 9 sets of radio modulators ;
5. That the contribution to the overall noise from all the sets of F.D.M. modulators mentioned in 3 above shall not exceed 2500 pW.

Note. — The permissible psophometric noise at a point of zero relative level in a voice-frequency channel should receive further study and form the subject of a further recommendation.





(Addendum to Document No. 66 revised of the C.C.I.R.)

FIGURE 1. — *Proposed nominal maximum circuit for F.D.M. radio-relay systems*

ANNEX 2
(to Question No. 24)

Proposals by the Cuban Telephone Company for the establishment of a single clause concerning noise on the various carrier systems

Introduction.

There is a need for a general noise objective to give guidance in the design of long-distance telephone systems intended for the international service. Such an objective is available for coaxial carrier systems, but it has been found less suitable for other transmission systems.

A proposal is made for a noise objective which is suitable for any new long-distance telephone circuit.

A. *Noise in Coaxial Circuits.*

The C.C.I.F. recommendation for noise at the end of the coaxial reference circuit (2500 Km) is that the psophometric noise should not exceed 10,000 pW at a point of zero level for more than 1 % of the time. The measurements are to be made during a period when the highest noise is expected (in general the busy-hour). (Yellow Book, Florence, 1951, Volume III *bis*, page 121.)

Figure 1 attached hereto shows the C.C.I.F. recommendation in graphical form plotted to a scale of linear probability (i.e. in such a way that normal probability is represented by a straight line).

B. *Comment on the coaxial circuit noise recommendation.*

The C.C.I.F. recommendation for noise in coaxial systems is intended as a guide to the design of coaxial systems for the international service.

The form of this recommendation renders it difficult to sub-divide the recommended maximum noise when there are several contributions to be counted into the total. The tendency is to sub-divide the permissible power rather than the time period, while in fact, of course, both must be considered when the complete noise allocation is to be divided up between a number of contributory sources.

In a coaxial system with a large number of channels, the actual noise produced by the system is of such statistical properties that the recommendation is reasonably fair in form. There will not be a very large variation in the noise level inside a period of high noise level, e.g. the busy-hour, because the noise produced in a coaxial system is fairly constant. It is considered, however, that even in this case it would be more in keeping with the behaviour of practical circuits and with the requirements of overall connections if the form of the recommendation had been in terms of a mean permitted noise power and a fluctuation allowance.

When other systems are considered, such as for instance, carrier systems with 12, 24 or 60 channels, and microwave radio links, the present C.C.I.F. coaxial noise specification is less appropriate for these systems in which the noise produced is much less constant than in the coaxial system.

The present C.C.I.F. coaxial system noise recommendation, when considered for other systems than the coaxial system, appears to be unnatural in two respects :—

1. The present recommendation does not recognize the advantage to the telephone network of the noise (during a period of high noise level) being below the value which has been specified as the maximum for most of the time (99 %).

This is unfair to systems producing a variable amount of noise.

Consider, for instance, two systems which both exactly meet the present recommendation, the first by providing a constant noise of the recommended value and the second by having a sloping noise statistical curve passing through the 1% 10,000 pW point and giving for instance, 2,000 pW at the 50% level. There can be no doubt that the second system is a better system than the first and that the noise effects in the second system could be allowed to increase by a certain amount before this second system would be judged to be not better than the first system.

2. The recommendation does not put any limit on noise which occurs less frequently than 1% of time (during any period of high noise level).

If designers were to make full use of this aspect of the recommendation the resulting system might well be found undesirable.

C. *The requirements that should be fulfilled by a general noise objective.*

The noise objective should be expressed in terms of a suitable planning length and should be based on what is considered acceptable for the telephone network, rather than on the type of performance obtainable with a particular type of system. The noise objective should be stated in such a way that it can justly be used in designing equipment for long-distance telephony.

The noise objective should recognise that the noise in actual systems is fluctuating. Short-term fluctuations are integrated out by the measuring means which would be used, the psophometer for instance with an integrating time of 200 milliseconds. The noise objective should be in terms of the slower fluctuations occuring at a period when the noise is high.

In making an allowance for fluctuation inside a test period it should be remembered that the amount of noise which will be permitted will be one that is safe, i.e. it will not by itself cause any very severe degree of ambiguity in the majority of telephone connections.

The speech level adopted in individual calls is fluctuating from call to call and it is the coincidence of a low-level call and high noise level which causes increased ambiguity. Such coincidences are rarer, of course, than the incidence of either of its constituent conditions.

The long-distance noise will in practice be combined with noise arising in other parts of the network and with subscriber sidetone noise, etc. All these noise contributions are fluctuating in time. The effect of increased noise during a particular call is likely in the first instance to be only that the subscribers, when the noise occurs, adopt a higher speech volume which (other things being equal) largely compensates for the temporary noise increase. One object of a long-distance circuit noise specification is therefore to make it unnecessary for the subscribers to raise their voices more than they would in the absence of the long-distance circuit noise.

The fact that all these noise contributions and their effects are fluctuating should be recognized in the noise specification for long-distance circuits by allowing this noise also to be fluctuating, and at :he same time it should be recognized that the average noise power (during periods of high noise level) is of fundamental importance. In adding together several fluctuating noise sources the average noise power of each contribution is of major significance in computing the total.

The specification should therefore give a maximum value for the mean noise power as well as a limit for the maximum fluctuations above the specified mean power. The specification for fluctuation should take account of the fact that the shorter the duration of the deviation the larger it may be, provided of course, that the mean noise power specification must also be met over the test period.

Experience with the noise produced in several types of systems has shown that the statistical variation in nearly all cases is of the " log. normal " type. This means that the logarithm of the noise power (noise expressed in dbm) is, statistically speaking, " normally distributed ". Noise of this type can be specified by two parameters—the median db power and the standard db deviation (root mean square db difference from the dbm mean).

This type of noise distribution has the property that the mean power expressed in dbm (that is power averaged over the test period) is equal to the median db value plus the square of the db standard deviation multiplied by the factor 0.115. In view of this last property, it is, of course, also possible to specify the mean power and the deviation and this method of specifying the curve is more useful for the present purpose.

D. *Proposal for the form of a general noise objective.*

Based on the foregoing, it is now proposed that the noise objective for long distance circuits should be of the following form :—

1. *Distance.* — The noise objective should be stated for 2500 Km. The distance used for specifying noise does not imply that longer circuits cannot be operated. The noise for a longer circuit will, of course, be larger and is readily derived from the 2500 Km objective. It is similarly also possible to derive the noise objectives for shorter distances. These objectives must, of course, be such that when a number of systems are put in tandem to give a 2500 Km circuit, their overall performance must meet the overall (2500 Km) objective. The operation of combining such " partial " systems in tandem is one that can be performed as a matter of computation.

2. *Power.* — The specification here should be in terms of mean power over the test period. This can be expressed either in pW or in dbm, in either case it must be measured through the weighting network by a power (RMS voltage) indicating instrument (psophometer). It is convenient to indicate noise powers either by the symbol pW or by dbm0 p. The letter 0 indicate that the measurement of power is referred to a point of zero relative level, while the letter p refers to the fact that the measurement must be made with a C.C.I.F. weighting network.

3. *Test Period.* — It is proposed that testing should be extended over one hour. The hours chosen should be those in which a high noise level is to be expected. For cable systems most noise is in general to be expected during the busy-hour, but on microwave radio relay links the worst propagation condition will generally not coincide with peak traffic.

4. *Fluctuation of noise.* — *(a)* It is proposed to define the maximum permissible fluctuation by a log. normal curve of mean power, as specified in 1 and with maximum standard deviation of 4 db. See Figure 2.

This implies that the median power is 1.84 db below the mean power and that the mean power may be exceeded by :—

$$\left.\begin{array}{r}3.3 \text{ db for } 10\% \\ 7.4 \text{ db for } 1\% \\ 10.5 \text{ db for } 0.1\% \\ 13.1 \text{ db for } 0.01\%\end{array}\right\} \text{ of time in the test hour}$$

It is proposed that only that portion of the curve between 30% of time and rarer should be specified.

If in an actual system the standard deviation of the noise is much smaller than what is permitted in the specification, the mean power will be the only criterion which will be operative. The fluctuation specification has not been carried beyond the 30% level at which it attains the mean power value. If in another system the noise has a very large fluctuation, then in this case the fluctuation specification only will be limiting and the mean power will be less than the specification value.

(b) It should be noted that the integrating time of the psophometer is approximately 200 milliseconds, which corresponds to approximately 0.005% of the test hour and that therefore very little meaning can be attached to results at the lowest levels of probability shown on Figure 2. For this reason it is proposed that the limiting curve should be terminated at the 0.03% level by a vertical line indicating that for periods of time totalling less than approximately one second in the test hour, no limit will be stated for tolerable noise power.

E. *The value of mean noise power which should be permitted.*

It is proposed that the mean noise power in the general noise objective in § D shall be :—

Mean noise power (test period) $\leqslant -50$ dbm0 p.
which is equivalent to :—

Mean noise power (test period) must not exceed 10,000 pW when measured with a psophometric network at a point of zero relative level.

A noise allowance of this order is well established—the ruling C.C.I.F. specification for noise in international circuits permits a figure of this order of magnitude, but without any time qualification.

The C.C.I.F. recommendation for noise in coaxial circuits specifies a maximum noise of 10,000 pW for a 2500 Km circuit for all but 1% of time during periods when a high noise level is expected.

It is believed, therefore, that the same figure now proposed for the mean noise power will be satisfactory for the needs of long-distance telephone networks.

F. *Summary.*

There is a need for a general noise performance objective for long-distance telephone circuits.

It is proposed that the weighted noise measured at the end of a 2500 Km circuit, during any hour, shall satisfy the two conditions :—

1. Have mean power $\leqslant$ 10,000 pW or -50 dbm0 p.

2. The noise distribution when plotted in dbm0 p to a scale of linear probability shall lie below a straight line joining two points for which the power co-ordinate and probability level are respectively :

10,000 pW or -50 dbm0 p and 30%
160,000 pW or -38 dbm0 p and 0.03%

Figure 3 illustrates these requirements.

The noise objective is intended for guidance in the design and planning of cable systems and of microwave radio relay systems intended for the international telephone service.

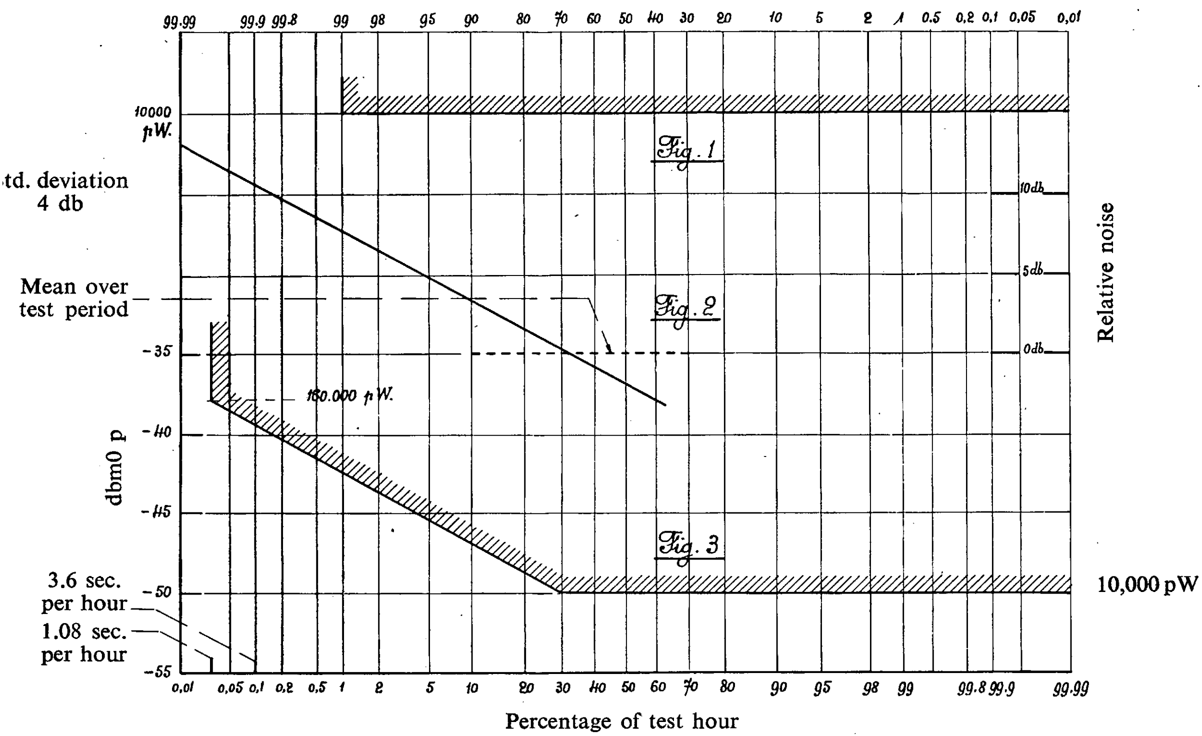


FIGURE 1. — *2500 km C.C.I.F. coaxial system*

FIGURE 2. — *Form of proposed objective*

FIGURE 3. — *2500 km proposed general noise objective*

1. Mean over test period $\leqslant -50$ dbm0, and
2. Noise distribution to be below the curve.

Question No. 25.

(3rd Study Group in co-operation with the 8th S.G.) (Category A 2) [urgent] (new question)

Is it necessary to protect carrier telephone apparatus against harmful voltage surges arising from switching signalling and dialling equipments ?

If so, what are the allowable limits for such voltages having regard to the overloading of carrier telephones systems ?

Question No. 26.

(3rd and 8th Study Groups in co-operation: Question No. 2 of the 8th S.G.) (Category A 1) [urgent] (new question).

Having regard to :—

— the experience obtained in the use of carrier telephone systems, as well as in the design and the construction of voice-frequency signal receivers,

— the advantages which could be obtained, as regards the simplicity and cost of such receivers, as well as an improvement in their reliability of operation, if higher limiting values could be allowed for the power and energy to be used for signals sent over international circuits,

would it not be both desirable and possible to revise the recommendations which appear on pages 21 and 22 of the *Yellow Book*, Volume VI, as regards these limiting values, and if so, what new limits should be recommended ?

Note. — These values could be revised for the following reasons :

1. The 3rd Study Groups considers it possible to modify :—

(a) the upper limit of − 3 nepers or − 26 decibels for the absolute level of power of a continuous sinusoidal wave and for the average power of signals composed of trains of sinusoidal waves ;

(b) the median value of 0.5 mV allowed for the psophometric e.m.f. produced on a signalling channel by signal pulses on an adjacent channel, and the average value of 62 decibels for the difference between the attenuation in the non pass band and the pass band of a filter of a channel of a carrier telephone system, as this would allow a new level to be fixed for the allowable power of a signalling pulse of short duration, according to its frequency.

2. The maximum energy which can be transmitted by the signals during the busy hour depends on the probability of the simultaneous emission of signals on several circuits in the same carrier current system : this probability could be made the subject of a new study, the singalling systems being now defined.

3. The working party of the 3rd Study Group, during its meeting in Geneva in January/February, 1955, remarked that it was necessary to take into account in this statistical study, not only the electrical signals, but also the tones transmitted over international lines. On this question, this working party drew attention to the fact that the allowable limit had not been fixed for the absolute power level of a tone at the point where it is injected into the international communication.

Question No. 27.

(3rd Study Group in co-operation with the 8th S.G.) (Category A 2) [urgent] (new question)

(a) Is it desirable to recommend, for carrier telephone systems which conform to the existing C.C.I.F. recommendations (with a carrier-frequency spacing of

4 kc/s), the transmission of signals outside the speech band of frequencies and if so, what signalling frequency and what level should be recommended ?

(b) If so, what should be the essential characteristics of the signalling circuit ?

Question No. 28.

(Category B) [non urgent] (continuation of Question No. 38 studied in 1952/1954)

What should be the limits of the " attenuation/frequency " characteristic of the filters at the output of the transmit equipment and at the output of the receive equipment, these characteristics being given in a form similar to the diagrams

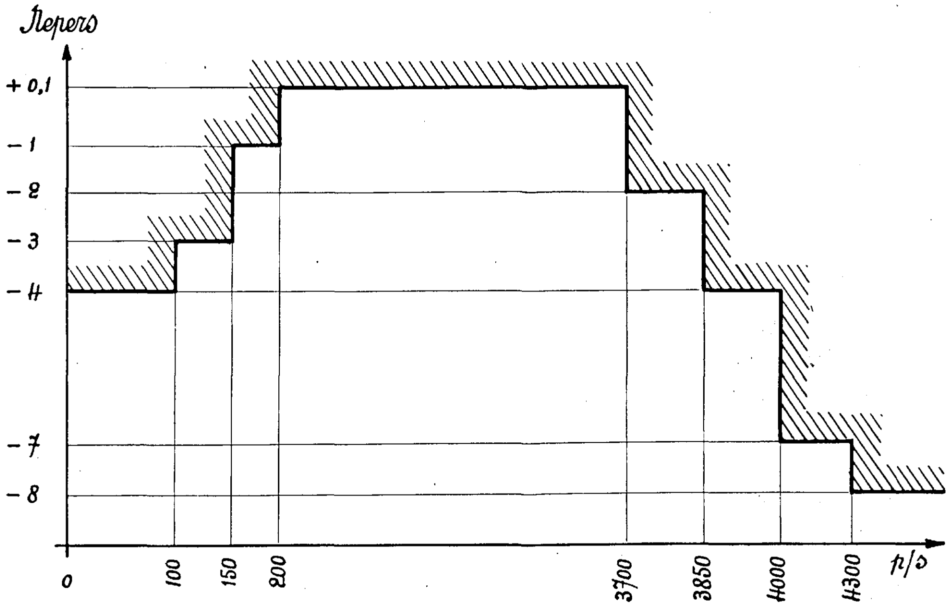


FIGURE 1. — *Output of transmit equipment for the sideband normally transmitted*

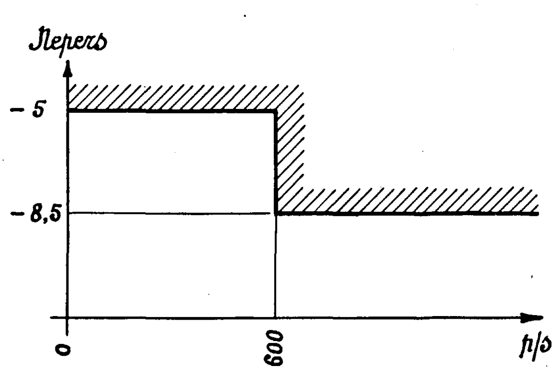


FIGURE 2. — *Output of transmit equipment for the sideband normally suppressed*

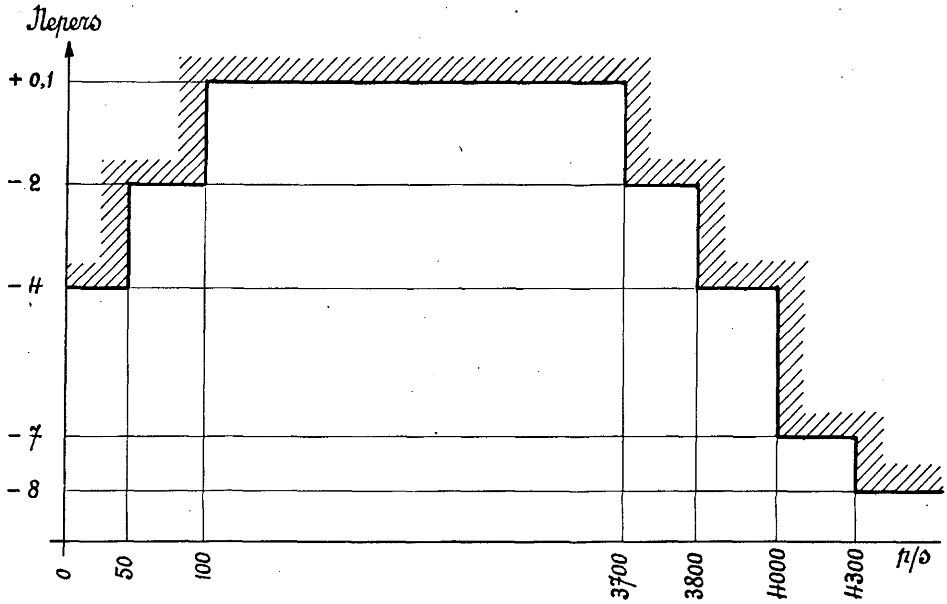


FIGURE 3. — *Output of receive equipment for the sideband normally transmitted*

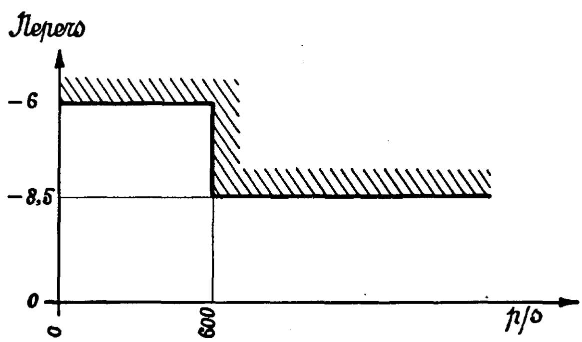


FIGURE 4. — *Output of receive equipment for the sideband normally suppressed*

given below as an example (these diagrams correspond to specifications fixed by the French Administration and refer to the telephone channels equipments themselves) ?

These similar characteristics, relating to the different carrier-system filters, should show, as precisely as possible, the spaces in the frequency spectrum, which are not used for the transmission of speech currents.

Note. — In all the diagrams below, the ordinates correspond to the relative values (relative to the reference value which corresponds to 800 c/s) of the power measured at the output of the equipment in question, when a constant power is applied (at the input of this equipment) at the frequency corresponding to the abscissa (Figures 1 and 2) or the frequency corresponding to the received audio frequency and represented along the abscissa (Figures 3 and 4).

In all cases, the measured characteristic should be contained within the area which is not shaded ?

Question No. 29.

(3rd Study Group in co-operation with the 9th S.G.) (Category A 2) [urgent] (new question)

What are the allowable limits for the stability of the pilot frequencies on carrier systems ?

Note. — For the economic design of suppression filters for the pilot frequencies it would be desirable to fix allowable limits for the variation of the frequencies of these pilot signals. For systems of twelve telephone circuits on open wire lines such a recommendation exists (see *Yellow Book*, Volume III *bis*, page 82). For cable systems the corresponding recommendation refers only to the virtual carrier frequencies. The above new question is proposed since in certain cases the pilot frequencies are not derived from one or more of the master oscillators of the carrier system.

Question No. 30.

(3rd Study Groups in co-operation with the 9th S.G.) (Category A 2) [urgent] (new question)

Is it necessary to standardize the method for the initial lining-up of the section of line crossing a frontier, for symmetrical-cable pairs and for coaxial-cable pairs ?

If so what measurements should be made and what levels should be recommended ?

Note. — The Permanent Maintenance Sub-Committee, during its meeting in September 1954, expressed the opinion that the rules for setting up a line crossing a frontier should be left to the initiative of the Administrations concerned.

Question No. 31.

(3rd Study Group in co-operation with the 9th S.G.) (Category A 2) [urgent] (new question)

Is it necessary to recommend a specification for setting up supergroup links (or group links) which cross one or more frontiers and comprise one or more supergroup sections (or group sections) ?

If so what should that specification be ?

Note 1. — The annex below reproduces the definitions adopted by the XVIIth Plenary Assembly of the C.C.I.F.

Note 2. — The Permanent Maintenance Sub-Committee, during its meeting in September 1954, expressed the opinion that it would be desirable that specifications be recommended by the C.C.I.F. for the establishment of these links.

ANNEX

(to Question No. 31)

Definitions to be used for the maintenance of international carrier systems

The figure 1 below represents a very long group set up over several carrier systems, on symmetrical or coaxial pairs, in series. It exemplifies the way in which the proposed terms are applied to the constituent parts of the circuit of the group.

The following definitions are proposed :

1. *Group section.* — The part of a group link between two consecutive group distribution frames or between two equivalent points.

2. *Group link.* — An assembly of transmission media of defined bandwidth (48 kc/s), connecting two group distribution frames or two equivalent points. A group link extends from the point at which the group is assembled to the point at which it is split up and the term customarily embraces the equipment for both directions of transmission.

3. *Transfer point of a group.* — A " group link " generally contains several " group sections " connected in series through " group transfer equipments " at points described as " transfer points of a group ".

4. *Supergroup section.* — The part of a supergroup link between two consecutive supergroup distribution frames or between two equivalent points.

5. *Supergroup link.* — An assembly of transmission media of defined bandwidth (240 kc/s) connecting two supergroup distribution frames or two equivalent points. A supergroup link extends from the point at which the supergroup is assembled to the point at which it is split up and the term customarily embraces the equipment for both directions of transmission.

6. *Transfer point of a supergroup.* — A " supergroup link " generally contains several " supergroup sections " connected in series through " supergroup transfer equipments " at points described as " transfer points of a supergroup ".

7. *Carrier line link.* — An assembly of transmission media used to carry one or more groups of twelve channels. It can be devided into two or more *sections of symmetrical pair line*, connected in series at intermediate points. The term customarily embraces the equipment for both directions of transmission.

8. *Carrier line section.* — The part of a carrier line link between two consecutive distribution frames or between two equivalent points.

9. *Coaxial line link.* — An assembly of transmission media in a carrier current system on coaxial pairs. A coaxial line link extends from the point at which a number of supergroups is assembled in the frequency band to be transmitted on the line to the point at which the assembly of supergroups is split up.

10. *Regulated line section* (on symmetrical or coaxial pairs). — A section of line in a carrier current system in which the line regulating pilot or pilots are transmitted from end to end without undergoing selective amplitude adjustment at any intermediate point.

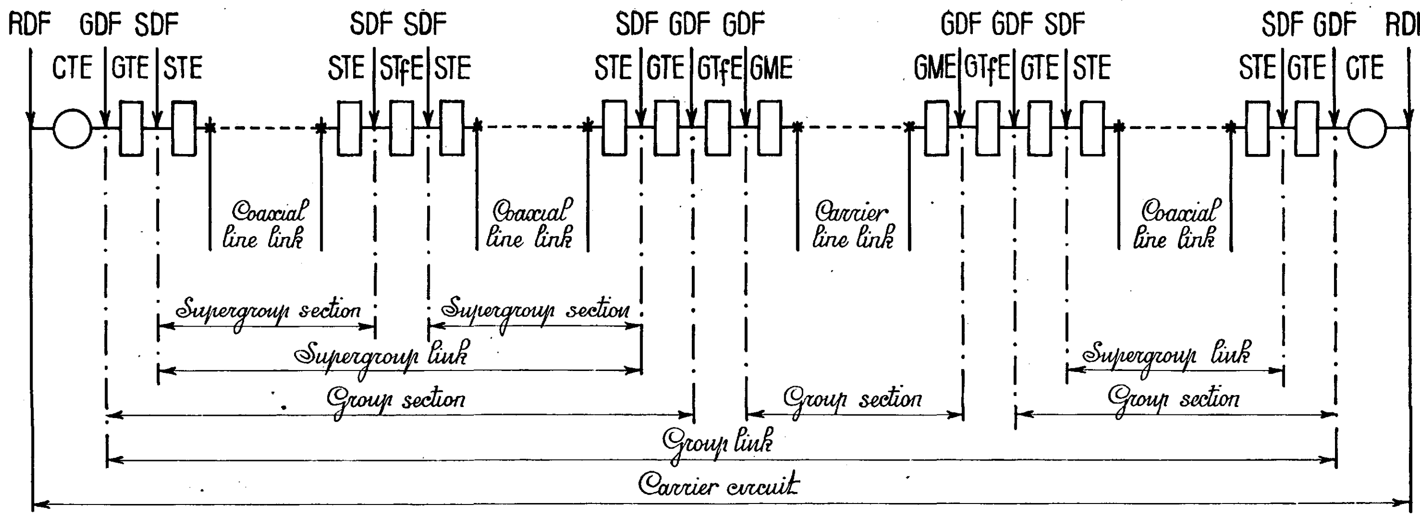


FIGURE 1

CTE — Channel translating equipment
GTE — Group translating equipment
STE — Supergroup translating equipment
GME — Group modulating equipment
STfE — Supergroup transfer equipment
GTfE — Groups transfer equipment
RDF — Repeater distribution frame
GDF — Group distribution frame
SDF — Supergroup distribution frame

Question No. 32.

(Category A 2) [urgent] (new question)

What should be the allowable limits for the ratio between the desirable components and the various harmful components (see *Yellow Book*, Volume III *bis*, page 133) for the transfer of a supergroup ?

Note. — Account should also be taken of the disturbances due to the line regulating pilots or to the additional measuring frequencies, namely the frequencies 308 and 556 kc/s (see Volume III *bis*, page 115).

Question No. 33.

(3rd Study Group in co-operation with the 5th S.G.) (Category A 2) [urgent] (new question)

What is the minimum value of the signal-to-noise ratio between the level of the group and supergroup pilots and the level of the background noise that can be allowed without disturbing the operation of the automatic level regulating devices installed on carrier land lines ?

Note. — In the study of this question, attention should be paid particularly to the following draft recommendation, submitted by the 3rd and 5th Study Groups to the XVIIth Plenary Assembly of the C.C.I.F. :—

" In order to ensure sufficient flexibility of interconnection between radio relay links and metallic systems in the international network, it is recommended that in every radio system likely to be interconnected with the international network, the possibility of accepting and reconstituting faithfully the pilots associated with groups and super-groups as recommended by the C.C.I.F. should be foreseen.

" On the other hand, any frequency which may be used within the radio link for regular supervision of its operation should be suppressed at the output of the radio system, according to the conditions quoted in Volume III *bis* of the *Yellow Book*, pages 131 and 133, in order that transmission on associated lines may not be affected."

Question No. 34.

(Category A 2) [urgent] (continuation of Question No. 24 studied in 1952/1954)

A. How can the magnitude of crosstalk on a circuit be forecast when planning a multi-channel carrier scheme using symmetrical pair cables ?

B. When designing such a scheme, how should the total noise permissible on a circuit be divided between :

(a) noise due to crosstalk,

(b) the sum of the basic noise and intermodulation noise ?

C. Assuming the adoption of a nominal maximum circuit of 2500 km, what limit should be fixed to the mean value of the line noise per km of the psophometric power related to a point of zero relative level, bearing in mind the possible alteration in position of the channels in the band transmitted ?

N. B. — In the reply to § A the following remark should be taken into consideration :—

The disturbing pairs may not transmit the same conversations over the whole length of line used by the disturbed circuit ; new conversations may be introduced on this line at transfer points in place of certain of the conversations originally transmitted.

Question No. 35.

(Category A 2) [urgent] (continuation of Question No. 23 studied in 1952/1954)

What are the relative power levels, measured at the output of the intermediate repeaters, to be recommended for carrier systems on balanced cable pairs transmitting 24, 36, 48 and 60 channels when these repeaters are remotely power fed ?

Note. — In the study of this question, account should be taken, in particular, of the contribution of the Administration of the U.S.S.R. which is reproduced in the following annex.

ANNEX

(to Question No. 35)

Extract from the reply of the Telephone Administration of the U.S.S.R. to Question No. 23 studied in 1952/1954

All apparatus (for 12, 24 and 60 channel systems) used in the U.S.S.R. for high-quality telephony over symmetrical-pair cables, allows of the remote power feeding of the intermediate repeaters, using the cable conductors carrying the telephony transmissions.

Experience in the field has shown that the remotely power fed repeaters can be unattended ; this presents important advantages both for construction and use of the systems. Because of these advantages, the remote power feeding of intermediate repeaters is widespread in the Soviet Union.

These systems use inexpensive and relatively low-power electronic tubes ; therefore the power which the repeaters can transmit without distortion does not allow of the use of 24 and 60 channel systems with the relative levels recommended by the C.C.I.F. (" C.C.I.F. — 1952/1954 — 3rd Study Group — Document No. 46 ", page 98).

Nevertheless, experience in using the systems with remote power feeding has shewn that, with high quality communication channels which satisfy the recommended standards of the C.C.I.F., the lower value of the power transmitted without distortion by the intermediate repeaters does not involve any reduction in the allowable attenuation (and, as a consequence, the reduction in length) of repeater sections ; it is even possible to increase the allowable attenuation if preemphasis (sloping frequency characteristic of the transmitted level) is used.

Therefore for high-quality symmetrical cable communication systems with remote feeding of the repeaters, the Telephone Administration of the U.S.S.R. recommends the establishment of new nominal values of relative levels of power measured at the output of an amplifier, perhaps :—

(a) if preemphasis is used (with sloping frequency characteristic of the transmitted level) :

for 24 channels systems : + 0.5 N for the highest channel
— 0.7 N for the lowest channel

for 60 channel systems : + 0.5 N for the highest channel
— 1.9 N for the lowest channel

The levels of transmission for other channels of the system should have intermediate values, determined from the straight line connecting the points corresponding to the values for the highest and lowest channels.

(b) if equal levels are used for all channels.
for 24-channel systems : +0.2 N.,
for 60-channel systems : —0.2 N.

Question No. 36.

(Category A 2) [urgent] (new question)

(a) Is a carrier telephone system providing more than 60 telephone channels on balanced-pair cables to be recommended and if so what frequency spectrum is suggested ?

(b) What should be the general electrical characteristics of the cable pairs and of the carrier equipment for such a system with more than 60 channels ?

Note. — It is possible, for example, by using insulating material with very low losses, to make balanced-pair carrier cables with an attenuation at high frequencies which is very much less than the attenuation of similar cables with paper insulation. The use of such cables providing 120 channels (up to 552 kc/s) for example, could be considered.

Question No. 37.

(Category A 2) [urgent] (continuation of Question No. 25 studied in 1952/1954)

Taking into consideration the present recommendations of the C.C.I.F. concerning carrier systems on open-wire lines, as well as the recommendations made by the XVIIth Plenary Assembly of the C.C.I.F. for the particular case considered in the annex below ;

Considering, furthermore, the desirability of standardizing the equipments, which would result in manufacturing and maintenance economies ;

What should be the general characteristics to be definitely specified for the various open wire carrier systems transmitting an effective frequency band of 300 to 3400 c/s ?

Note. — Account should be taken of the possible existence on the same route of the old systems recommended in the *Yellow Book*, and of the new systems.

ANNEX
(to Question No. 37)

Description of a system recommended by the XVIIth Plenary Assembly of the C.C.I.F. for the provision of three carrier telephone circuits on an open wire pair

The particular system described below may be used in regions with a low telephone traffic density. This two-wire system gives three good quality telephone circuits situated above the existing audio-frequency channel (this system should in all cases be located below the band of frequencies given in scheme 1, sub-section 3.2.2 above, for a 12-circuits telephone system). The principal problem is to recommend a line frequency allocation such that at a junction point between two systems it is not necessary to use demodulation and remodulation because this junction point may be in a completely uninhabited region. In addition, it must be so arranged that each of the three carrier telephone circuits of the system may be used to provide 18 to 24 voice-frequency telegraph circuits. It is also equally necessary to obtain with this system one carrier telephone circuit and one both-ways old-type broadcast programme transmission circuit. It must also be possible to provide a both-way normal type broadcast programme circuit in addition to a voice-frequency telephone circuit.

The following specification has been prepared for the particular case described.

(a) *Frequency band transmitted.*

The spacing of the carrier frequencies should be 4 kc/s as in all the other recommendations of the C.C.I.F. for modern carrier systems.

It is recommended that the lowest band transmitted to line for one direction of transmission should lie between 4 and 16 kc/s and that the highest band for the other direction of transmission should lie either between 18 and 30 kc/s, or between 19 and 31 kc/s in order to permit staggering of the carrier frequencies if it should be necessary at a later date to place a second system of this type on the same open wire-route.

(b) *Relative power levels.*

The relative power level at the output of the terminal equipments and the intermediate repeaters, on each channel and for the frequency on the channel which corresponds to an audio frequency of 800 c/s should not exceed + 2 N (+ 17 db).

(c) *Pilots.*

In the four methods of frequency allocation given above, the pilot frequencies will be 16.110 kc/s for the lower frequency band and 31.110 kc/s for the upper frequency band. The absolute power level of the line pilots will be — 1.73 N (— 15 db) at a point of zero relative level.

(d) *Variations* (as a function of frequency) *of the equivalent at the output of the sending terminal equipment.*

(e) *Non-linear distortion.*

(f) *Crosstalk.*

(g) *Impedance.*

(h) *Stability of the carrier and pilot frequencie generators.*

In order that the effect of the modulations or demodulations shall never produce a difference of more than 2 c/s between the voice frequency applied at one end of a channel and that which is received at the opposite end (in the case where there is no intermediate demodulation and remodulation), the stability of the generators of the pilot frequencies must be such that the frequency be exact within 2.5×10^{-5} approximately.

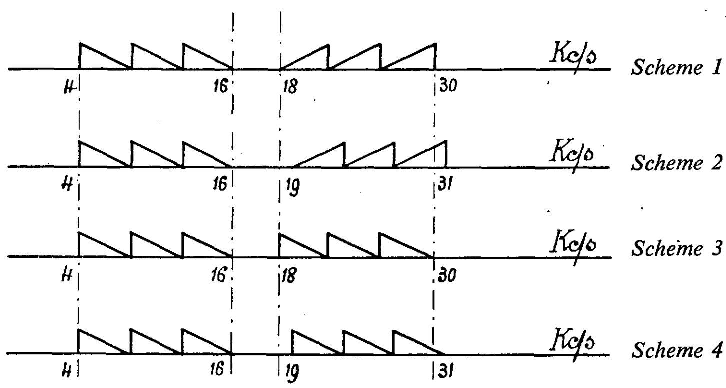
(i) *Carrier leak transmitted to line.*

At a point of zero relative level, the absolute power level of the carrier leak should not exceed :—

- 2.0 N (— 17 db) for one channel and for each direction of transmission,
- 1.7 N (— 14.5 db) for all the channels of a system and for each direction of transmission.

Note. — It remains to be studied how the systems corresponding to the particular specification stated above might be used on the more important routes. The C.C.I.F. has examined from the last point of view allocations which may be suitable for the 1st, 2nd, 3rd and 4th systems provided on the same route and also the possibility of using frequency staggering and inversion of the sidebands. Taking these considerations into account the C.C.I.F. recommends the four methods of frequency allocation shown in the following diagrams : no order of preference between these schemes has been fixed and the Administrations concerned should choose in each particular case the most appropriate scheme or schemes.

Remark. — By agreement between Administrations and Private Operating Companies concerned the lower frequency band may be inverted in schemes Nos. 2 and 4.



Question No. 38.

(3rd Study Group in co-operation with the 1st S.G.) (Category A 2) [urgent] (new question)

(a) What is the maximum permissible value of the psophometric e.m.f. of the noise measured at the end of the nominal maximum circuit on 12-circuit open-wire carrier systems (point of relative level — 0.8 N or — 7 db) ?

(b) What is the maximum permissible value of each of the main components of the total noise defined under *(a)*, for example, line noise, repeater noise, noise from terminal equipments, intermodulation and noise introduced by power lines ?

(c) What limits may be fixed for crosstalk at the end of the nominal maximum circuit on 12 circuit open-wire carrier systems taking into account the improvement

which may be obtained by inversion of the transmitted frequency bands, by staggering the carrier frequencies used for various systems on the same route, and by means of compandors ?

(d) What essential characteristics (static and dynamic) should be recommended for voice operated compandors ?

Note. — The following Annex indicates the considerations which have led to the definition of the nominal maximum circuit on open-wire lines.

ANNEX
(to Question No. 38)

Considerations concerning the definition of the nominal maximum circuit on 12-circuit open-wire carrier telephone systems

(a) *General.*

A Working Party has examined the proposal made by the Sub-Committee for Middle East and Southern Asia at Lahore in December 1953, regarding the definition of the nominal maximum circuit for 12-circuit systems on open-wire lines. After an exchange of views this Working Party came to the following conclusions which were approved by the 3rd Study Group and the XVIIth Plenary Assembly of the C.C.I.F.

This nominal maximum circuit may have a length of 2500 km (1600 miles) and may include 3 pairs of channel translating equipment and 3 pairs of group translating equipment.

Taking into account the problems peculiar to the operation of open-wire lines, the limits for noise, crosstalk and for the variation of the equivalent of the circuits with time may differ from those recommended in the *Yellow Book* for circuits established on carrier circuits in cables.

(b) *Length of circuit.*

The recommended figure of 2500 km (1600 miles) agrees with the suggestion of the Sub-committee for Middle East and Southern Asia and also with the length of the nominal maximum cable circuit. This Sub-committee, however, suggested that the circuit could be made up of five separate systems in tandem, but the Working Party envisaged only three separate systems in tandem, which is more in line with the coaxial cable standard. The Working Party took into account the fact that, as shown in the document " C.C.I.F. — 1952/1954 — 3rd Study Group — Document No. 41 " (U.S.S.R. Administration) and " C.C.I.F. — 1952/1954 — 3rd Study Group — Document No. 83 " (Australian Administration, open wires have to traverse very great distances in some countries, compared with the usually shorter distances covered by cables ; but noted that the length of the nominal circuit does not by any means represent the maximum distance over which a circuit may be established. In fact the nominal maximum circuit is intended only for the purpose of enabling design objectives to be established, for example, for equipment, for repeater station spacing and for transposition schemes. The Working Party also took note, in discussing this point that the extent to which extra long circuits made up of 12-channel open-wire carrier systems in tandem are used, is affected by tariff considerations, especially where the circuit has to traverse several countries ; and at the same time it was noted that, as pointed out at Lahore, other forms of communication may be found preferable in certain cases by some administrations to extra long open-wire circuits. An example of this would be the establishment of communications between the Middle East and South Asia on the one hand and Europe on the other.

(c) *Noise.*

The Working Party examined the information available on the noise values observed in practice on open-wire lines on which 12-circuit carrier telephone systems are used, including the information available in Documents Nos. 41 and 83. Having calculated the noise for a nominal circuit of 2500 km, the Working Party came to the conclusion that for such channels on open-wire lines the objective that the psophometric electromotive force at the end of the circuit should not exceed 5 millivolts for at least 90% of the time could easily be met. This is the objective recommended in the reply to Question No. 26 on page 118 of Document " C.C.I.F. — 1952/1954 — 3rd Study Group — Document No. 46 ". But the standard of 2 millivolts which has been adopted for the nominal maximum circuit on coaxial pairs would not be met fully.

The Working Party concluded that, at the present stage, it would be premature to make a firm recommendation for the admissible limit for the noise at the end of the nominal maximum circuit on open-wire lines. However, taking into account the experience gained in several countries, it is suggested that a noise value of 3 mV psophometric electromotive force at the end of this circuit (at a point with reference level — 0.8 N or — 7 db) could be used provisionally as a basis for further discussion. This value corresponds approximately to the value of 20,000 pW (psophometric) at a point of zero relative level. At the same time it is necessary to take into account the fact that for a certain percentage of the time (probably not more than 10%) the open-wire lines may be adversely affected by very unfavourable weather conditions and sometimes other forms of disturbances, during which time the noise at the end of the circuit may exceed the values indicated above.

(d) *Cross-talk.*

The cross-talk problem which arises with carrier systems on open-wire lines requires special study because certain factors which apply in the case of open-wire lines, for example frequency staggering and inversion, do not apply in the case of cable circuits. The introduction of frequency staggering and inversion produces an improvement in respect of crosstalk. Frequency inversion makes the crosstalk unintelligible and as it reduces the extent of the annoyance and the interference with conversation, a higher level of crosstalk can be tolerated. The use of frequency staggering also improves the situation, firstly because it reduces the energy of the crosstalk and therefore increases the crosstalk attenuation, and secondly, because it also reduces the intelligibility of the crosstalk.

Another point which needs consideration is that there are two types of unintelligible crosstalk in the case of open-wire carrier working. The first is the type just referred to ; and is the usual crosstalk between lines, rendered unintelligible by the frequency inversion and staggering. The second is crosstalk between different channels within a system, similar to that which occurs in cable systems, and should be treated as noise, as is done in cable systems. The Working Party recommends that these factors should be taken into consideration in the further studies of noise and crosstalk on open-wire carrier systems.

For these reasons, the Working Party proposed § (c) of the above question regarding the improvement which can be gained by frequency inversion and staggering between systems on the same route. When considering the questions on crosstalk, it is suggested that the reply should propose design objectives for single-frequency crosstalk attenuation between pairs in the same route, measured at a given frequency and taking account of the improvement obtained by means of frequency staggering and/or inversion, and also by the rearrangement of systems between the various pairs on the route, at repeater stations, to improve the worst combinations of crosstalk values between systems.

Question No. 39.

(Category A 1) [urgent] (continuation of Question No. 26 studied in 1952/1954)

What is the maximum allowable length for a 12-circuit open-wire carrier telephone system, on an open-wire pair, this system conforming to the conditions given on pages 68 to 73 of Volume III, of the *Yellow Book* of the C.C.I.F. and the telephone circuits established on this system satisfying all the recommendations of the C.C.I.F. concerning stability, noise, variation of equivalent as a function of frequency, and crosstalk ?

In the replies to this question all useful information will be given concerning the construction of the open-wire lines, spacing of repeaters, climatic conditions, etc.

Note 1. — It would be desirable to study in particular, within the framework of this question, means of improving the stability of transmission on very long open-wire lines, and also to see how the effects due to excessive variations due to climatic conditions may be remedied.

Note 2. — The present state of this question is described in the following annex.

ANNEX

(to Question No. 39)

Note concerning the revision of the Recommendations of the C.C.I.F. on the subject of international open-wire lines used for 12-circuit carrier telephone systems

In the reply made to Question No. 26 during the meeting in Geneva, in October 1953, the 3rd Study Group of the C.C.I.F. gave the following opinion :—

" In the present state of technique, it can be said that modern 12-circuit open-wire carrier telephone systems are capable of meeting all practical requirements for long-distance land circuits, always provided that special precautions are taken, particularly as regards :—

— uniformity of the construction of the route,
— accurate operation of the automatic regulators,
— the possibility of modifying, if necessary, the level diagram of the telephone circuits, to take account of climatic conditions which are special and seasonal (frost, etc.).

" Further, it is necessary to consider with care the noises in each particular case, and to fix the spacing of the repeaters, in order to have an adequate signal/noise ratio for a great part of the time.

" Provisionally, in designing such systems, the target should be for the psophometric e.m.f. at the end of the circuit (taking account of all noise with the exception of disturbances due to radio-transmitters) not to exceed 5 mV during at least 90% of the time, it being understood that this target cannot always be achieved economically, when there are very unfavourable climatic conditions ".

On the other hand, in their reply to this Question No. 26, the Cuban Telephone Company gave their opinion as follows :—

" It is considered that 12-circuit carrier telephone systems on open-wire lines, fulfilling the conditions shewn on pages 74 to 89 of Vol. III *bis* of the *Yellow Book* of the C.C.I.F., could be used for distances of at least 1000 kilometers, providing the line is suitably constructed.

" In fact, such systems have been used over much greater distances, but to obtain this result a standard of construction, higher than is usual, would be necessary, and in particular in the majority of the repeater sections the lowest relative level should be maintained well above the minimum specified by the C.C.I.F."

Having regard to the current extension of the European network into countries of the Mediterranean Basin and Southern Asia, where for many years only long open-wire lines can be used to carry international telephone traffic, it is important to clarify the recommendations of the C.C.I.F. on the subject of 12-circuit carrier systems on open-wire lines because these recommendations would be of great interest to the countries in the above-mentioned areas.

On this question, during the meeting at Lahore (Pakistan) of the Sub-Committee of the Middle East and Southern Asia in December, 1953 it was suggested that the C.C.I.F. should establish a nominal maximum circuit for telephony on open-wire lines, similar to the nominal maximum circuit in cable, which has two variants, one for coaxial pairs, and the other for symmetrical pairs. The study of this question by the 3rd Study Group of the C.C.I.F., at Geneva in September 1954, led to the drafting of Question No. 38 above.

Question No. 40.

(Category B) [urgent] (new question)

A. What types of construction and transposition rules for open-wire lines intended for several 12-circuit carrier systems on the same route, have given or seem likely to give good results ?

B. Is it possible to recommend a method of construction and transposition for general application to open-wire lines for 12-circuit carrier systems ?

C. Is it possible to recommend rules, of general application, for the improvement of existing open-wire lines with the object of adapting them for use with 12-circuit carrier systems ?

Question No. 41.

(3rd Study Group in co-operation with the 9th S.G.) (Category A 2) [urgent] (continuation of Question No. 28 studied in 1952/1954)

(a) What is the absolute power level (referred to a point of zero relative level deduced from the hypsogramme of the telephone circuits routed on the carrier system) which should be definitely recommended for the upper line regulating pilot of a carrier system providing either 10 supergroups or 16 supergroups on coaxial cables ?

(b) What are the tolerances to be finally fixed for the level, for the initial setting and for the variations of the pilot level as a function of time ?

Note. — An absolute power level of — 10 db with a tolerance of ± 0.5 db for the initial setting and of ± 0.3 db for the variations with time or an absolute power level of — 1.2 N with tolerances of ± 0.05 N and ± 0.03 N respectively have been provisionally recommended.

Question No. 42.

(3rd Study Group in co-operation with the 9th S.G. (Category A 2) [urgent] (continuation of Question No. 35 studied in 1952/1954)

To determine, in particular cases, the maximum number of dependent (remotely fed) stations which can be inserted between two power feeding stations on coaxial pairs of the type recommended by the C.C.I.F. (2.6/9.4 mm), it is desirable to study the two following points :—

A. With the dielectric strength and insulation resistance characteristics at present specified by the C.C.I.F. for coaxial pairs (*Yellow Book*, Volume III *bis*, page 238), what values are to be recommended for :—

(a) the maximum power feeding voltage ? (In the two cases of d.c. and 50 c/s a.c. respectively) ;

(b) maximum power feeding current ? (In the two cases of d.c. & 50 c/s a.c. respectively) ;

(c) for the mean resistance of the power feeding circuit ? (Both where power is fed over a circuit consisting of two centre conductors of coaxial pairs, and where power is fed over a circuit comprising the inner conductor and the outer conductor of a coaxial pair.)

B. If, in order to increase the voltage with which electric power is transmitted over coaxial pairs, it is desired to modify the existing C.C.I.F. specification clauses for dielectric strength and insulation resistance of the coaxial pair, would this involve modifications to the other essential clauses of Specification A VI (*Yellow Book*, Volume III *bis*, pages 237-239), and what should be these modifications (it being understood that this specification would apply to particular cases where a distance is required between power feeding stations) ?

C. The dielectric strength test given on page 238 of the *Yellow Book*, Volume III *bis*, consists of the application for two minutes of an alternating voltage of 2000 volts r.m.s. at 50 c/s, between the centre conductor and the outer conductor connected to the cable sheath. Is it possible to accept, as an alternative, a test in which a specified d.c. voltage is applied for a specified time, these specified values to be determined ?

Question No. 43.

(Category A 2) [urgent] (continuation of Question No. 36 studied in 1952/1954)

A. What is the minimum value of near-end crosstalk ratio desirable for simultaneous television transmissions in the two directions of transmission of a coaxial cable ?

Note. — There is at present only a provisional recommendation of the C.C.I.F. applicable to the special case of the 405-line television standard.

B. What conditions, from the near-end crosstalk point of view, can reasonably be realised between the two directions of transmission of a carrier system on coaxial pairs :

(a) in the case of all telephone circuits (these circuits may be used for duplex voice-frequency telegraphy which requires a near-end crosstalk ratio provisionally fixed at 4.0 N or 35 db) ?

(b) in the case of programme circuits established on channels of this system ?

(c) in the case of television transmissions in the two directions of transmission on coaxial pairs in the same cable ?

Note. — When replying to this question, account should be taken of the reply of the 3rd Study Group to Question No. 36 in 1953 ; this reply, reproduced below as an annex, applies both to the case of symmetrical pairs in cable and the case of coaxial pairs.

ANNEX

Reply made by the 3rd Study Group to question No. 36 in 1953

Part A.

The present recommendations of the C.C.I.F. for the near-end crosstalk between different circuits, and applicable to circuits routed over cable systems with not less than 12 carrier telephone circuits are given on the following pages of the C.C.I.F. *Yellow Book*, Volume III *bis* :—

Volume III bis, *page 41.* — Case of ordinary telephony, and page 101, case of circuits in carrier systems on symmetrical pairs in cable.
The near-end crosstalk ratio between two complete circuits terminated at the same point, and in terminal service, should be not less than 6.7 N or 58.2 db for 90% of the combinations of two 4-wire circuits and 6 N or 52.1 db for all combinations of such circuits.

Volume III bis, *page 146.* — Case of old-type programme circuits.
The near-end crosstalk attenuation (for speech) between two programme circuits, or between one of these circuits and a telephone circuits, should be at least 9 N or 78 db for circuits in cable.

Volume III bis, *page 156.* — Case of normal programme circuits.
The near-end crosstalk attenuation (for speech) between such a circuit and any other circuit for telephony or programme transmission, should be at least 8.5 N or 74 db for circuits in cable.

Volume III bis, *page 163.* — Case of high-quality programme circuits.
The near-end crosstalk attenuation (for speech) between such a circuit and any other circuit for telephony or programme transmission, should be at least 9 N or 78 db for circuits in cable.

Volume III bis, *page 171.* — Case of television circuits.
As a provisional standard, for coaxial pairs in international telephone cables used for television transmission with the 405-line standard, the logarithmic ratio between the vision signal and the unwanted signal due to crosstalk should be at least 5.8 N or 50 db. This logarithmic ratio corresponds to the ratio between the amplitude of the peak-to-peak vision signal (video signal excluding the synchronizing signal) and the peak-to-peak amplitude of the unwanted signal. This limit, which is only an order of magnitude, applies to the crosstalk between two television circuits, or between a television circuit and any other circuit in the same cable.

This being so, it seems desirable to specify a minimum value for the near-and crosstalk between the two directions of transmission of a carrier system only in the following cases :

(a) duplex voice-frequency telegraphy on the two channels normally comprising the telephone circuit,

(b) duplex transmission of programmes, that is to say use of three telephone channels corresponding to the same frequency band transmitted to line in the two directions, to provide either a bothway circuit for programme transmissions, or two circuits for different programme transmissions.

(c) television transmissions in the two directions on coaxial pairs in the same cable.

(d) transmission of pilots in the two directions (in this case the exact frequencies of the pilots transmitted in the two directions may differ slightly, and it is necessary to impose a limit on the magnitude of the resulting beats).

(a) *Case of voice-frequency telegraphy.*

The 3rd Study Group proposes to the C.C.I.T. and to the XVIIth Plenary Assembly of the C.C.I.F., that on page 189 of Volume III *bis* of the *Yellow Book* of the C.C.I.F., at the end of the note headed " Conditions that should be fulfilled by circuits used for voice-frequency telegraphy ", the following new paragraph should be added :—

" 3. The near-end crosstalk ratio between the two directions of transmission of a telephone circuit used for voice-frequency telegraphy should be not less than 4 N (35 db)."

The C.C.I.T. will be asked to determine the minimum value of this near-end crosstalk ratio which is really necessary for voice-frequency telegraphy ; the attention of the C.C.I.T. will be drawn to the fact that the value mentioned above may be obtained in the case of the " nominal circuit ", with the specification limits applied to each channel " modulator-demodulator " by certain Administrations (see the following reply to part B of this question).

(b) *Case of programme transmissions.*

If it is desired to use for programme transmissions, the circuits corresponding to the two directions of transmission, the near-end crosstalk requirements that must be met are those already recommended for two different circuits (see above).

(c) *Case of television transmissions.*

If it is desired to use coaxial pairs in the same cable for television transmissions in opposite directions, the minimum near-end crosstalk ratio between the two directions of transmission corresponds to the values given above for two different circuits.

(d) *Transmission of pilots in the two directions of transmission.*

The 3rd Study Group proposes to the XVIIth Plenary Assembly of the C.C.I.F. that the following recommendation be issued :—

" The near-end crosstalk ratio between the two directions of transmission, at frequencies used for all pilots or additional maintenance measuring frequencies on carrier systems, should be not less than 4.6 N (40 db)."

Part B. — Case of coaxial cable pairs.

In so far as the crosstalk due to the cable itself is concerned, the 3rd Study Group considers that in a repeater section (approximately 9 km (5.6 miles) in length) of a carrier system on coaxial pairs of the type recommended by the C.C.I.F., it is reasonable to obtain a value of near-end crosstalk ratio given by the symbol E in the formula :—

$$E = 80 + 50.5\ \sqrt{f}\ \text{decibels} \qquad (f \text{ in Mc/s})$$

or

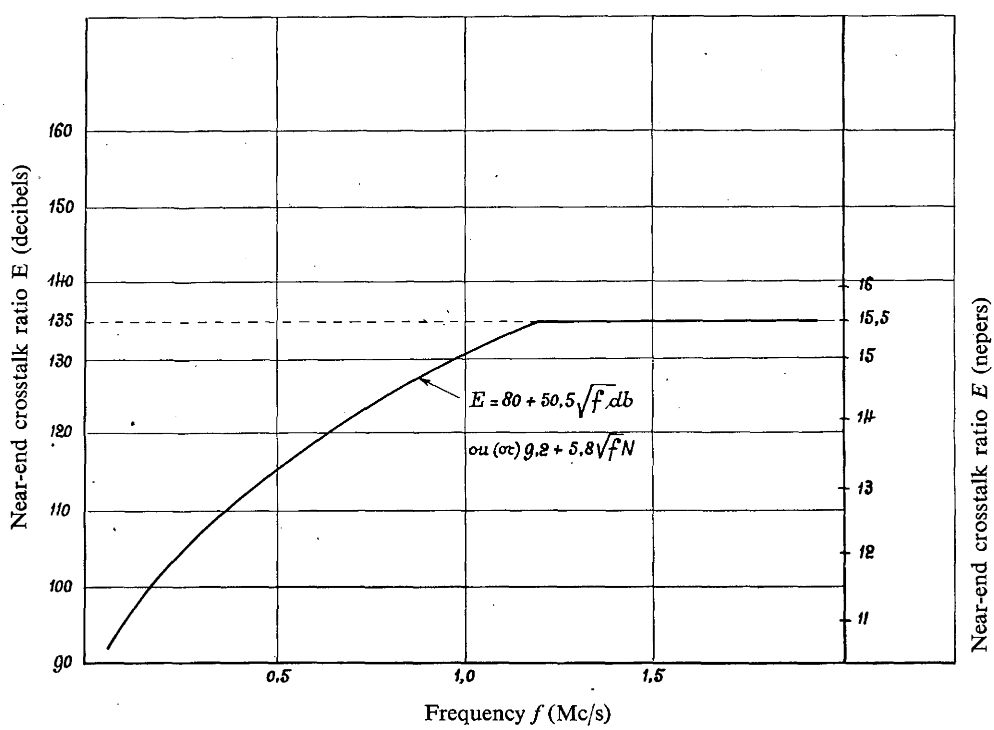
$$E = 9{,}2 + 5.8\ \sqrt{f}\ \text{nepers} \qquad (f \text{ in Mc/s})$$

for values of E which do not exceed 135 db or 15.5 N : in other cases a constant value of 135 db or 15.5 N should be taken (see the following figure).

If crosstalk introduced by the equipments is taken into consideration, then it is normally possible to guarantee between the two directions of transmission of any telephone circuit, a near-end crosstalk attenuation of 35 db on the " nominal maximum circuit on coaxial pairs ". This value assumes a ratio of 50 db between the two directions of transmission in each channel " modulator-demodulator ", the value specified by a number of Administrations. It should therefore be possible to use any telephone circuit on modern carrier systems in cable for duplex voice-frequency telegraphy, providing the C.C.I.T. accepts the value proposed in the reply to part A.a of this question.

These channel modulators and demodulators do not affect the pilots, and there should be no difficulty in obtaining the near-end crosstalk ratio of 4.6 N (40 db) recommended in reply to part A.d of this question.

In the case of programme circuits, it is necessary to make special arrangements if it is desired to satisfy the conditions indicated in the reply to part A.b above.



Near-end crosstalk ratio for repeater sections of approximately 9 kilometres (5.6 miles) consisting of 2.6/9.4 millimetres (0.375 inch) coaxial pairs

Question No. 44.

(Category A 2) [non-urgent] (continuation of Question No. 33 studied in 1952/1954)

What recommendations can be made on the subject of the allowable value of the signal harmonic ratio of a repeater, for multi-channel carrier telephony on coaxial cable pairs ?

Question No. 45.

(Category A 2) [urgent] (new question)

What is the most economic means of obtaining, with the coaxial pair already standardized by the C.C.I.F., more than 960 carrier telephone circuits utilizing, as far as possible, the existing equipment ?

Question No. 46.

(3rd Study Group in co-operation with the 5th S.G. of the C.C.I.F. and with the C.C.I.R.)
(Category A 2) [urgent] (new question, corresponds to Question IX-91 of the C.C.I.R.)

(a) What are the advantages, if any, of a system on coaxial pairs suitable for the alternative or simultaneous transmission of telephony and television ?

(b) If there are any advantages in thus combining the two types of transmission : what are the essential characteristics to be considered for the specification for international transmission of such mixed systems on coaxial pairs, and what are the admissible limits for these characteristics ?

Note. — The interconnection of such systems on coaxial pairs with radio relay links used for the same type of transmission, is dealt with in Question No. 14 of the 5th Study Group.

Question A (Supplementary).

(Category A 2) [urgent] (new question)

Administrations are requested to state if it is possible for them to accept the following provisional recommendations, relating to cross-talk between national trunk and junction cable circuits, involved in an international communication, and the cross-talk between telephone circuits (national or international) on open-wires lines.

Recommendations relating to linear cross-talk between telephone circuits

1. *Case of international cable circuits* (existing recommendation in the *Yellow Book*, Vol. III *bis*, page 41, modified to take account of the fact that in future all international circuits will have to be four-wire circuits—see Vol. III *bis*, page 43).

The far-end or near-end cross-talk ratio between two international circuits entirely in cable (four-wire circuits), terminating at the same point, in terminal traffic, should not be less than 6.7 N or 58.2 db for 90% of the combinations of the two circuits, and 6 N or 52.1 db for all combinations of such circuits.

2. *Case of circuits in cable between an international exchange and a trunk exchange* (provisional recommendation proposed to replace that appearing in the *Yellow Book*, Vol. V, page 63).

The far-end or near-end cross-talk ratio between two circuits entirely in cable, between the same points and connecting international exchanges to the terminal trunk exchanges, should be not less than 6.7 N or 58.2 db for 90% of the combinations of the 2 circuits and 6 N or 52.1 db for all combinations of the two circuits.

3. *Case of circuits on open-wire lines connecting either two international exchanges or an international exchange to a terminal trunk exchange* (provisional recommendation proposed to replace that of the *Yellow Book*, Vol. III *bis*, page 70, which will not be reproduced in the *Green Book*).

The far-end or near-end cross-talk ratio at audio frequencies at the trunk exchange (only intelligible cross-talk being considered), either between two audio frequency channels or between a carrier channel and the audio frequency channel on the same pair of open wires, or between any two carrier channels transmitted over the lines in different frequency bands, or between a carrier channel and any audio frequency channel on wires of the same route, should be greater than 6.7 N or 58.2 db ; the far-end or near-end cross-talk under the same conditions between any two carrier channels on the wires of the same route and transmitted over the lines in identical frequency bands, should be greater than 5.4 N or 46.9 db.

Question B (Supplementary).

(Category A 2) [urgent] (new question)

What should be the allowable limit for the basic noise of an intermediate repeater in the case of international repeaters on non-loaded symmetrical pairs providing more than three primary groups ?

Question C (Supplementary).

(Category A 2) [urgent] (new question)

Is it necessary to make it clear whether the value of — 1.2 N or — 10 db recommended for the absolute power level (referred to zero relative level) of the additional measuring frequencies, on carrier systems on coaxial pairs applies to the case where additional measuring frequencies are transmitted one after the other, or where the number of additional measuring frequencies transmitted simultaneously at such a level is limited ?

Note. — What is needed is to clarify the recommendation made by the XVIIth Plenary Assembly of the C.C.I.F., which appears on page 68 of the document " C.C.I.F. 1952/1954 — 3rd S.G. — Document No. 94 " ; this recommendation will be reproduced in Vol. III of the *Green Book*, section 3.4.1, § C-5°.

Question D (Supplementary).

(Category A 2) [urgent] (new question)

Recommendations have been made to cover precautions to be taken with line regulating pilots and additional measuring frequencies at a supergroup transfer point, but it remains to define the precautions to be taken with the pilot for synchronising or checking the carrier frequencies and, if necessary, with the switching pilot. What recommendations should be made on this question ?

Note. — What is needed is to amplify the recommendation made by the XVIIth Plenary Assembly of the C.C.I.F. which appears on page 70 of the document " C.C.I.F. — 1952/1954 — 3rd S.G. — Document No. 94 ".

Question E (Supplementary).

(Category A 2) [urgent] (new question)

What conditions should be laid down for open-wire lines and associated equipments as regards electrical performances, so that audio circuits set up on such lines may be used in the international telephone service ?

Note. — It is a question of revising the text in Vol. III *bis* of the *Yellow Book* of the C.C.I.F. under the title : " Establishment of lines on open wires—B—Electrical performances " (pages 49 to 52), so that the new text may be applied to audio circuits transmitting effectively the frequency band of 300 to 3400 c/s.

Question F (Supplementary).

(Category A 2) [urgent] (new question)

What instructions should be recommended for the construction and loading (continuous or lumped) of cables inserted in open-wire lines providing in particular an audio circuit effectively transmitting the frequency band of 300 to 3400 c/s ?

Note. — It is a question of revising the " Directives for the construction and loading of cables inserted in open-wire lines (at present shewn on pages 54 and 55 of Vol. III *bis* of the *Yellow Book*), so that the new Directives may be applied to audio-frequency circuits effectively transmitting the frequency band 300 to 3400 c/s.

Question G (Supplementary).

(Category A 2) [urgent] (new question)

(a) How should non-linear distortion of a complete telephone circuit, between voice frequency terminals, be defined ?

(b) What are the limits to be recommended for the characteristics thus defined ?

Note. — On pages 41 and 42 of Vol. III *bis* of the *Yellow Book*, are the results of tests (already out-dated) concerning non-linear distortion (variation of the quality for a telephone communication, as a function of input power), but no recommendation is made, as far as telephone circuits are concerned, for avoiding excessive non-linearity.

Question H (Supplementary).

(Category A 2) [urgent] (new question)

What are the essential technical clauses to be recommended in a model specification for the supply of thermionic valves used in the transmission path of repeaters and other carrier equipment :—

(a) for telephony ?

(b) for programme transmissions ?

(c) for television ?

Question I (Supplementary).

(Category A 2) [urgent] (new question)

In Specification B VIII covering cabling of audio repeater stations (*Yellow Book* Vol. III bis, pages 257 and 258) two values are given for cross-talk attenuation. Would it not be better to specify the cross-talk ratio and would it be possible to fix for this cross-talk ratio, the single limit of 8.5 N. or 74 db for all combinations of two or four-wire circuits in the same or in opposite directions ?

Question J (Supplementary).

(Category A 2) [urgent] (new question)

Given that it may be necessary to provide on carrier systems, old-type programme circuits, effectively transmitting a frequency band of at least 50 to 6400 c/s.

(a) For this purpose should the space corresponding to two telephone channels in the band of frequencies transmitted over the lines, be used ?

(b) If so, what are the best positions for these two channels in a basic group, and what is the carrier frequency to be recommended ?

Question K (Supplementary).

(Category A 2) [urgent] (new question)

Given that the provisional limits recommended by the C.C.I.F. for the general characteristics of normal circuits for programme transmissions have been established on the basis of a circuit 1000 kilometres long,

and on the other hand that the " nominal maximum circuit for television transmission " is 2500 kilometers long,

the question arises of adopting in parallel a " nominal maximum circuit for programme transmissions " 2500 kilometres long, it being understood that this " nominal maximum circuit " represents a combination of the international circuit or circuits and the national extension or extensions.

What should be the constitution of this " nominal maximum circuit for programme transmission " and how should the above-quoted provisional limits, relating to the characteristics for normal-type programme circuits, be revised in the case of circuits 2500 kilometres long ?

Note 1. — It might be desirable to use a make-up in general similar to that of the " nominal maximum circuit for television transmissions on coaxial pairs " (see the note 1 of the text of Question No. 12 above).

Note 2. — Amongst the characteristics to be considered, there are attenuation distortion, phase distortion and circuit noises.

Question L (Supplementary).

(Category B) [urgent] (new question)

The present recommendation of the C.C.I.F. concerning the non-linear distortion for programme circuits is based on consideration of the signal harmonic ratio. This criterion does not perhaps altogether correspond to the harmful effects actually produced on high-quality music transmissions by non-linearity, in particular because it does not take account of the differential sounds which can considerably upset musical harmony.

It would ther efore be necessary to make on programme circuits in use, measurements of quadratic or cubic distortion as defined in the following Annex which reproduces a passage of a C.C.I.F. document (Oslo 1938) which has not been included in the works of the C.C.I.F. printed since 1945.

(a) Administrations are requested to communicate to the Secretariat of the C.C.I.F., the results of the measurements of quadratic distortion and cubic distortion made on various types of national circuits for programme transmission (old-type circuits, special pairs for broadcast transmissions, unloaded carrier phantom circuits, circuits established on carrier systems), these measurements being made in accordance with the following Annex.

(b) If it is considered desirable to replace the existing recommendation of the C.C.I.F., which is based on signal-harmonic ratio, by a recommendation based on quadratic or cubic distortion, what limits could be guaranteed in the present state of technique ?

ANNEX
(to supplementary Question L)

Definitions and methods of measurement relating to non-linear distorsion

Coefficient of differential tones of a non-linear quadripole is the ratio (measured at the output of the quadripole), of the sum of the r.m.s. values of the differential frequencies to the sum of the r.m.s. values of the two fundamental frequencies.

According to whether the differential tone of the first order, or the two differential tones of the second order, are considered, the coefficient is either quadratic distortion or cubic distortion.

Note 1. — In the expression " coefficient of differential tones ", the word " tone " is used in its general sense to mean a sound wave or an electric wave, and the quadripole considered could be an electric quadripole, and electro-acoustic quadripole, or a purely acoustic quadripole.

Note 2. — The sum of the r.m.s. values of the component frequencies considered here should not be confused with the r.m.s. value of the two frequencies taken together. The sum of the r.m.s. values of the two component frequencies of an amplitude a and of different frequencies is $a\sqrt{2}$, while the r.m.s. value of the two frequencies considered here when taken together is a.

Measurement of the coefficient of quadratic distortion. — In order to measure the coefficient of quadratic distortion, for example of an electric quadripole, for a frequency f, and for an input level p, at the input of the quadripole are simultaneously applied two sinusoidal waves of equal amplitude, the frequencies of which are $f + 30$ c/s and $f - 30$ c/s differing the one from the other by 60 c/s, so that the sum of the r.m.s. values of the two fundamental frequencies is equal to the r.m.s. value of a sinusoidal voltage of level p. The value of the peak applied to the quadripole is thus the same as if it were a sinusoidal voltage of which the r.m.s. value corresponded to the level p. The quadripole should be, during the measurement, terminated under service conditions. The measuring apparatus connected to the terminals of the terminating impedance, should have a relatively high input impedance. At the output of the quadripole, a differential frequency of the first order is received amongst others, and this has a frequency of 60 c/s. After passing through a band-pass filter with a very narrow pass-band, which extends from $60 - E$ to $60 + E$, E being a small quantity, the amplitude of this differential frequency of 60 c/s is measured at this point (see Figure 1 below). Let U_1 represent the value of the voltage thus received. If a sinusoidal wave of frequency 60 c/s is then applied at the input of the filter, having an r.m.s. value equal to the sum of the r.m.s. values of the two fundamental frequencies $f+30$ c/s and $f - 30$ c/s, at the output of the filter will be received a voltage of the value U_2. The ratio U_1/U_2 expresses the coefficient of the quadratic distortion of the quadripole for the frequency f and for the input level p.

Measurement of the coefficient of cubic distortion. — In order to measure the coefficient of cubic distortion, for example of an electric quadripole, for a frequency f and for an input level p, at the input of the quadripole are applied simultaneously two sinusoidal waves of equal amplitude, and having frequencies $f + 15$ c/s and $f - 15$ c/s differing the one from the other by 30 c/s, so that the sum of the r.m.s. values of the two fundamental waves is equal to the r.m.s. value of a sinusoidal voltage or level p. The peak applied to the quadripole is thus the same as if it were a sinusoidal voltage of which the r.m.s. value corresponded to the level p. The quadripole should, during the measurement, be terminated under service conditions. The measuring apparatus connected to the terminals of the terminating impedance should have a relatively high input impedance. At the output of the quadripole, will be received, amongst others, the two differential waves of the second order $2(f + 15) - (f-15) = f \times 45$ c/s and $2(f-15)-(f+15) = f-45$ c/s and the two fundamental waves $f+15$ c/s and $f-15$ c/s. This mixture of frequencies is applied to a rectifier with a square

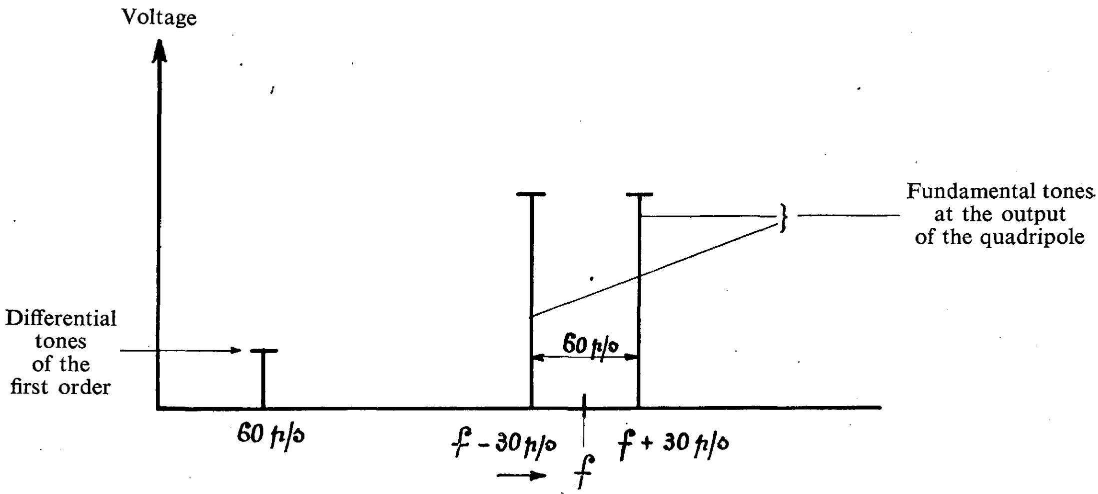


FIGURE 1. — *Measurement of coefficient of quadratic distortion*

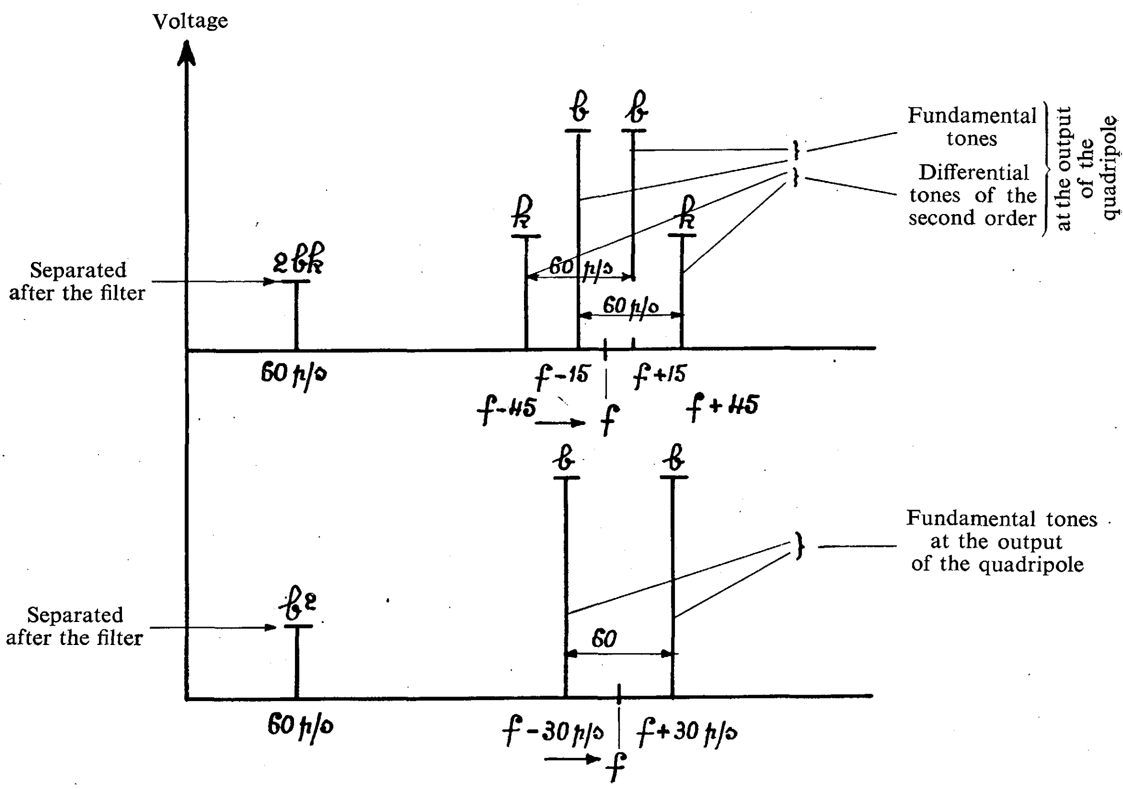


FIGURE 2. — *Measurement of coefficient of cubic distortion*

law characteristic. After rectification amongst others two waves of frequencies 60 c/s are obtained which are the differential waves of the first order produced on the one hand by the waves $f+45$ c/s and $f+15$ c/s. These differential frequencies of 60 c/s obtained at the output of the rectifier are filtered through a band-pass filter with a very narrow pass-band extending from $60-\varepsilon$ to $60+\varepsilon$, ε being a small quantity, and at this point the total wave of frequency 60 c/s is measured (1st measurement, see top of Figure 2 below). Let U_1 represent the value of the voltage thus received. If then, instead of the two frequencies $f+15$ c/s and $f-15$ c/s, two waves of the frequencies $f+30$ c/s and $f-30$ c/s, having the same level are applied to the input of the quadripole, at the output of the filter a voltage of the value U'_2 will be obtained. The half of the ratio U'_1/U'_2 expresses the coefficient of the cubic distortion of the quadripole for the frequency f and for the input level p.

In the first measurement, the rectifier produces in particular, by intermodulation between each of the two fundamental frequencies of amplitude b (see at the top of Figure 2) and a differential of amplitude k, two frequencies of 60 c/s, the amplitudes of which are proportional to the product bk. As these two frequencies have very nearly the same phase, they form a resultant with a frequency of 60 c/s and an amplitude bk. In the second measurement, by intermodulation between the two fundamentals of amplitude b, are obtained (see bottom of Figure 2), a single frequency of 60 c/s, and an amplitude proportional to b^2. If the ratio of these two results of measurements is calculated, $\frac{2\,bk}{b^2} = 2\frac{k}{b}$ is obtained, this being independent of whether peak or r.m.s. values are measured. On the other hand, as the definition is based on the ratio of the sum of the r.m.s. values of the two differential frequencies of amplitude k, and the sum of the r.m.s. values of the two fundamental frequencies of amplitude b, which ratio is equal to k/b, the ratio of the values measured should be divided by 2, as given above.

Question M (Supplementary).

(Category A 2) [very urgent] (new question)

Since, with the diagrammatic apportionment of frequencies in coaxial-pair carrier telephone systems finally recommended by the C.C.I.F. XVIIth Plenary Assembly, consideration has to be given to the transmission of frequencies up to 4 Mc/s on a coaxial pair of the kind recommended by the C.C.I.F. (Specification A VI of the *Yellow Book*, Volume III, *bis* pages 237 to 239), should we not, in the paragraph of this Specification headed " Impedance ", lay down the impedance for a 4 Mc/s frequency ? If so, what limits should be set for impedance measured at 4 Mc/s ?

Question N (Supplementary).

(Category A 2) [very urgent] (new question)

In the C.C.I.F. specifications for various kinds of cable, should we not introduce a clause to the effect that dielectric strength can be checked at will, either by tests with alternating current such as those now specified in Volume III *bis* of the C.C.I.F. *Yellow Book*, or by tests with direct current, as described in Annex 23 in the Book of Annexes to Volume III of the *Yellow Book* ?

SUMMARY

Transmission questions to be started or continued by the 3rd Study Group in 1955, 1956 and 1957

Question No.	BRIEF DESCRIPTION	CATEGORY	STUDY GROUP (other than the 3rd S.G.) or other interested international organisations	REMARKS
1	Characteristics of long intercontinental land circuits	A 1		Non-urgent (continuation of old Question No. 1)
2	Noises on intercontinental circuits	A 1	1st and 5th S.G. C.C.I.R.	Non-urgent (continuation of old Question No. 2)
3	Volume of the speech sounds of a talking subscriber and variations of the equivalent as a function of time	B	4th and 9th S.G.	Urgent (continuation of old Question E *bis*)
4	Risk of singing in the semi-automatic service	A 1	8th S.G.	Non-urgent (Question No. 8 of the 8th S.G.)
5	Reduction in transmission quality due to circuit noise	A 1	1st, 4th and 8th S.G. C.M.I.	Part *(a)* only urgent (continuation of Question No. 5)
6	Frequency-modulated voice-frequency telegraphs	A 1	C.C.I.T.	Urgent (new question)
7	Photo-telegraphic transmissions	A 2	C.C.I.T.	Urgent (continuation of old Questions Nos. 12 and 12 *bis*)
8	Cross-talk on programme circuits	A 2	C.C.I.R., I.B.O., E.B.U.	Urgent (new question)
8 *bis*	Cross-talk on a repeater section of loaded cable	A 2		Urgent (new question)
9	Psophometer for programme transmissions	A 1	1st and 4th S.G. C.C.I.R., I.B.O., E.B.U.	Non-urgent (continuation of old Question No. 15)
10	Influence of various factors on the quality of television pictures	A 1	C.C.I.R.	Non-urgent (corresponding to the Study Programme No. 75 of the C.C.I.R.)
11	Characteristics of a circuit for television transmissions	A 1	C.C.I.R., I.B.O., E.B.U.	Non-urgent (continuation of old Question No. 10)
12	Equipments forming part of the nominal maximum circuit for television transmissions	A 2	C.C.I.R., I.B.O., E.B.U.	Urgent (continuation of old Questions Nos. 16-E and 16 *bis*)
13	Variations as a function of time of the attenuation of a television circuit	A 2	C.C.I.R., I.B.O., E.B.U.	Urgent (continuation of old Question No. 16-F)

Question No.	BRIEF DESCRIPTION	CATEGORY	STUDY GROUP (other than the 3rd S.G.) or other interested international organisations	REMARKS
14	Weighting curve for television interferences		C.C.I.R.	To be studied by the C.C.I.R. (continuation of old Question No. 16-G)
15	Ratio between television signals and recurring interference	A 2	5th S.G. C.C.I.R.	Urgent (continuation of old Question No. 16-G)
16	Television repeaters	A 2		Urgent (continuation of old Question No. 16-G)
17	Synthesis of networks in the transitory state	B	C.C.I.R., I.B.O., E.B.U.	Non-urgent (continuation of old Question No. 17)
18	Composition in the transitory state of circuits using different television standards	B	C.C.I.R., I.B.O., E.B.U.	Non-urgent (new question)
19	Regularity of the impedance of a coaxial pair used for television	A 1		Urgent (continuation of old Question No. 18)
20	Matching of the impedances of the television repeater to the line	A 1		Urgent (continuation of old Question No. 20)
21	Definition and the admissible distortion of the television test signals	A 2	9th S.G. C.C.I.R., I.B.O., E.B.U.	Urgent (continuation of old Questions Nos. 19 *bis* and 21)
22	Cost prices of television transmissions	A 2	5th S.G.	Urgent (new question)
23	Admissible variation, as a function of time, of the signal-noise ratio	A 2	4th and 5th S.G.	Urgent (continuation of old Question E, Question No. 6 of the 4th and 5th S.G.)
24	Noise clause for all carrier systems	A 2	5th S.G. C.C.I.R., C.C.I.T.	Urgent (new question, Question No. 7 of the 5th S.G.)
25	Objectionable impulses arising from signalling	A 2	8th S.G.	Urgent (new question)
26	Admissible signalling power	A 1	8th S.G.	Urgent (Question No. 2 of the 8th S.G.)
27	Interband signalling	A 2	8th S.G.	Urgent (new question)
28	Spaces between telephone channels or other groups	A 2	9th S.G.	Non-urgent (continuation of old Question No. 38)

Question No.	BRIEF DESCRIPTION	CATEGORY	STUDY GROUP (other than the 3rd S.G.) or other interested international organisations	REMARKS
29	Stability of pilot frequencies	A 2	9th S.G.	Urgent (new question)
30	Setting-up of a frontier section of a carrier system	A 2	9th S.G.	Urgent (new question)
31	Setting-up a group or super-group link	A 2	9th S.G.	Urgent (new question)
32	Transfer of a super-group	A 2		Urgent (new question)
33	Ratio between group or super-group pilot, and noise	A 2	5th S.G.	Urgent (new question)
34	Noise on the nominal maximum circuit on symmetrical pairs	A 2		Urgent (continuation of old Question No. 24)
35	Remotely power-fed repeaters for symmetrical pairs	A 2		Urgent (continuation of old Question No. 23)
36	Systems of more than 60 circuits on symmetrical pairs	A 2		Urgent (new question)
37	3-circuit carrier systems for open wire lines	A 2		Urgent (continuation of old Question No. 25)
38	Noise on the nominal maximum circuit on open wire lines	A 2	1st S.G.	Urgent (new Question)
39	Maximum length of a 12-circuit system on open-wire lines	A 1		Urgent (continuation of old Question No. 26)
40	Transposition of open-wire lines	B		Urgent (new Question)
41	Absolute power level of the upper line-regulating pilot in coaxial systems	A 2		Urgent (continuation of old Question No. 28)
42	Maximum number of remotely power-fed stations on a cable with coaxial pairs	A 2	9th S.G.	Urgent (continuation of old Question No. 35)
43	Near-end cross-talk between coaxial pairs	A 2		Urgent (continuation of old Question No. 36)
44	Non-linear distortion of an amplifier of a carrier system	A 2		Non-urgent (continuation of old Question No. 33)

Question No.	BRIEF DESCRIPTION	CATEGORY	STUDY GROUP (other than the 3rd S.G.) or other interested international organisations	REMARKS
45	Systems of more than 960 channels on coaxial pairs	A 2		Urgent (new question)
46	Alternative or simultaneous telephone and television transmission on coaxial pairs	A 2	5th S.G. C.C.I.R.	Urgent (corresponding to question IX-91 of the C.C.I.R.)
A	Cross-talk between telephone circuits	A 2		Urgent (new question)
B	Basic noise of a repeater on symmetrical-cable pairs	A 2		Urgent (new question)
C	Level of additional measuring frequencies on coaxial pairs	A 2		Urgent (new question)
D	Derivation of the carrier frequency control pilots or switching pilots	A 2		Urgent (new question)
E	Electrical properties of open-wire lines	A 2		Urgent (new question)
F	Cables inserted in open-wire lines	A 2		Urgent (new question)
G	Non-linear distortion of a telephone circuit	A 2		Urgent (new question)
H	Thermoionic valves for repeaters and carrier systems	A 2		Urgent (new question)
I	Cross-talk in the cabling of voice-frequency repeaters	A 2		Urgent (new question)
J	Old-type programme circuits on carrier systems	A 2		Urgent (new question)
K	Nominal maximum circuit for programme transmissions	A 2		Urgent (new question)
L	Non-linear distortion of programme transmission circuits	B		Urgent (new question)
M	Coaxial-cable impedance at 4 Mc/s	A 2		Very urgent (new question)
N	Tests of dielectric strength	A 2		Very urgent (new question)

LIST OF QUESTIONS

concerning the specification of telephone transmission performance and the circuits connecting subscribers to the trunk exchange on which they are dependent, the study of which is to be undertaken or continued by the 4th Study Group during 1955, 1956 and 1957

Question No. 1.

(4th Study Group in co-operation with the 3rd and 5th S.G.) (Category A 1) [non urgent] (continuation of Question No. 1 studied in 1952/1954)

(a) What is the effect upon the numerical results of the method of reading a volume meter (used on continuous telephonic conversational speech) ?

(b) Would it be possible to recommend a standard method of reading a volume meter used on continuous telephonic conversational speech ?

Question No. 2.

(Category B) [non urgent] (new question)

(a) What conditions are used by your Administration for the measurement of the reference equivalent of the side tone of subscriber's telephone sets for speech ?

(b) Can a measuring technique be recommended for the determination of the reference equivalent of side tone for speech and for room noise when using the A.R.A.E.N. as a reference system ?

(c) What is the minimum limit that your Administration admits for the reference equivalent of side tone, for speech and for room noise, measured by your method ?

Question No. 3.

(4th Study Group in co-operation with representatives of the 3rd S.G. and of the (Category A 1) [non urgent] (new question)

(a) What methods and what apparatus should be recommended for the objective measurement of a quantity representing the subjective disturbing effect of short pulses produced on trunk telephone circuits, for example by automatic switching equipment (isolated clicks) ?

(b) What limit can be fixed for the maximum permissible value of these noises as measured by these methods ?

Note. — This, of course, concerns clicks such as are observed on international circuits which have been included within an automatically operated route.

Note by the C.C.I.F. Secretariat. — After the wording of this question had been drafted by the 4th Study Group the XVIIth Plenary Assembly approved the following conclusions by the 3rd Study Group :

" In connection with clicks and other noises due to automatic switching apparatus, the 3rd S.G. considers that there is no need to carry out any tests in the C.C.I.F. Laboratory. In fact, on the one hand no standardised method of measurement is available for the evaluation of the importance of such noises and, on the other hand, it would seem that, if the apparatus is sufficiently well maintained, such noises should not cause an appreciable reduction in transmission quality. The 3rd S.G. draws the attention of the 8th S.G. to the necessity of taking all possible precautions to avoid these clicks. In addition, precautions should be taken in automatic exchanges to avoid the overhearing by crosstalk on one circuit of ringing, dialling and engaged tones, etc., that are transmitted over other circuits."

To take account of this decision of the Plenary Assembly the question has been classified as non-urgent and the Note 2, in which the 4th S.G. had provided for the carrying out of tests in the C.C.I.F. Laboratory using recordings of clicks, has been deleted.

Question No. 4.

(4th Study Group in co-operation with the 1st and 3rd S.G.) (Category A 1) [urgent] (continuation of Question No. 4 studied in 1952/1954)

A. Considering that the psophometer for commercial circuits is mainly suitable for the measurement of noises of a continuous nature, would it not be desirable to specify an instrument for the measurement of the disturbing effect of impulse noises or of the disturbing effect of other transitory phenomena ?

B. *(a)* Should the readings of the psophometer be corrected in order to take account of the character of the noise being measured ?

(b) If so what method is to be recommended for the classification of the noises and the application of the corrections ?

(c) If not, should the specification of the psophometer be modified to permit the connection of more than one type of indicating instrument to the weighting network ?

Note. — In order to determine the corrections that may possibly be applied to the readings made with a psophometer, with the object of taking account of the character of the noise measured, for the various types of circuit noises, the results of the 11th Series of experiments of the C.C.I.F. Laboratory may be taken as a basis. The programme of the 11th series at present concerns white noise, rectifier noise, noises existing on radio relay links and the noises existing on carrier systems over balanced pairs or over coaxial pairs (see Question No. 6 below).

Question No. 5.

(Category A 1) [urgent] (continuation of Question No. 5 studied in 1952/1954)

(a) What method or apparatus should be used to determine the impairment due to noise reproduced by telephone receivers ?

(b) What is the limiting value of these noises which can be regarded as admissible ?

Note. — The results already obtained under the 11th series of experiments of the C.C.I.F. Laboratory are given in the documents " C.C.I.F. — 1952/1954 — 4th S.G. — Document No. 25 " and " C.C.I.F. — 1952/1954 — 4th S.G. — Document No. 25 *bis* ".

Question No. 6.

(3rd, 4th and 5th Study Groups in co-operation; Question No. 23 of the 3rd S.G. and No. 6 of the 5th S.G.) (Category A 2) [urgent] (corresponds to Question No. 112 of the C.C.I.R.)

What is the variation (as a function of time) of the signal-to-noise ratio that can be allowed in an international telephone call ?

Note 1. — It would be desirable to approach one or the other of the specifications concerning the total noise for carrier systems on coaxial pairs, balanced pairs and radio relay links. Furthermore, Administrations are asked to communicate to the C.C.I.F. Secretariat results of observations made on each of these systems, regarding the variation of the total noise as a function of time.

The comparison of these results will enable it to be seen whether it is possible to have, for this total noise, a clause common to all systems ; this point forms the subject of Question No. 24 of the 3 S.G.

Note 2. — The C.C.I.F. Laboratory will make articulation tests under the following conditions. The Laboratory is already in possession of recordings of typical noises produced at the extremity of a radio relay link in the absence of any telephone conversation. Administrations and Private Operating Agencies are asked to send to this Laboratory as soon as possible magnetic tape recordings of the total noise observed at a peak period, on a circuit established on one of the carrier systems of the following types :

1. A system having a very large number of telephone channels (for example 600 channels) on coaxial pairs.
2. A 60-channel system on balanced pairs.

The equivalent of the telephone circuit is to be adjusted to 0.8 nepers or 7 decibels. These recordings will be sent to the C.C.I.F. Laboratory with all the necessary documentation and will be used as a source of noise in the tests to be carried out.

To allow (at the beginning of the articulation tests made in the Laboratory) the adjustment of the average intensity of these noises, the above-mentioned recordings should include (before and after the portion of the tape used for the articulation tests) recordings of a pure tone of 800 c/s having an absolute power level equal to − 40 db at the point where the recording was made. This 800 c/s recording will permit, if necessary, the later study of the form of the variations (as a function of time) of the noise level on the radio relay link.

A study will be made, at the C.C.I.F. Laboratory, by means of tests at a *constant speaking level*, of the reduction of articulation produced by such noises for different values of the reference equivalent for the total connection between the two subscriber's telephone sets. In this way will be determined the impairment corresponding to these variable noises and consequently corresponding to a variation of the signal to noise ratio.

Question No. 7.

(Category A 1) [non urgent] (continuation of Question No. 7 studied in 1952/1954)

(a) How can " relative transmission performance ratings " of the various component parts of a telephone circuit be determined from objective measurements and what objective measurements would be required for this purpose ?

(b) Would it be possible to apply, in the future, for the specification of transmission performance, a method based on volume measurements ?

Note 1. — As an example of the kind of studies to be pursued can be quoted the transmission performance ratings (A.E.N.) calculated by the Chile Telephone Company for the subscribers' telephone sets and circuits used in the 6th series of experiments of the S.F.E.R.T. Laboratory making use of the " sensitivity frequency " characteristics of these telephone sets and circuits (C.C.I.F. — 1947/1948 — 4th Study Group — Document No. 1). These calculations are reproduced in Annex 1 below. Attention is also drawn to the methods of calculation described in the document " C.C.I.F. — 1952/1954 — 4th S.G. — Document No. 49 " for articulation in the case of sounds of the Japanese language, and in the document " C.C.I.F. — 1952/1954 — 4th S.G. — Document No. 54 " for articulation in the case of sounds of the Russian language.

Note 2. — Annexes 2, 3 and 4 below contain proposals relating specially to the examination of the results of the 8th, 9th and 10th series of experiments of the C.C.I.F. Laboratory.

Note 3. — For an example of the type of studies to be carried out under the heading of part *(b)* of this question, reference should be made to Annex 5 below.

ANNEX 1

(to Question No. 7)

Comparison of effective transmission equivalents and transmission performance ratings obtained from calculated values of articulation

The band articulation has been calculated by Dr. Collard's method (see *Yellow Book*, Brussels, 1930, pages 153 to 194) for the 10 systems used in the 6th series of tests and for different values of attenuation (in decibels) of the connecting line.

The calculations have been based on the characteristics of the systems given in S.F.E.R.T. Technical Report No. 171 together with the frequency-sensitivity characteristics of the microphones and receivers and measurements of noise done in the Chile Telephone Co's laboratory.

The values of A.E.N. have been deduced from curves of band articulation against line attenuation, for a value of band articulation of 40%, which corresponds approximately to a value of sound articulation of 80%.

The following table shows the comparison of the transmission performance ratings so obtained with the effective transmission equivalents.

System	A	B	C	D	E	F	G	H	J	K
1. Relative mean value of vocal sound power	-5.7	-2.6	0	-3.1	-3.7	-3.1	-2.6	-3.2	-3.1	-2.5
2. Relative mean value of A.E.N. at band articulation 40%	13.4	3.0	0	4.5	6.5	9.0	10.4	6.5	8·4	12.4
3. Relative value of transmission performance rating (2-1)	19.1	5.6	0	7.6	10.2	12.1	13.0	9.7	11.5	14.9
4. Relative value of effective transmission equivalent (from tests by the American Telephone and Telegraph Co. on repetition rates)	17.4	5.0	0	5.0	8.7	12.0	13.3	10.0	12.5	14.7
Difference (3-4)	1.7	0.6	0	2.6	1.5	0.1	-0.3	-0.3	-1.0	0.2

All the values in this table are relative to those for System C.

The relative values of vocal sound power and of effective transmission equivalent (from tests based on repetition rates carried out by the American Telephone and Telegraph Co.) are deduced from numerical data furnished by the American Telephone and Telegraph Co.

The last line of this table gives the difference between the transmission performance rating based on calculated articulation and the effective transmission equivalents based on repetition rates.

The example given above is taken from document " C.C.I.F. — 1947/48 — 4th S.G. — Document No. 1 " wherein is also given a more general relation between calculated articulation and repetition rate.

ANNEX 2

(to Question No. 7)

Recommendations concerning objective measurements which should be made to render possible the calculation of articulation (and therefore of A.E.N. values) for the telephone sets used in the 8th, 9th and 10th Series of tests at the C.C.I.F. Laboratory

It is evident that articulation scores are influenced by a number of physiological and psychological factors many of which have been only partly investigated ; it is not the intention to introduce any such new considerations, but to confine recommendations to the determination of the data required for the calculation of articulation by existing methods.

The fundamental data required are as follows :

1. The frequency response-characteristic of the entire system measured between an artificial mouth at the modal speaking position and the output of the receiver as measured on an artificial ear.

2. The spectrum of the total noise in the ear of the listener ; this includes both the noise received over the side-tone path and the airborne noise leaking past the telephone receiver to the listening ear.

Alternatively, the masking due to the total noise may be measured at a number of frequencies distributed over the range of speech frequencies.

3. Measurements appropriate to the calculation of the effects of non-linear distortion.

Determination of the response characteristic of the system

Although for many purposes it is convenient to measure transmitting end, line and receiving end responses separately it is assumed that for the present purpose the practice of measurements of overall response will be continued.

If, however, the measurements are to be extended to the combinations of sending and receiving system (as in the case of the 8th series of tests, it would be advantageous to measure these systems separately adopting appropriate precautions in regard to terminal impedances to ensure that a correct overall response will be obtained by adding the ordinates of the separate sending and receiving responses.

The artificial mouth used for these measurements should have a suitably small orifice as the source of sound (e.g. 2 to 4 square cms).

The microtelephone should be mounted in the position used for the determination of A.E.N. values and with the guard ring which defines the lip position placed centrally and in close proximity to the orifice of the artificial mouth (as close as possible without being in contact).

The sequence of operations shall be to close the d.c. circuit feeding the microphone and then rotate the microphone twice about its axis through 270° before placing it in the test position defined above.

The tone supplied by the artificial mouth shall then be swept over the frequency range 100-4000 c/s and back, taking about 3 seconds for the sweep in each direction and having the tone intensity adjusted to the level to be used for the measurements.

The recording of the frequency response shall be commenced immediately after the sweep operation.

The tracing of the response curve should preferably occupy about 15 to 30 seconds ; in the event of a slower rate of tracing being employed a complete reconditioning may be carried out at any part of the frequency response characteristic and as often as may be necessary to establish a stable reproduceable curve.

The sound pressure to be used for the measurements should be independent of frequency and may be defined as corresponding to 1 dyne per sq cm at the microphone of the A.R.A.E.N. when the artificial mouth is placed at the A.R.A.E.N. lip position. (The general question of the sound pressure which should be used for the purpose of articulation calculation is, however, one which needs further study).

While it may be of interest to make the proposed measurements on more than one type of artificial ear, it is not desired to multiply unduly the number of response curves that may be obtained with different measuring systems. It would be desirable to use for the present purpose either a single artificial ear selected according to available experience as most likely to give representative results in the different receivers to be tested or a representative selection of real ears.

Spectrum of total noise in the ear of the listener

The equipment necessary for an objective determination of this data may not be readily available ; a probe microphone capable of measuring the rather low sound pressure due to the noise and a set of narrow band analysing filters is required.

It is recommended, that although it entails a certain amount of time, in the present circumstances, it would be desirable to substitute a subjective determination of the masking for an objective measurement of the noise.

The subjective tests required are determination of the threshold of audibility in the presence of room noise and without room noise, for each type of receiving system. The technique for this determination with 4 simultaneous listeners is believed to be well established.

The results would be recorded in terms of the e.m.f. of a 600 ohm generator applied to each receiving system when the tone was adjusted to threshold value.

If the result is given in this form the noise level in the ear can be computed (if required) from the threshold voltage and the frequency response characteristic of the receiving system.

The threshold determination should be made at such frequencies as will best define the shape of the masking curve in each case ; the threshold determination without noise must be made at the same frequencies.

Effects of non-linearity

For the calculation of articulation (and in particular for deriving A.E.N. values) by the method of Dr. Collard, non-linearity has not ordinarily been taken into consideration when the transmitting characteristic is measured using a pure tone as the source. In using the method of Dr. Fletcher it is necessary to measure the variation of transmitter output with input at 1000 c/s over a range of input pressures from *0.1 barye to 35 baryes on the diaphragm of the microphone.*

According to the article by Fletcher and Galt in J.A.S.A., March, 1950, it is necessary to determine a factor of correction depending upon the harmonics produced by non-linearity of the microphone. The necessary measurements are rather difficult and it is not certain that the formula for application of this correction to the calculation of articulation is appropriate in the case of calculation based on pure tone frequenc-yresponse curves.

It is therefore proposed not to make measurements of harmonic distortion ; in this case, the calculated values of " A " or " b " may be found to differ from the experimental values by a factor which is in principle H.p. (where H represents harmonic distortion, and *p* represents crew factor). Ideally the value of *H.p.* should be the same for all tests made with a particular sending system, but may be slightly different for different sending systems.

Finally, it is to be pointed out that the relation to be expected between " A " or " b " and the observed sound articulation is not known and will have to be derived by trial fitting of the experimental and calculated data.

This inconvenience does not reduce the value of the proposed work for studying the use of calculated articulation to establish A.E.N. values, because values of A.E.N. may be deduced directly from curves of " A " or " b " against attenuation, adopting a fixed value of " A " or " b " (eg. 40%) as the equivalent of 80% sound articulation.

ANNEX 3

(to Question No. 7)

Objective articulation measurements carried out on telephone apparatus

(Contribution of the Swiss Telephone Administration)

Summary. — The Research Laboratory of the Swiss Telephone Administration, in agreement with the C.C.I.F. Laboratory at Geneva, undertook to complete by some objective measurements the subjective articulation measurements which the latter had made on

certain telephone apparatus. The object of these measurements was to obtain, by objective methods, the A.E.N. values which were found at the C.C.I.F. Laboratory by subjective methods. At the same time these measurements represent a contribution to the study of Question No. 7 of the 4th Study Group of the C.C.I.F. .

After a description of the objective methods employed, the author compares the results thus acquired with those obtained during the 8th, 9th and 10th Series of tests at the C.C.I.F. Laboratory and finds a satisfactory agreement.

1. *Principle of the calculation of articulation.*

H. Fletcher and R. Galt describe a method which allows of the calculation of the articulation of a transmission system from its physical characteristics [1]. This method is applied to the articulation calculations presented below and a summary description is given of its essential features.

In the calculation of articulation it has been observed that it was desirable to establish an " articulation index ". This is based on the supposition that each frequency band of a speech sound makes a contribution to the articulation independently of the other bands. The sum of these different contributions gives the total articulation. In their article, Fletcher and Galt establish the relationship between the articulation index " A " and the sound articulation " s ". They deduce therefrom the following expression (see Figure 1) :

$$s = 1 - 10^{-\frac{A\,.\,p}{0.55}}$$

where " p " is a " practice factor " which, for a normal manner of talking and listening, can generally be considered as equal to 1.

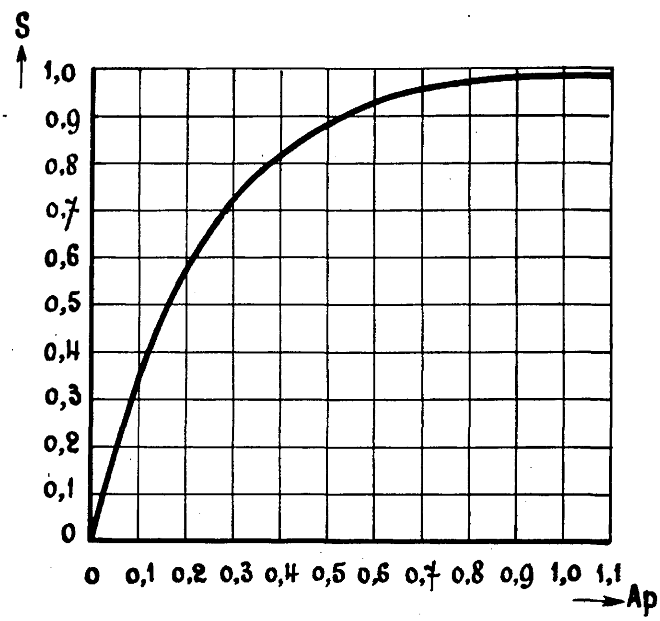


FIGURE 1. — *Relation between the sound articulation and the articulation index*

To find the important weighting factor indicating in what measure each frequency band contributes to the articulation, the articulation index for an ideal transmission system was examined for various cut-off frequencies. If A_f represents the greatest articulation index possible which occurs when the tests are made at the optimum level received, the derivative dA_f/df gives the required weighting factor D. We have, therefore, the relation :

$$A_f = \int_0^f D.df$$

The article in question indicates furthermore, that the articulation index of any transmission system is composed of four factors :

$$A = V.E.F.H.$$

The two factors V and E are functions of the received level above that of the threshold of hearing and take account of the change in A when supplementary attenuations or gains are inserted in the system. V takes account of the fact that, when the level decreases, ever increasing numbers of vocal components fall below the threshold of hearing and can no longer make any contribution to the articulation. When room noise is present a supplementary masking effect is produced. If the energy spectrum of the room noise at the entry of the ear is known, it is possible, with the help of the "critical bandwidth", to calculate the rise in the threshold of hearing.

If the received level exceeds a certain value the high acoustic pressure fatigues the ear. This fatigue is expressed by the factor E. The influence of these two effects has been examined in articulation tests and the values of V and E are shown in the tables as a function of the received level.

The factor F depends uniquely on the shape of the frequency characteristic. It is a a maximum value and indicates the influence on the articulation index when the received level for this system has been so chosen that the articulation is greatest. This optimum received level is at 68 db. The value of F is 1 when the characteristic is flat and is included between 0 and 1 for any other shape of curve. This value is given by the following equation :

$$F = \int_0^\infty D.W.df$$

D representing the weighting factor. The factor W determines the reduction of dA in the interval df when the received level is less than optimum. It has been possible to obtain the function W in an ideal manner by means of articulation measurements carried out on a system for which the level of each frequency interval could be separately adjusted. The other frequency bands were only influenced when it again became necessary to bring the received level to the optimum value of 68 db for the total transmission.

Since, during the course of normal mouth-to-ear transmission, there is a modification of the acoustic pressure due to the dimensions of the listener's head, account must be taken of the " orthotelephonic transmission " factor during the tracing of the frequency characteristic. To calculate the articulation it is necessary to take account, at each frequency, of the difference in decibels between the system considered and the orthotelephonic reference system.

The fourth factor H on which depends the articulation index includes all the effects which are not included in the three other factors. By this is meant certain kinds of non-linear distortion, misalignment of frequencies in carrier systems, etc.

The object of the present work is to calculate a curve which gives the relation existing between the articulation of a system and the attenuation introduced in this system. This allows the calculation, on an objective basis, of the A.E.N. value introduced by the C.C.I.F. as a new quantity for the evaluation of the quality of a telephone system. This new quantity is based on the comparison of a commercial telephone system with a reference system and is consequently independent, to a large extent, of the characteristics of the testing crew. It is not absolutely necessary, for the calculation, to know the training factor and the hearing acuity. The absolute value of the articulation will therefore vary but the difference in the attenuation as defined will remain constant.

To calculate the A.E.N. value it is therefore necessary to know the following quantities :

1. Frequency characteristics of the reference system and of the telephone system.
2. Speech power at the microphone.
3. Interfering noise at the entry of the ear.

2. *Measurement of the frequency characteristics of a carbon microphone.*

It is difficult to make an exact and reproducible measurement of the frequency characteristic of a carbon microphone, since the position of the carbon granules is not defined in an absolute manner and may vary to an appreciable extent according to the nature of the acoustical excitation. This is why the methods of measurement known at the present time often give very different results.

In principle, these objective measurements may be divided into two groups :

1. Measurement of the frequency characteristic using a continuous spectrum.
2. Measurement of the frequency characteristic using pure tones.

In the two cases, the microphone is excited acoustically, in the position indicated by the C.C.I.F. recommendations, by means of an artificial mouth.

2.1 *Measurement of the frequency characteristic using a continuous spectrum.*

For the measurement of the frequency characteristic using a continuous spectrum, a noise generator is used as a source of energy. The acoustic pressure generated is thus composed of all the frequencies of the band concerned simultaneously. The spectral composition of the output voltage of the carbon microphone is determined with the aid of a noise analyser. When this noise spectrum is known it is easily possible to calculate the frequency characteristic of the carbon microphone.

Since the energy supplied by the voice extends simultaneously over a large number of frequency bands this form of excitation corresponds to normal working conditions.

Although this method appears to be clear, it presents, however, a fundamental difficulty. The relation between the contact resistance of the carbon granules and the acoustic pressure in not linear. Hence, when the microphone is excited by several frequencies, its distortion gives rise to new frequencies. If, in any one of the bands, the sum of these supplementary frequencies is greater than the useful voltage of that band, the measurement of the frequency characteristic is rendered inaccurate.

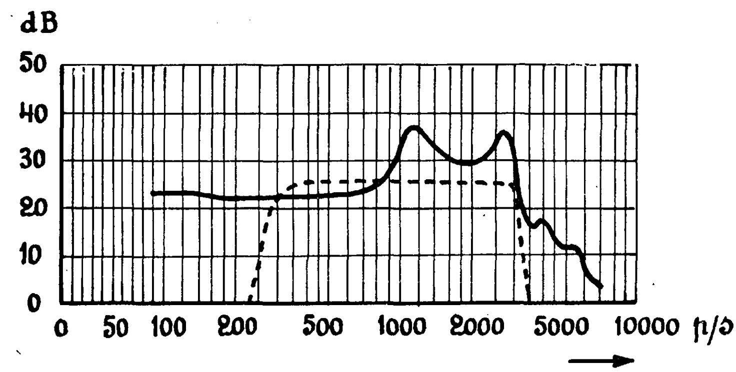


FIGURE 2. — *Response curve for microphone A (dotted curve indicates the energy spectrum of the sound)*

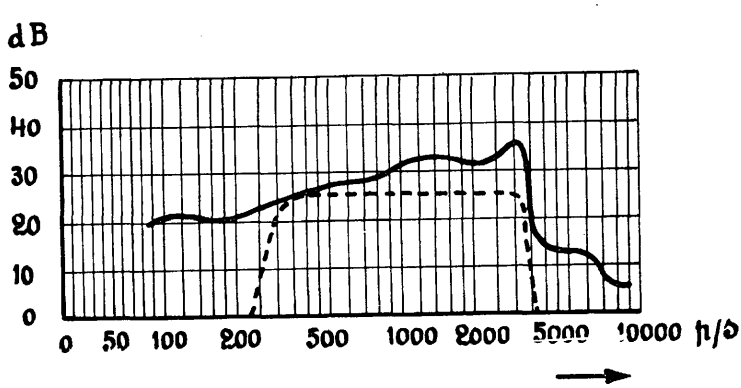


FIGURE 3. — *Response curve of microphone B (the dotted curve indicates the energy spectrum of the sound)*

In order to determine for what proportion of cases this is true for commercial carbon microphones, the following experiment was made : by means of an artificial mouth two types of microphone, A and B, were artificially excited. The sound source used was a noise generator having a flat characteristic. With the aid of filters its bandwidth was restricted to 280-3400 c.p.s. The effective acoustic pressure on the diaphragm of the microphone was 11.6 dynes/cm^2. The two microphones were measured while mounted in a telephone set.

Figures 2 and 3 show the frequency characteristics obtained.

Since no fall in sensitivity occurs below the pass band, it may be concluded that, due to the distortion in the carbon microphone, the sum of the modulation products in the range of the lower frequencies is greater than the useful voltage. This appears particularly clearly for microphone A where the energy per cycle remains constant below 500 c.p.s. At the high frequencies, the harmonics and the supplementary frequencies are also noticed, but they are less troublesome than the low frequencies.

Since the intermodulation factor of a carbon microphone lies between 5 and 30% it cannot be expected to obtain with the noise analyser, as experience has confirmed, differences of level greater than 10 to 25 db in the pass band. If it was desired to measure greater fluctuations in the frequency characteristic of the carbon microphone for a continuous spectrum noise and using an analyser, it would be necessary to modify the spectrum of the acoustic pressure. For those frequencies near which the sensitivity of the carbon microphones is small, it would be necessary to increase the acoustic pressure.

2.2 *Measurement of the frequency characteristic using pure tones.*

For the measurement of the frequency characteristic of carbon microphones with pure tones use is made of a heterodyne oscillator whose frequency is varied by means of an automatic device and whose output voltage remains constant throughout the whole range of frequencies. The requirements imposed, by this method, regarding the frequency characteristic of the artificial mouth are not great. Since at any given instant there is only one sound, the pressure may be monitored by means of a probe microphone and maintained constant with the aid of an amplifier with automatic gain control.

According to the time necessary to cover the given frequency range a distinction may be made between a slow sweep or a rythmic variation of frequency.

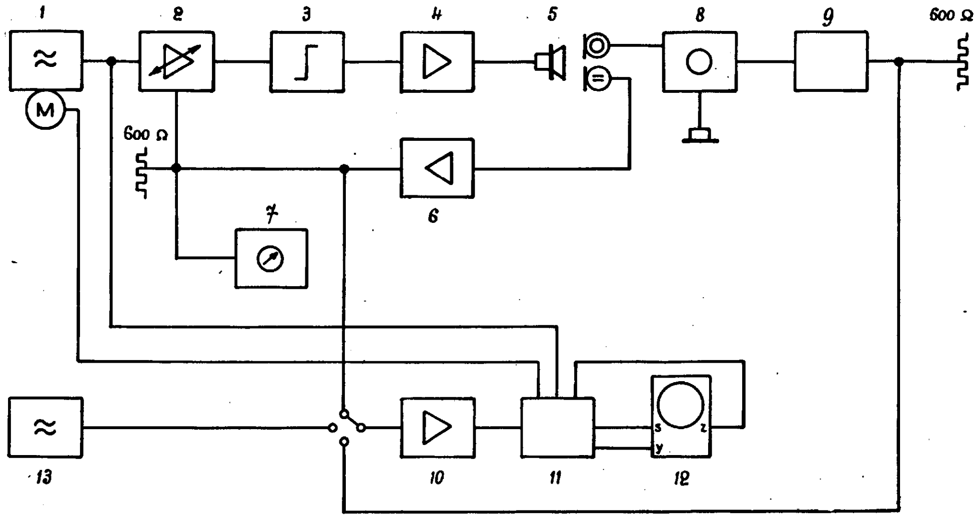
For the measurement of the frequency characteristic using a slow sweep the frequency generator constructed according to C.C.I.F. recommendations is used. The frequency range of 30 to 10,000 c.p.s. is swept automatically in 120 seconds. Since the sweep is slow the instanteneous variations in voltage remain small and a mechanical instrument can be used for recording the characteristic. The objection to the slow sweep is that, during the acoustic excitation, the carbon granules have time to rearrange themselves. The microphones become " packed " and entirely lose their sensitivity (see Figure 10).

For the measurement of the frequency characteristic using a rhythmic variation of frequency the oscillator should be set up for a rapid sweeping of the frequency band. The frequency with which the band is swept lies between 1 and 5 c.p.s. For this reason, the instanteneous variations of voltage are large. A level recorder can no longer be used and it is necessary to record the frequency characteristic by means of a cathode ray oscilloscope. However, in order to measure large differences of level this is preceded by an amplifier whose output voltage is the logarithm of its input voltage.

A measuring device is described below which has proved very serviceable for the measurement of the frequency characteristics of carbon microphones. Figures 4 shows the overall block diagram of an arrangement used for measuring the sending loss of a subscriber's telephone set.

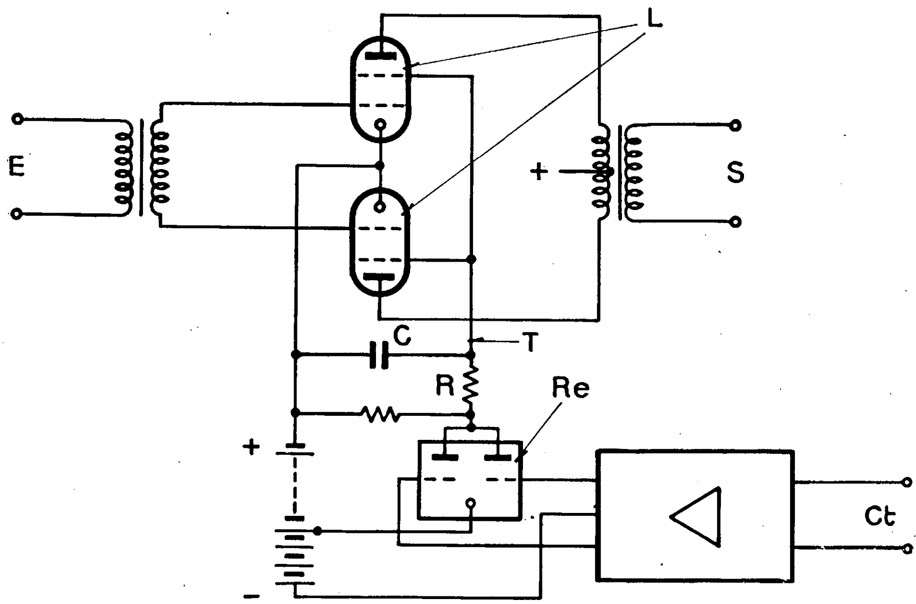
For the rhythmic generator a heterodyne oscillator having a frequency range of 50 to 10,000 c.p.s. was used. The frequency scale is divided logarithmically and the frequency is adjusted by means of a precision condenser that can be easily rotated. This condenser has a working angle of about 230° but may be turned through 360° and is directly coupled to the shaft of the driving motor.

As it is indispensable to have an acoustic pressure which is as constant as possible, an amplifier with automatic volume control is used which compensates the variations of the



1 = Rhythmic oscillator
2 = AVC amplifier
3 = Equaliser
4 = Amplifier
5 = Artificial mouth
6 = Amplifier
7 = Volume meter
8 = Subscriber's telephone set
9 = Feeding bridge
10 = Logarithmic amplifier
11 = Impulse generator for synchronisation and frequency ordinates
11 = Cathode ray oscillograph
13 = Sine-wave generator
M = Driving motor

FIGURE 4. — *Arrangements for the objective measurement of sending efficiency*



T = A.V.C. voltage
L = Control valves
Ct = Input for the controlling voltage
Re = Rectifier
E = Input
S = Output

FIGURE 5. — *Basic principles of the A.V.C. amplifier*

frequency characteristic of the artificial mouth. The choice of a time constant for this amplifier presents certain difficulties. On the hand it is necessary to compensate for the rapid variations and, on the other hand, to provide for the passage of the low frequencies without distortion. An experiment showed that the time constant for one sweep per second ought to be about 0.05 seconds. If, in addition, the degree of regulation is fixed at 3.3% so that all the variations are reduced to one-thirtieth of their value, the lowest measuring frequency which remains stable and without distortion is about 200 c.p.s. It is to be noted that the rectifier providing the control voltage is of the push-pull type (frequency doubling) and that the time constants are the same in both directions of control. The basic principle of the amplifier with automatic volume control is illustrated in Figure 5.

The artificial mouth which generates the acoustic field has already been described in a previous publication [2]. The principal details may be summarised as follows : the orifice of the mouth, as determined by empirical means, is a form of short mouthpiece having a rapidly increasing diameter and so preventing the formation of very pronounced beams at high frequencies : it offers no plane surfaces, which therefore prevents the formation of stationary waves between the microphone to be measured and the artificial mouth. Figure 6 gives the properties of the artificial mouth provided with an amplifier and an equalizer.

As is shown in Figure 4, the microphone is measured in a normal circuit with the subscriber's telephone set and the usual exchange feeding bridge. The terminating impedance is 600 ohms.

Unlike the usual logarithmic amplifiers which have a time constant, the amplifier used provides an instantaneous logarithmic amplification. At any instant the output voltage corresponds to the logarithm of the input voltage. It is thus possible to make an exact study of the large and rapid variations which occur during the measurement of microphones using rhythmical frequency variation. In the amplifier in question the logarithmic function is obtained by approximation from linear sections. Between the various stages of amplification linear networks are inserted which are composed of pure resistances and crystal diodes with predetermined operating voltages. Figure 7 gives an overall diagram of the amplifier and Figure 8 shows the connection of the coupling units.

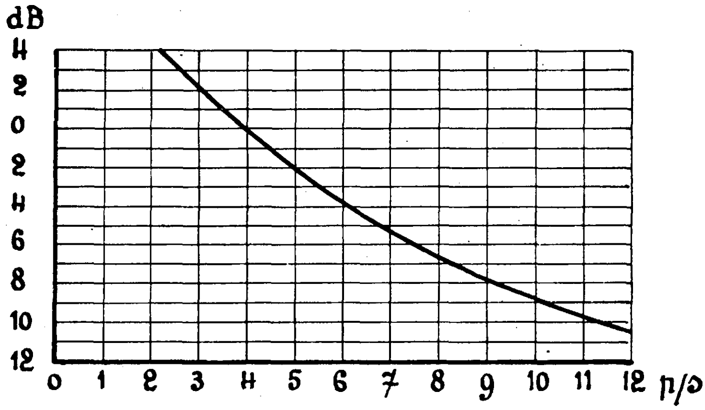
With the push-pull rectifier it is possible to apply the two half waves on each side to the neutral line. If the envelopes of the two half waves coincide it can be said with certainty that even-order distortions are small. The distance betwene the two envelopes is thus a measure of these distortions and the measuring device in question allows not only the determination of the frequency characteristic of a carbon microphone but also the evaluation of its non-linear distortion. In order to render the curve of the frequency characteristic visible on the screen of the cathode ray oscilloscope use may be made of a special setting of the amplifier which is provided for this purpose whereby the rectified voltage may be smoothed by means of a condenser.

The electrical characteristics of the logarithmic amplifier are as follows :

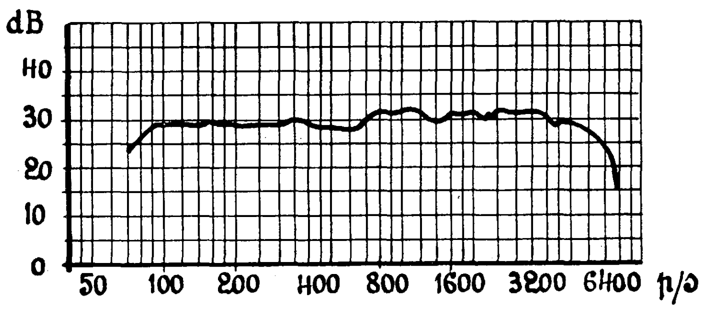
— Range of the input potentiometer	50 db
— Accuracy of the logarithmic indications	± 0.3 db
— Input potentiometer calibrated in steps of	5 db
— Input impedance.	100,000 ohms
— Input voltage with the potentiometer	0.7 mV to 70 V
— Rectified output voltage for the cathode ray oscilloscope	0 to 5.5 V
— Frequency range	30 to 50,000 cps.

The positions of the switch are as follows :

1. Direct indication on an instrument up to 50 db.
2. Connection of an external instrument consuming 5 mA (e.g. a recording device).
3. Direct output of the amplifier giving the instantaneous logarithm of the input voltage for the modulation of the cathode ray oscilloscope.
4. Rectified output.
5. Rectified and filtered output for the modulation of the cathode ray oscillograph.

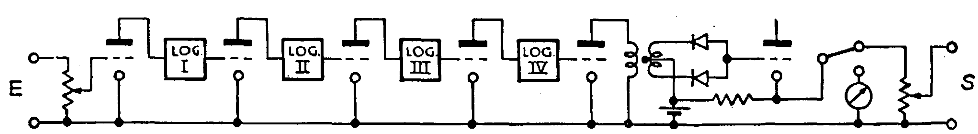


1. Decrease of the mean acoustic pressure along the axis



2. Response curve

FIGURES 6. — *Characteristics of the artificial mouth*



E = Input S = Output

FIGURE 7. — *Basic principles of the logarithmic amplifier*

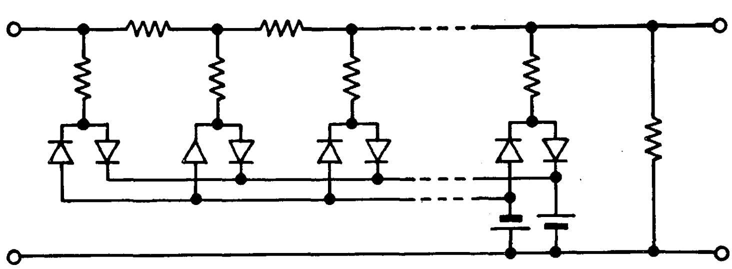
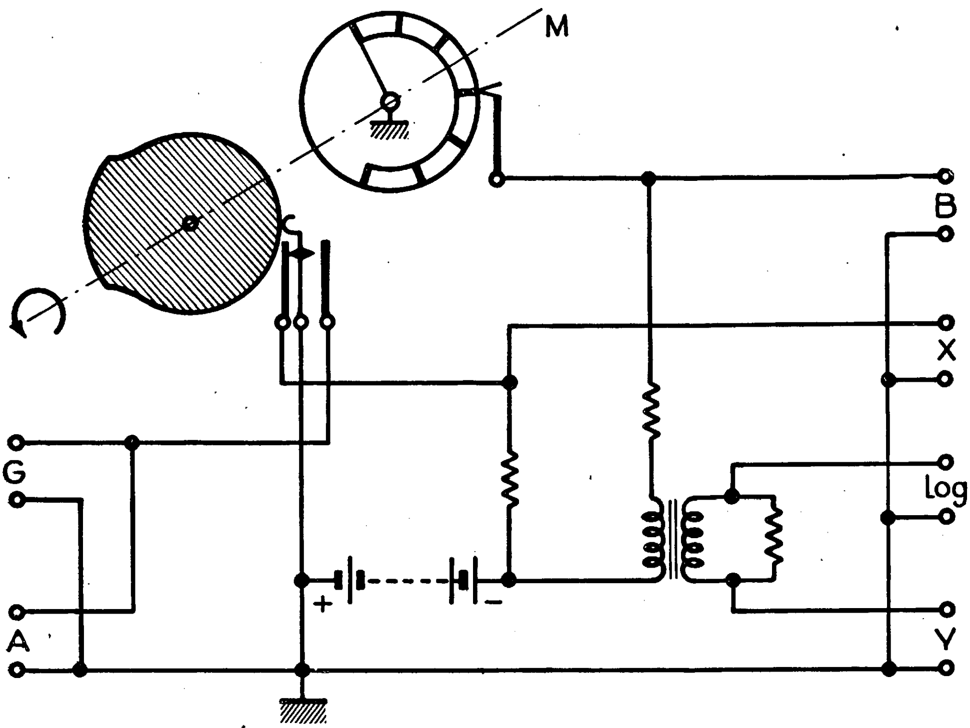


FIGURE 8. — *Coupling circuit (combination of linear elements)*

The calibrated potentiometer connected to the input of the amplifier allows the control at any time of the accuracy of the logarithmic indications.

The indicating instrument used is the cathode-ray oscillograph with a direct-current amplifier. Figure 9 shows how the synchronisation of the time base and the frequency marks is arranged.



A = Input to the A.V.C. amplifier
B = Modulation of the spot intensity
G = Output of the rhythmic generator
Log = Output of the logarithmic amplifier
M = Shaft of the driving motor
X = Synchronisation of the time base
Y = Plates of the oscillograph

FIGURE 9. — *Generator of pulses for the synchronisation of the cathode-ray oscillograph and for the frequency ordinates*

The shaft of the rythmic generator also rotates two discs with cams and contact springs. The first disc operates a contact which makes connection to the output of the oscillator during its useful angle and short-circuits it during the remainder of that angle. In addition it supplies a synchronising pulse for the start of the time base of the cathode ray oscillograph. The second disc with the contact cams generates short pulses at certain adjustable angles of the shaft. By means of a transformer these pulses are superimposed on the useful voltage applied to the Y plates and give rise to visible frequency ordinates on the screen of the cathode ray oscillograph. If the cathode ray oscillograph is provided with the facility of modulating the spot intensity by means of an external voltage the frequency ordinates can be made even more prominent.

As has been shown by experience the best method is to sweep the frequency band from the high frequencies to the low frequencies. The carbon granules which are acoustically excited at the resonant frequencies of the microphone require some time to return to their rest position. It is for this reason that the method of measurement by rythmic variation of the frequency allows the exact recording of the steep flanks of the frequency characteristic only if the change is from the frequency at which the sensitivity is lowest to that at which the frequency is greatest. Since, for the majority of carbon microphones the upper cut-off frequency is very marked, it is best to start the acoustic excitation at the high frequencies.

An accessory apparatus enables the photographing of the frequency characteristics shown on the screen. The calibration of the Y axis is accomplished with the aid of the potentiometer of the logarithmic amplifier. When taking the photograph of the frequency characteristic the 5 db scale markings are immediately superimposed. Even the smallest errors in the logarithmic indication are thus nullified and the frequency characteristic can be measured very exactly on an enlargement of the photograph.

Figure 10 shows the characteristic of a microphone measured using a slow frequency sweep. Figure 11 shows the frequency characteristic of the same microphone on the screen of the cathode ray oscilloscope. It can clearly be noticed that with the first method the microphone " packs " between 400 and 1400 cps. With the other method the resonant frequency reactivates the carbon granules and the microphone recovers its normal sensitivity.

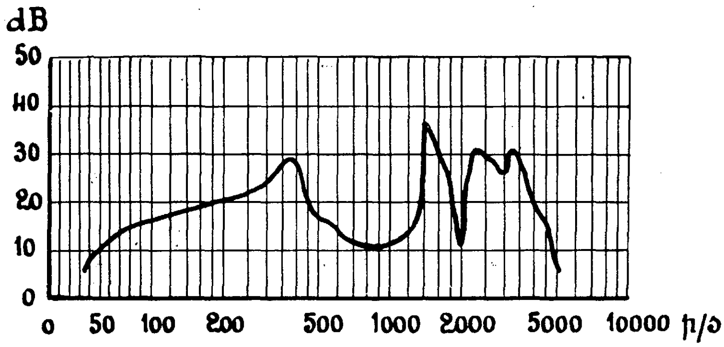


FIGURE 10. — *Response curve of a carbon microphone measured using a slow frequency sweep*

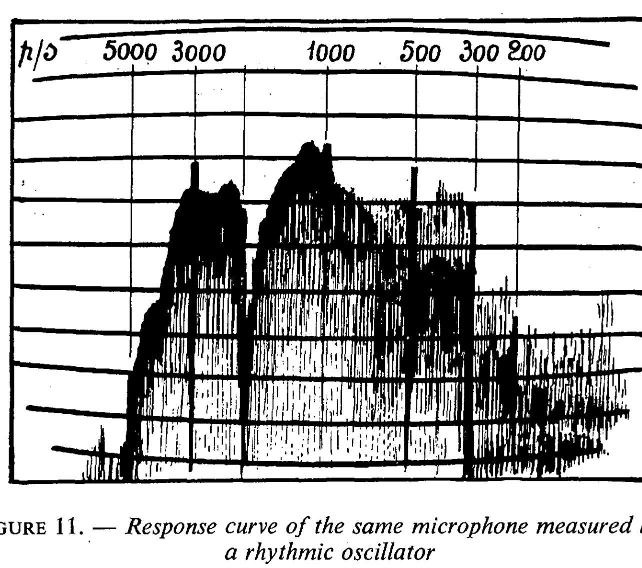


FIGURE 11. — *Response curve of the same microphone measured using a rhythmic oscillator*

3. *The artificial ear used for the measurement of the telephone receivers.*

In the case of modern telephone receivers of high efficiency and whose mechanical impedance is relatively small it is noticed that the frequency characteristic is greatly dependent upon the acoustic loading. Receivers of this kind must therefore be measured by means of an artificial ear whose acoustic properties correspond to those of the human ear. Moreover, for the calculation of articulation it is indispensable to know the absolute acoustic pressure at the entry of the human ear.

H. Weber [3] has described an artificial ear whose acoustic properties have already proved themselves. In consequence, the basic principles of its construction were adopted for the development of the new artificial ear.

This new artificial ear is also composed of two cavities which are interconnected by a heavily damped passage. For frequencies above 1000 cps an acoustic impedance is thus obtained which is greater than that corresponding to the total volume of the two cavities. In addition the interconnecting passage contributes an acoustic resistance.

The first cavity between the condenser microphone (Western Electric type 640 AA) and the opening of the artificial ear has a volume of 1.5 cm^3. The volume of the circular cavity to which the first is coupled is 1.4 cm^3. The interconnecting passage is formed of four 45 degree segments of a ring having internal and external diameters of 19 and 30 mm and a thickness of 0.16 mm. The total volume at low frequencies is therefore 3.0 cm^3 and about 1.5 cm^3 for the high frequencies. To these volumes should be added, in each case, the volume included between the receivers ear-cap and the outer surface of the artificial ear.

The outer form of the artificial ear has been so chosen as to correspond, for the forms of receiver ear-caps considered, as exactly as possible to the human ear. For this purpose account was taken of the results of the measurements made by K. Braun [4]. As some ear-caps have a large diameter opening, the aperture of the artificial ear has been given a conical form. The new form of construction has permitted the extension of the field of application and the enlargement of the frequency band. Figure 12 shows the frequency characteristic measured with the new artificial ear.

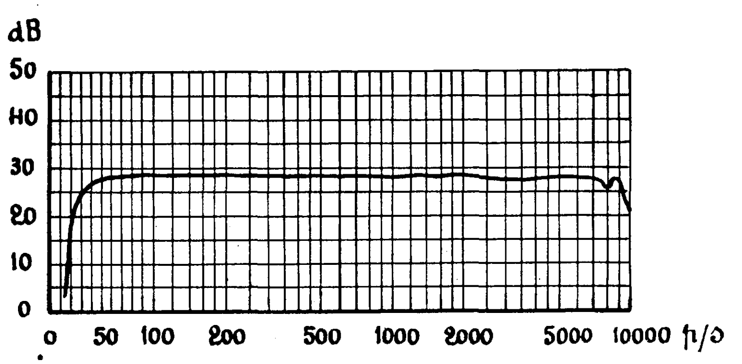
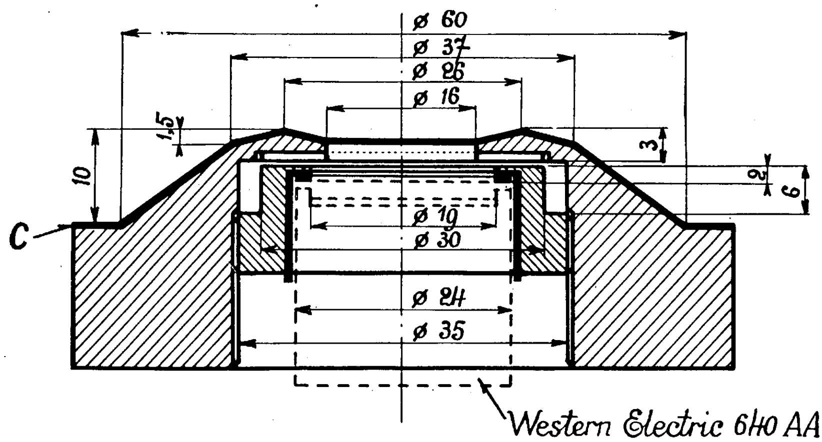


FIGURE 12. — *Response curve of a standard receiver measured with the new artificial ear*

In order to verify the exterior shape, measurements were made on the receiving systems of telephone sets from six different administrations and the equivalent attenuation was calculated as indicated by K. Braun [57]. Table I allows the comparison of the values thus obtained with those measured subjectively at the C.C.I.F. Laboratory.

The dispersion of these values is within the limits imposed by the precision of the measurements and calculations and the agreement can be considered asvery satisfactory.

Figure 13 shows a section through the new artificial ear.



C = Rubber, thickness : 0,5

FIGURE 13. — *Section of the new artificial ear*

TABLE I

System No.	Form of the receiver ear-cap	Calculated db	Measured in C.C.I.F. Laboratory db	Difference db
1	Thick, conical cavity	2.5	3.1	0.6
2	Large, flat.	0.9	2.8	1.9
3	Medium, spherical cavity	6.1	4.9	−1.2
4	Medium, spherical cavity	8.1	7.6	−0.5
5	Thick, conical cavity	3.5	4.5	1.0
6	Medium, conical cavity	1.3	2.5	1.2

4. *Determination of the interfering noise at the entry of the ear.*

The masking effect of the noise has the result of raising the threshold of hearing. Some speech components disappear below the noise and no longer make any contribution to the articulation.

For the purposes of the calculation of articulation, the question must be posed whether, in monaural listening, as is the case with the telephone, only the noise reaching the listening ear influences the articulation, or whether the noise reaching the other ear has also an influence. To check this point the following experiment was carried out. The thresholds of

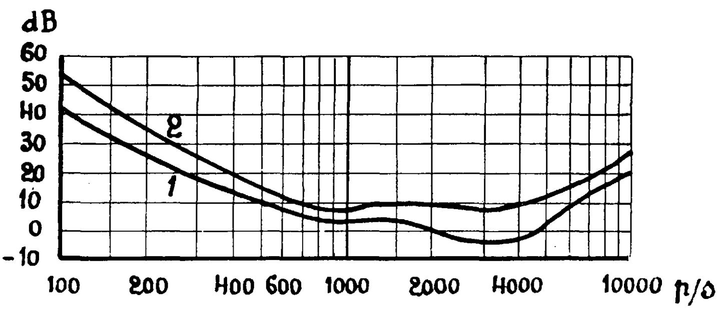
TABLE II

Frequency	2nd ear		Difference
	open	covered	
p/s	db	db	db
200	−58.7	−59.7	+1.0
400	−70.0	−69.7	−0.3
800	−77.2	−78.8	+1.5
1600	−77.5	−78.5	+1.0
3200	−77.5	−79.7	+2.2

hearing of twelve persons were measured using a telephone receiver. The room noise of 60 db had a flat frequency characteristic. During the first test the free ear was exposed and during the second test it was covered. Table II shows, in decibels, with reference to IV, the average voltage for the threshold as measured at the input of the telephone set.

The last column of Table II shows that the noise penetrating into the ear exposed to the room has so little effect that it can be neglected.

The room noise penetrates into the ear covered by the receiver ear-cap by two paths : through the leak between the ear-cap and the ear and by the microphone and the receiver i.e. the side-tone path. If equipment is available for the generation of a room noise and if the persons taking part in the experiment have normal thresholds, the masking effect can be directly determined by a measurement of the threshold of hearing. However, it is often preferable to separate the two paths and to have knowledge of their effects independently of one another. If a probe microphone is not available the acoutic attenuation of the leak between the ear-cap and the ear can be measured by determining the threshold of hearing for pure tones. To this end a loud-speaker provides sound pulses whose amplitudes can be adjusted by means of a precision attenuator. The thresholds determined by this method are very exact. The difference of the values obtained for rising and falling level is only about a decibel. At the input to the loud-speaker a measurement is made of the voltages for the thresholds when the ear is exposed and for when it is covered by the receiver. The ratio of these voltages diminished by the rise in the threshold with one ear covered gives the required attenuation directly. Figure 14 brings out the difference in the thresholds when listening under free field conditions and when listening with the ear covered by a receiver ear-cap (see H. Fletcher and R. Galt).



Curve 1 : for mon-aural listening under free field conditions.
Curve 2 : for mon-aural listening with the ear covered by a receiver.

FIGURE 14. — *Thresholds of hearing in decibels above 10^{-16} W/cm²*

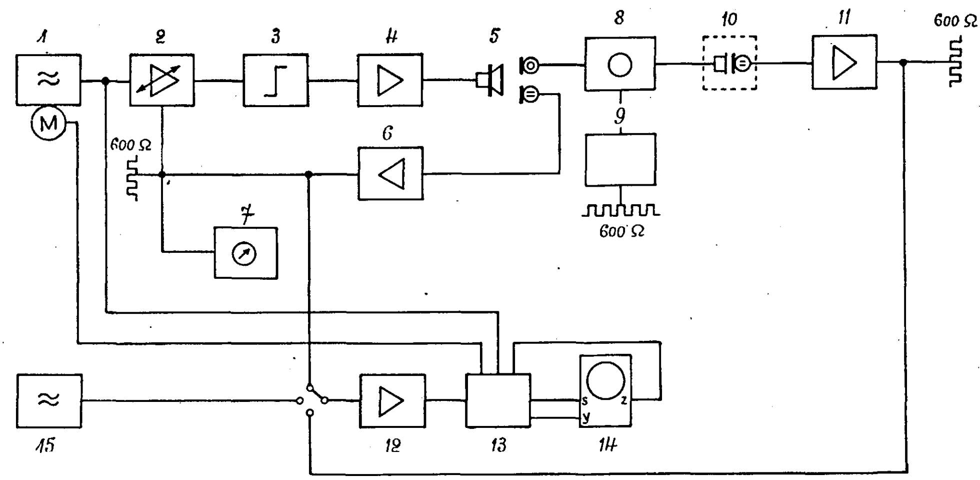
For the calculation of the noise penetrating into the ear through the leak between the ear and the ear-cap of the receiver account will, of course, be taken of the increase in the acoustic pressure caused by the listener's head.

In order to calculate the noise which reaches the ear through the receiver a measurement is made of the attenuation of the side-tone path. This can be measured directly with the aid of the artificial mouth and the artificial ear as shown in Figure 15.

The various items of the apparatus have already been described in § 2. The only difference lies in the fact that it is not shougt here to measure the voltage at the output of the subscriber's telephone set but to measure the acoustic pressure at the ear-cap by means of the artificial ear. As the attenuation of the side-tone path depends to a large degree on the impedance of the termination to the telephone set the feeding bridge is closed with a resistance of 600 ohms.

As a result of the non-linearity of the carbon microphone, the acoustic pressure generated in front of the microphone must correspond to that observed during the articulation tests. If, in order to exclude interfering noises during the measurement of the frequency characteristic, it is desired to make the measurement using a higher acoustic level, account must be taken, in the calculation, of the change in sensitivity of the microphone.

The change in pressure due to the dimensions of the listener's head is no longer appreciable owing to the distance between the mouth and the microphone. According to our measurements the increase of pressure at a distance of 3 cms from the mouth is about $^1/_3$ or $^1/_2$ of the orthotelephonic increase. This increase is, to a large extent, compensated at high frequencies by the directional effects of the microphones.



1 = Rhythmic oscillator
2 = A.V.C. Amplifier
3 = Equalizer
4 = Amplifier
5 = Artificial mouth
6 = Amplifier
7 = Volume meter
8 = Subscriber's telephone set
9 = Feeding bridge
10 = Artificial ear
11 = Amplifier
12 = Logarithmic amplifier
13 = Generator for synchronization and for the frequency ordinates
14 = Cathode-ray oscillograph
15 = Sine-wave generator
M = Driving motor

FIGURE 15. — *Arrangements for the measurement of the side-tone equivalent for a subscriber's telephone set*

5. *Example of calculation and measurement.*

A subscriber's telephone system of the Swiss Telephone Administration has been measured under conditions which are identical with those under which the articulation tests were made at the C.C.I.F. Laboratory. The system is composed of three parts : a telephone set, model 1950, a subscriber's line of 3 km and a feeding bridge. Figures 16 and 17 give the circuit diagrams of the arrangements.

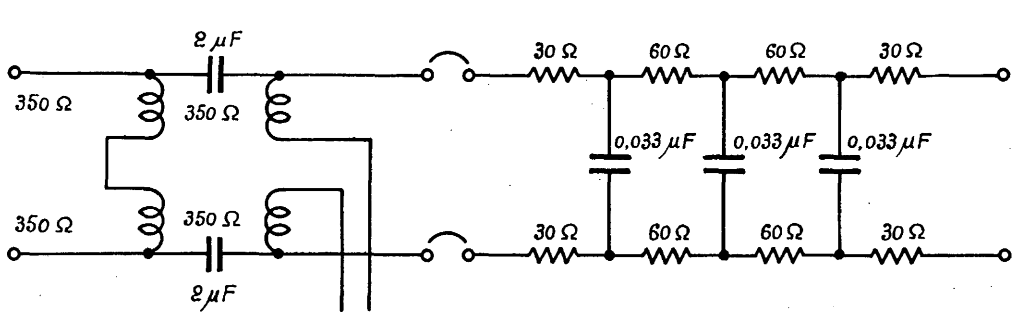
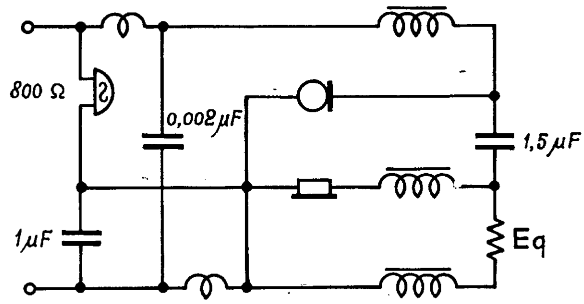


FIGURE 16. — *Circuit of the feeding bridge and the subscriber's line*



Eq = Balancing device

FIGURE 17. — *Circuit of the subscriber's telephone set*

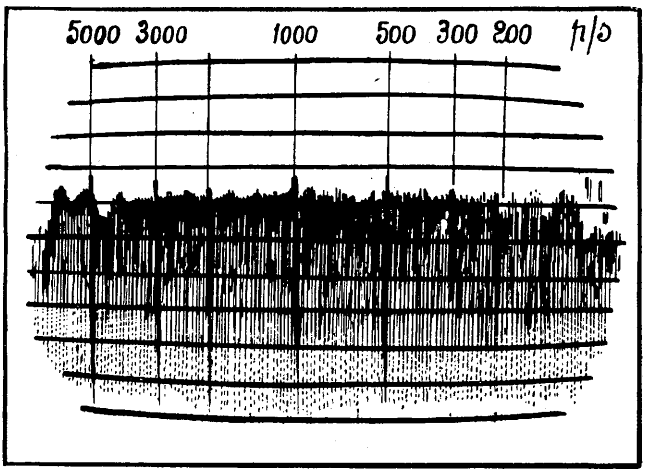


FIGURE 18 *a.* — *Response curve of the reference system*

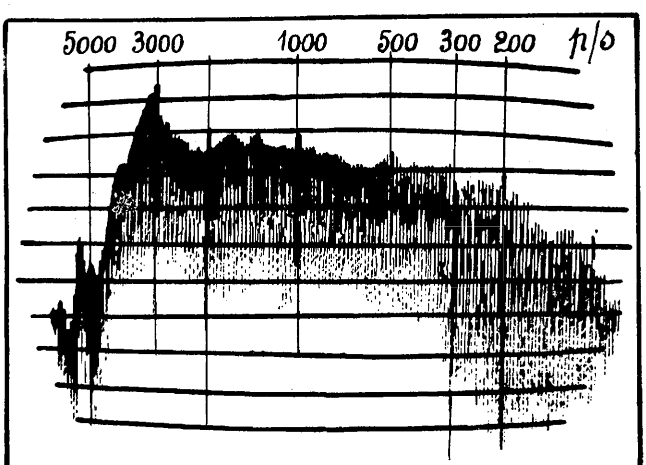


FIGURE 18 *b.* — *Response curve of the commercial system*

With the aid of the measuring device described in § 2, measurements were made on the sending systems of 5 subscriber's sets. The acoustic pressure at the mouthpiece of the microphone was 11.3 dynes/cm^2. Figure 18 shows, by way of example, the trace obtained on the screen of the cathode ray oscillograph of the reference system and of the subscriber's system. The average sensitivity of the reference system was 26.6 mV/dyne/cm^2 ; from this the sensitivity of the commercial system can immediately be deduced.

The receiving systems of the five subscriber's telephone sets have been measured by the usual method using an oscillator with a slow sweep, the artificial ear and a level recorder.

As the sending system and the receiving system are measured separately any one system can be combined with another system for the calculation of articulation. The combinations with the reference system used in the C.C.I.F. Laboratory for the articulation measurements (A.R.A.E.N.) ares particularly interesting.

For the four following combinations a determination of the transmission quality has been made and also a calculation of the articulation :

	Sending	Receiving
1	R	R
2	CH	R
3	R	CH
4	CH	CH

R = Reference system (A.R.A.E.N.)
CH = Subscriber's telephone system of the Swiss Administration

In each case the 300/3400 cps band-pass filter was inserted in the reference system.

The frequency characteristics shown in the Figures 19 to 22 show the difference between these systems and a 1 metre air path with mon-aural listening and an orthotelephonic correction ; the latter being taken as a basis for comparison. For the definition of the speaking level it is supposed that the sound pressure at a distance of 33.6 cms from the lips of the talker is 1 dyne/cm^2. It results from this, on the one hand, that for the distance standardized by the C.C.I.F. recommendations, the sound pressure at the mouthpiece of the Swiss handset, model 1946, is 11.3 dynes/cm^2 or 95 db above 10^{-16} W/cm^2. On the other hand we have, at a distance of 1 metre from the lips of the talker, an acoutic pressure of 64 db above 10^{-16} W/cm^2. To obtain the acoustic pressure in the ear for the purposes of articulation the last mentioned pressure must be increased by the values in decibels shown in Figures 19 to 22.

To determine the interfering noise in the listening ear a measurement has been made of the acoustic attenuation of the leak between the ear and the receiver by means of a threshold test and by the measurement of the attenuation of the sidetone path, using the measuring arrangement shown in Figure 15.

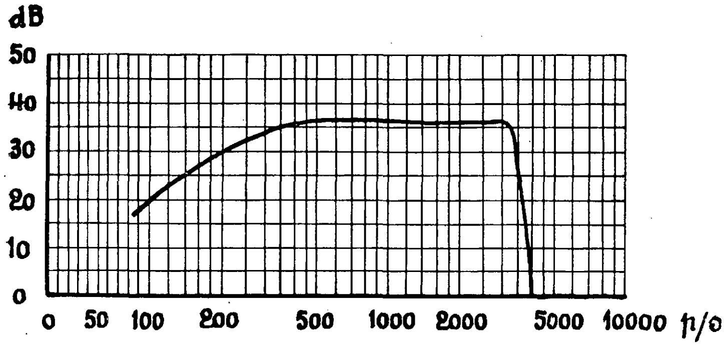
The room noise generated in the listening room during the articulation measurements made at the C.C.I.F. Laboratory has an energy spectrum based on the observations made by Hoth. The level has been fixed at 60 phons (see Figure 23).

The noise resulting from this has been shown in Figure 24 for the reference system and in Figure 25 for the commercial system. The curve shows the energy distribution per cycle at the entry of the ear and the curve *(b)* the increase in the threshold for speech due to the masking effect, account being taken of the critical bandwidth.

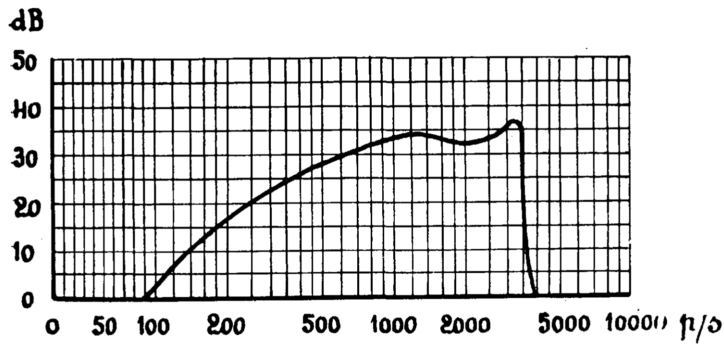
The non-linear distortion of the carbon microphone has been measured by the method using two sinusoidal frequencies as recommended by the C.C.I.F. The difference between these two frequencies remains constant and equal to 200 cps. If β_o db represents average output level due to the two fundamental tones and β_d db the output level of the resultant complex tone, the influence on the articulation index, if $(\beta_o-\beta_d)$ is less than 25 db, will be given by the following equation :

$$H = l - 0.009\,[25 - (\beta_o - \beta_d)]$$

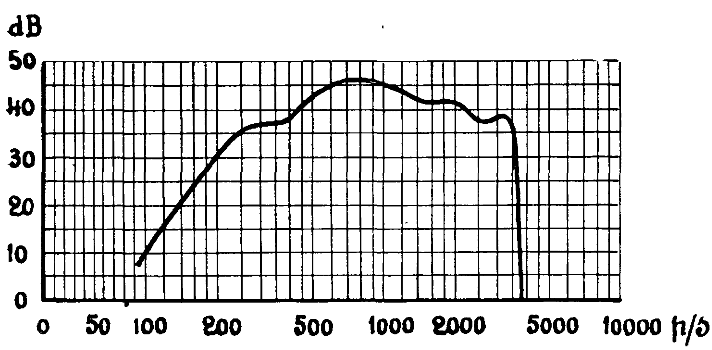
For the difference $(\beta_o-\beta_d)$, the average value has been taken of 8 different measurements uniformly distributed over the frequency band.



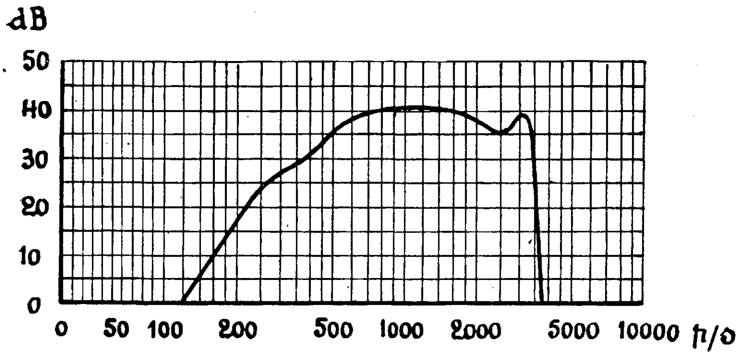
System 1 = R/R



System 2 = CH/R



System 3 = R/CH



System 4 = CH/CH

FIGURES 19 TO 22. — *Response curves of systems 1 to 4*

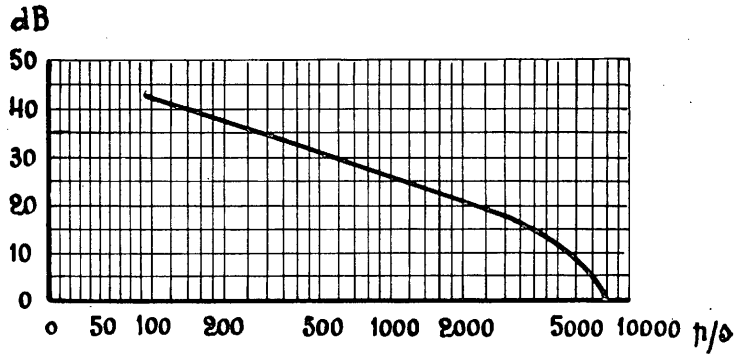


FIGURE 23. — *Energy spectrum of the room noise (according to Hoth) relative to $10^{-16} W/cm^2$ per cycle for a level of 60 phons*

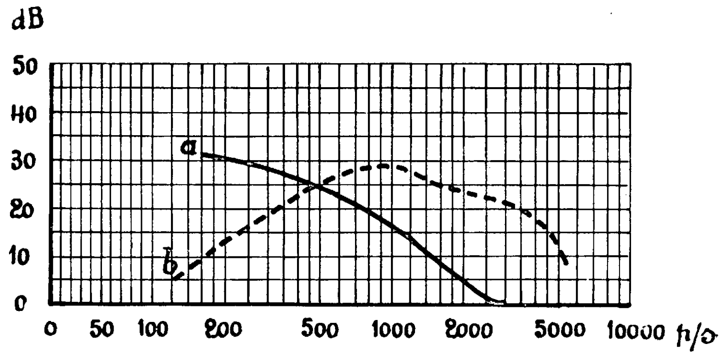


FIGURE 24. — *Interfering noise at the entry of the ear for the reference system*

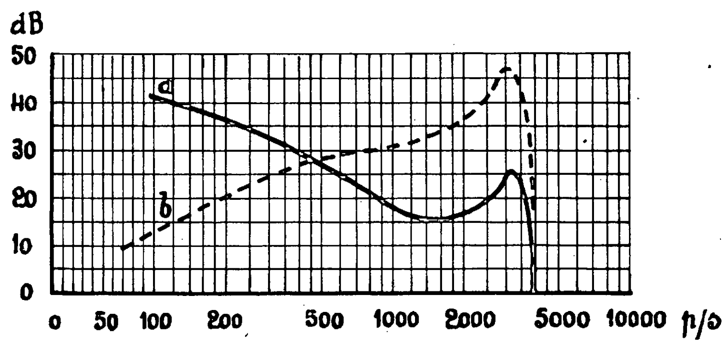


FIGURE 25. — *Interfering noise at the entry of the ear for the commercial system*

In Table III are grouped together the principal quantities which occur in the calculation of H. Fletcher and R. Galt and values are given for the four systems.

TABLE III

		R/R	CH/R	R/CH	CH/CH
β_t	Talking level in db above 10^{-16} W/cm^2.	64.5	64.5	64.5	64.5
β_H	Hearing loss in db (Approximate estimated average).	− 4	− 4	− 4	− 4
R	Frequency characteristic referred to the average talking level	fig. 19	fig. 20	fig. 21	fig. 22
B	Spectral distribution of the interfering noise	fig. 24	fig. 24	fig. 25	fig. 25
M	Masking effect	fig. 24	fig. 24	fig. 25	fig. 25
γ	Influence of the frequency characteristic on the average hearing level	0	0	0	0
$(R-M)_1$ $(R-M)_4$	Average value of (R-M)	+ 11.0 + 8.0	+ 8.0 + 5.0	+ 14.0 + 7.5	+ 9.5 + 3.5
α	Supplementary gain in db inserted in the system	α	α	α	α
$-\alpha_o$	Attenuation to be inserted in the system to bring the speaking level down to the threshold	− 67.5	− 64.5	− 70.5	− 66
F	Influence of the frequency characteristic on the hearing index	0.825	0·821	0.775	0.779
p	Training factor (for a trained crew)	1	1	1	1
$\beta_o - \beta_d$	Distortion attenuation in db	∞	26	∞	26
H	Influence of the non-linear distortions on A	1	1	1	1

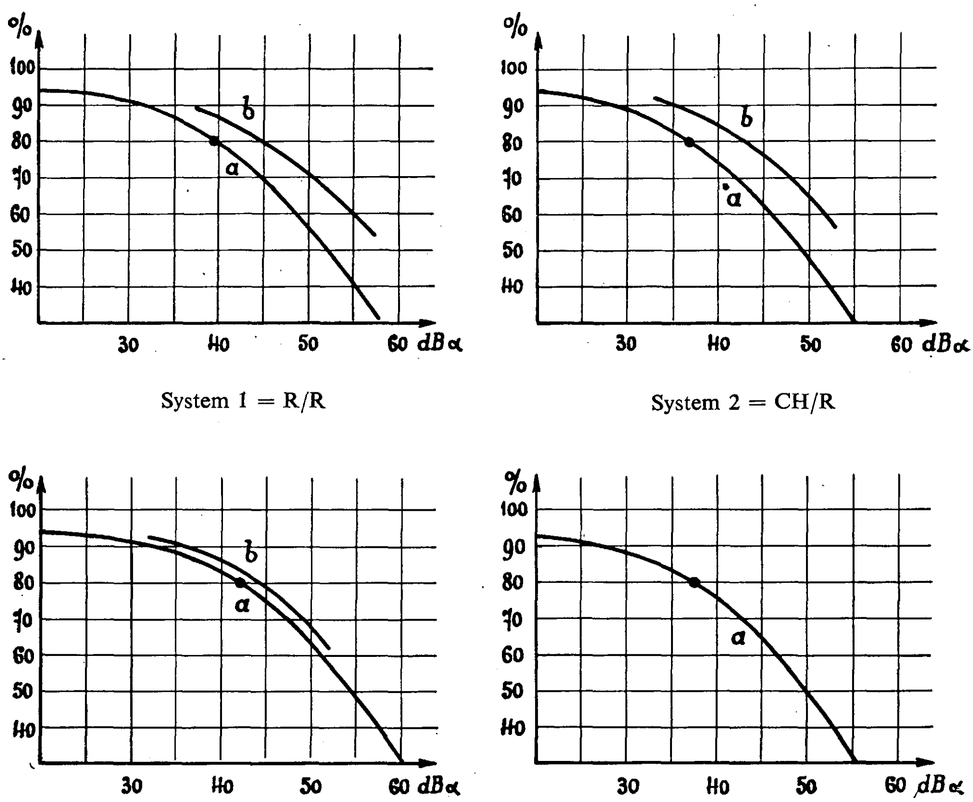
The masking effect of the operator's own voice is small owing to the steep slope of the high frequencies and can be neglected for the calculation of the A.E.N. since it exerts more or less the same influence on all the systems. In the calculation no correction has been made for the factor F. It has also been noticed that the influence of the non-linearity factor of the microphone on the factor F was negligible.

TABLE IV

Systems		α for 80%		Difference	A.E.N.		Difference
		Calculated db	Measured at the C.C.I.F. Laboratory db	db	Calculated db	Measured at the C.C.I.F. Laboratory db	db
1	R/R	− 40.0	− 45.6	− 5.6	0	0	
2	CH/R	− 37.2	− 43.2	− 6.0	2.8	2.4	0.4
3	R/CH	− 42.1	− 44.6	− 2.5	− 2.1	1.0	3.1
4	CH/CH	− 37.8	—	—	2.2	—	—
				− 4.7 (Average)			

The Figures 26 to 29 show the sound articulation as a function of the attenuation inserted in the system. The curve *a* has been established by calculation and the curve *b* represents the results of subjective measurements made at the C.C.I.F. Laboratory.

In Table IV have been recorded the values of α for a sound articulation of 80%. Comparison with the reference system (A.R.A.E.N.) gives the required A.E.N. values.



System 1 = R/R

System 2 = CH/R

System 3 = R/CH

System 4 = CH/CH

FIGURES 26 TO 29. — *Curves of the variation of sound articulation of the four different systems as a function of the line attenuation*

6. *Comparison of the objective calculations and the subjective measurement of A.E.N.*

As the A.E.N. has been introduced as a new criterion for the judgement of the quality of a telephone system the comparison between the calculated and the subjective determination presents a great interest. To this end measurements have been made, according to the method described above, on the subscriber's telephone systems belonging to other administrations on which the C.C.I.F. Laboratory has already made articulation measurements during the 8th and 9th Series, and the articulation has been calculated. Except for the talking level which was 2 db lower, all the conditions were the same for the example described above. Table V gives a summary of the results. The different subscriber's system are numbered from I to V.

The column of Δα shows that during the determination of the A.E.N.s at the C.C.I.F. Laboratory the attenuation was on the average 7.7 db greater. As the hearing loss and training factor of the testing crew are unknown, little can be said about this difference.

TABLE V

Sending system	Receiving system	F	H	α_o	α for 80%			$\Delta\alpha$	A.E.N.		Δ A.E.N.
					Calculated	Measured at the C.C.I.F. Laboratory			Calculated	Measured at the C.C.I.F. Laboratory	
						8th Series	9th Series				
				db	db	db	db		db	db	db
R	R	0.825	1.0	− 65.5	− 38.0	−46.1	− 48.0	− 9.1	0	0	0
I	R	0.800	0.865	− 49.0	− 17.0		− 21.5	− 4.5	21.0	26.5	5.5
R	I	0.777	1.0	− 69.9	− 35.6		− 41.7	− 6.1	2.4	6.3	3.9
I	I	0.779	0.865	− 44.4	− 8.6	−61.7		− 8.1	29.4	29.4	0
II	R	0.814	0.946	− 54.5	− 26.0		− 36.3	− 10.3	12.0	11.7	− 0.3
R	II	0.785	1.0	− 63.6	− 30.6		− 35.2	− 4.6	7.4	12.8	5.4
II	II	0.767	0.946	− 50.1	− 16.2	−19.0		− 2.8	21.8	27.1	5.3
III	R	0.788	0.955	− 54.3	− 22.6		− 32.6	− 10.0	15.4	15.4	0
R	III	0.746	1.0	− 62.8	− 24.0		− 32.1	− 8.1	14.0	15.9	1.9
III	III	0.734	0.955	− 41.6	− 2.9	−16.6		− 13.7	35.1	29.5	− 5.6
IV	R	0.797	0.820	− 45.5	− 13.7		− 21.5	− 7.8	24.3	26.5	2.2
R	IV	0.759	1.0	− 62.3	− 28.7		− 36.3	− 7.6	9.3	11.7	2.4
IV	IV	0.746	0.820	− 40.2	− 1.5	− 7.4		− 5.9	36.5	38.7	2.2
V	R	0.804	0.820	− 56.3	− 23.5		− 31.1	− 7.6	14.5	16.9	2.4
R	V	0.752	1.0	− 71.2	− 32.8		− 39.9	− 7.1	5.2	8.1	2.9
V	V	0.775	0.820	− 52.8	− 14.3	−24.8		− 10.5	23.7	21.3	− 2.4
								− 7.7			

It is to be supposed, however, that the Esperanto consonants used for the tests were more readily understood than the English consonants on which the articulation calculations are based.

The column of Δ A.E.N. allows the establishment of the following averages :

Combination		Average discrepancy
Sending	Receiving	
X	R	2.0
R	X	3.3
X	X	− 0.2
R = Reference system X = Commercial system.		

As the experiments have shown, the method of measurement and calculation described gives the possibility of determining the A.E.N. of an unknown system from its physical characteristics. The discrepancies with respect to the direct subjective measurement are due to the difficulty of understanding the real circumstances under which the articulation measurements are made and of taking them into account in the calculations. Even if the absolute values are associated with certain discrepancies it is possible, however to determine for a given system, the influence of the various components forming the transmission path this being of great importance for the design of telephone networks.

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ANNEX 4

(to Question No. 7)

Determination of thresholds of hearing for sinusoidal waves in steady state with the different commercial telephone systems used in the 8th, 9th, 10th and 11th series of tests of the C.C.I.F. Laboratory

The thresholds of hearing have been measured of each of the members of the crew who took part in the above named series of tests. Schematic diagrams of the circuits used for the measurements are given by figures 1 and 2 below.

The determination of the threshold of hearing was made both in room noise of Hoth type at 50 db (or 60 db) with feed current supplied and not supplied to the commercial telephone, and also, in the absence of room noise, with and without feed current.

I. *Test Frequencies.*

The following frequencies were used in the measurements : 300, 600, 900, 1200, 1700, 2400, 3200 c/s.

II. *Method of measuring the threshold of hearing.*

The method of measuring the threshold of hearing with the receiver held to the ear is as follows :—

The variable frequency oscillator is connected to the receiving system (see Figures 1 and 2) through an attenuator adjustable in steps of 1 decibel over a range of 100 decibels. For each test frequency the output voltage of the oscillator is first adjusted so as to apply at the input of a specimen of the commercial receiving system, or of the receiving system of the A.R.A.E.N. (or of the S.F.E.R.T.) (point A in Figures 1 and 2 above) a generator of internal impedance 600 ohms and of 1 volt e.m.f. when the adjustable attenuator is at zero on its scale. Then this attenuator is set to 100 decibels, and, for the corresponding value of the voltage at the input of the measuring circuit (point A) the sound intensity is always inaudible by the operator being tested.

The operator listens on the receiver of the telephone system under test, this receiver being held to the left ear in the normal position for listening, the right ear being completely free and the receiving system being in the conditions of the test (with or without room noise or feeding current). First the operator hears the test frequency so that he can identify its sound. The adjustable attenuation, initially set to 100 db is progressively reduced (by about 2 db per second) ; the setting n, db on the attenuator when the operator begins to hear the sound is noted. This value marks the " ascending threshold " of this operator ; the attenuator is then progressively decreased by about 30 db from the value n_1 and, without pause, the attenuation is increased and the value n_2 is noted (the setting on the attenuator) when the operator signals that he ceases to hear the sound ; this value n_2 marks the " descending

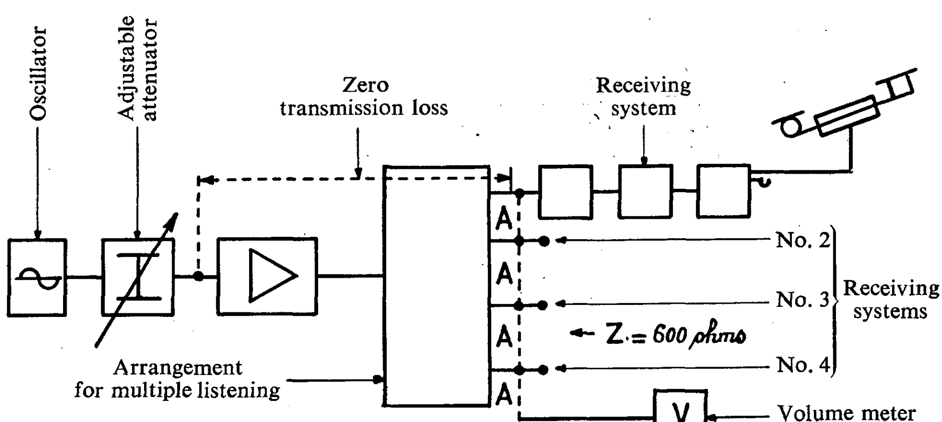

FIGURE 1

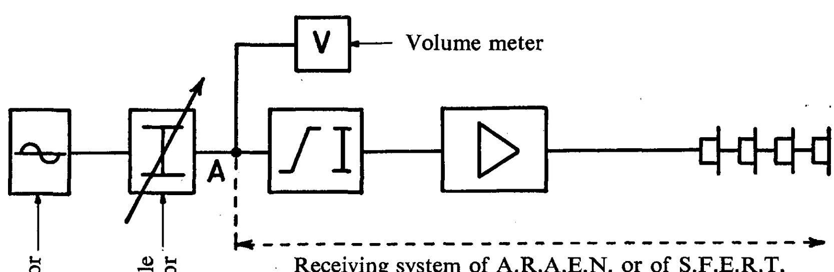

FIGURE 2

threshold ". The attenuator is then set to the 100 decibel position. This test is repeated several times to obtain accurate values of n_1 and n_2 (on average four tests for each operator and for each system). At the beginning of each test a flashing signal indicates to the operator that the test is about to start ; in order to avoid errors in the signals made by the operator, the time interval separating the beginning of the test (appearance of the flashing signal) and the moment when the operator should hear the sound is different in all tests.

III. *Tests carried out.*

Thresholds of hearing have been measured in the following four conditions :—

(a) In room noise, with feeding current.

(b) In room noise, without feeding current.

(c) No room noise, with feeding current.

(d) No room noise, without feeding current.

For the determination of the threshold of hearing with the receiving system of the A.R.A.E.N. (or of the S.F.E.R.T.) the two test conditions were as follows :—

(a) In room noise.

(b) No room noise.

IV. *Presentation of results.*

The average values of the " ascending thresholds " and of the " descending thresholds " for the whole testing crew of the C.C.I.F. laboratory are described, for each frequency, by the e.m.f. of a generator of 600 ohms internal impedance at the input either of a commercial telephone receiving system or of the receiving system of the A.R.A.E.N. (point A in Figures 1 and 2). This e.m.f. is expressed in decibels below 1 volt.

Notes :—

1. The experimental technique described above has always been used ; however for the first tests the average values of thresholds of hearing were referred to a *p.d.* of 1 volt applied at the input of the telephone system. At the request of the Sub-Committee for specification of quality of transmission, the tests were, thereafter, carried out referring values of the thresholds of hearing to an *e.m.f.* of 1 volt supplied by a generator of 600 ohms internal impedance applied to the input of the telephone system.

2. The C.C.I.F. Laboratory has determined for each test frequency, the correction to be applied to the value of the threshold of hearing referred to a p.d. of 1 volt, in order to obtain a value of the threshold of hearing referred to an e.m.f. of 1 volt ; these corrections are given in Table No. 1 below.

V. *Summary of all results of measurements of Thresholds of hearing mentioned in different C.C.I.F. Laboratory technical reports, account being taken of the corrections stated in § IV.*

Tables 2 to 23 summarize all the test results of thresholds of hearing obtained with the different crews of the C.C.I.F. Laboratory which took part in the tests ; these thresholds of hearing were determined with different commercial telephone systems. The values not in brackets in the tables were obtained at constant e.m.f. (or are referred to a constant e.m.f. by corrections of Table 1) ; they are expressed in decibels below an e.m.f. of 1 volt. The values in brackets correspond to values of threshold which were measured or which would have been measured working at a constant p.d. at the input to the receiving system ; they are expressed in decibels below a p.d. of 1 volt.

TABLE No. 1

Telephone systems		Test Frequency (c/s) 300	600	900	1200	1700	2400	3200	Corrections to apply to the results of tests mentioned in :
		db	db	db	db	db	db	db	
8th and 9th Series of tests	Chile	−4.7	−3.5	−3.4	−3.8	−4.8	−6.5	−8.3	C.C.I.F. Laboratory Technical Report No. 202
	France	−5.3	−4.8	−4.2	−3.6	−3.4	−4.0	−5.3	C.C.I.F. Laboratory Technical Report No. 202
	Great Britain	−5.2	−4.7	−3.9	−3.8	−3.6	−4·8	−6.0	C.C.I.F. Laboratory Technical Report No. 202
	Norway	−3.8	−3.1	−3.3	−3.7	−4.5	−5.5	−6.6	C.C.I.F. Laboratory Technical Report No. 202
	Sweden	−3.1	−4.2	−4.3	−4.4	−4.7	−5.5	−6.5	C.C.I.F. Laboratory Technical Report No. 202 and the Document " C.C.I.F. — 1952/1954 — 4th S.G., Document No. 25 ".
10th Series of tests	Germany	−5.6	−4.3	−3.5	−3.2	−3.8	−4.8	−6.0	C.C.I.F. Laboratory Technical Report No. 215 and Document " C.C.I.F. — 1952/1954 — 4th S.G. — Document No. 7 ".
	Belgium	−5.3	−3.8	−3.9	−3.2	−3·0	−3.8	−4.9	C.C.I.F. Laboratory Technical Report No. 215 and Document " C.C.I.F. — 1952/1954 — 4th S.G. — Document No. 7 ".
	Italy	−5.3	−3.6	−3.1	−3.0	−3.1	−4.0	−5.3	C.C.I.F. Laboratory Technical Report No. 215 and Document " C.C.I.F. — 1952/1954 — 4th S.G. — Document No. 7 ".
	Mexico	−2.8	−3.6	−3.4	−3.6	−3.7	−4.4	−5.7	C.C.I.F. Laboratory Technical Report No. 215 and Document " C.C.I.F. — 1952/1954 — 4th S.G. — Document No. 7 ".
	Czechoslovakia	−5.2	−6.2	−5.8	−5.2	−4.3	−3.7	−3.8	C.C.I.F. Laboratory Technical Report No. 215 and Document " C.C.I.F. — 1952/1954 — 4th S.G. — Document No. 7 ".
	Japan	−5.5	−4.0	−3.5	−3.7	−4.6	−6.0	−7.7	C.C.I.F. Laboratory Technical Report No. 215, and Document " C.C.I.F. 1952/1954 — 4th S.G. — Document No. 25 *bis* ".
	Holland	−3.7	−3.5	−3.2	−2.9	−2.8	−3.0	−3.6	C.C.I.F. Laboratory Technical Report No. 215, and Document " C.C.I.F. 1952/1954 — 4th S.G. — Document No. 25 *bis* ".
	Switzerland	−3.9	−4.1	−4.2	−4.2	−4.2	−4.3	−4.6	C.C.I.F. Laboratory Technical Report No. 215, and Document " C.C.I.F. 1952/1954 — 4th S.G. — Document No. 25 *bis* ".
A.R.A.E.N. and S.F.E.R.T.		−6.0	−6.0	−6.0	−6.0	−6.0	−6.0	−6.0	

TABLE No. 2

(see Technical Report No. 215 — Table No. 2)

Commercial telephone receiving system of Belgium

Value of the e.m.f. (expressed in db below 1 volt) applied at the input of the receiving system corresponding to the average threshold of hearing of the testing crew of the C.C.I.F. Laboratory (10th series of tests)

c/s	In room noise of 60 db				In absence of room noise			
	with feed current		without feed current		with feed current		without feed current	
	Value of e.m.f. at threshold				Value of e.m.f. at threshold			
	Ascending	Descending	Ascending	Descending	Ascending	Descending	Ascending	Descending
300	50.9 (56.2)	50.8 (56.1)	58.9 (61.3)	58.8 (61.2)	68.3 (73.6)	68.3 (73.6)	75.3 (77.7)	75.3 (77.7)
600	69.5 (73.3)	68.0 (71.8)	80.3 (82.8)	78.3 (80.8)	87.1 (90.9)	86.5 (90.3)	92.9 (95.4)	92.2 (94.7)
900	70.8 (74.7)	67.6 (71.5)	83.4 (86.2)	81.4 (84.2)	92.6 (96.5)	91.3 (95.2)	98.1 (100.9)	97.2 (100.0)
1200	69.0 (72.2)	67.2 (70.4)	79.1 (81.4)	76.5 (78.8)	89.0 (92.2)	86.2 (89.4)	93.3 (95.6)	90.7 (93.0)
1700	63.7 (66.7)	60.0 (63.0)	71.4 (74.0)	67.5 (70.1)	76.9 (79.9)	73.1 (76.1)	78.5 (81.1)	74.6 (77.2)
2400	54.6 (58.4)	51.7 (55.5)	62.8 (66.3)	58.0 (61.5)	68.7 (72.5)	65.3 (69.1)	69.4 (72.9)	66.0 (69.5)
3200	56.5 (61.4)	53.2 (58.1)	61.6 (66.5)	59.5 (64.4)	69.3 (74.2)	66.1 (71.0)	70.6 (75.5)	67.0 (71.9)

TABLE NO. 3

(see Technical Report No. 202 — Table No. 1)

Commercial telephone receiving system of Chile

Value of the e.m.f. (expressed in db below 1 volt) applied at the input of the receiving system corresponding to the average threshold of hearing of the testing crew of the C.C.I.F. Laboratory (8th and 9th series of tests)

c/s	In room noise of 60 db				In absence of room noise			
	with feed current		without feed current		with feed current		without feed current	
	Value of e.m.f. at threshold				Value of e.m.f. at threshold			
	Ascending	Descending	Ascending	Descending	Ascending	Descending	Ascending	Descending
300	62.0 (66.7)	61.4 (66,1)	65.0 (68.7)	63.7 (67.4)	75.7 (80.4)	75.0 (79.7)	79.3 (83.0)	77.9 (81.6)
600	76.5 (80.0)	72.9 (76.4)	79.6 (82.6)	75.5 (78.5)	89.4 (92.9)	85.6 (89.1)	92.4 (95.4)	88.4 (91.4)
900	78.5 (81.9)	76.9 (80.3)	83.6 (86.5)	81.6 (84.5)	90.3 (93.7)	87.6 (91.0)	92.8 (95.7)	91.3 (94.2)
1200	79.1 (82,9)	76.3 (80.1)	84.2 (87.5)	80.4 (83.7)	88.7 (92.5)	86.9 (90.7)	92.4 (95.7)	90.0 (93.3)
1700	72.9 (77.7)	70.2 (75.0)	82.1 (86.9)	78.0 (82.8)	85.8 (90.6)	81.5 (86.3)	88.3 (93.1)	85.2 (90.0)
2400	68.1 (74.6)	64.2 (70.7)	76.4 (83.0)	70.6 (77.2)	79.6 (86.1)	74.7 (81.2)	81.8 (88.4)	77.2 (83.8)
3200	63.2 (71.5)	58.8 (67.1)	66.9 (75.0)	62.5 (70.6)	72.2 (80.5)	67.5 (75.8)	72.5 (80.6)	67.7 (75.8)

Table No. 4

(see Technical Report No. 202 — Table No. 2)

Commercial telephone receiving system of France

Value of the e.m.f. (expressed in db below 1 volt) applied at the input of the receiving system corresponding to the average threshold of hearing of the testing crew of the C.C.I.F. Laboratory (8th and 9th series of tests)

c/s	In room noise of 60 db				In absence of room noise			
	with feed current		without feed current		with feed current		without feed current	
	Value of e.m.f. at threshold				Value of e.m.f. at threshold			
	Ascending	Descending	Ascending	Descending	Ascending	Descending	Ascending	Descending
300	53.6 (58.9)	53.2 (58.5)	58.9 (63.7)	58.6 (63.4)	72.0 (77.3)	70.4 (75.7)	74.4 (79.2)	73.3 (78.1)
600	63.7 (68.5)	62.2 (67.0)	73.4 (77.6)	71.8 (76.0)	81.3 (86.1)	80.0 (84.8)	85.9 (90.1)	83.6 (87.8)
900	65.9 (70.1)	65.2 (69.4)	82.4 (85.9)	80.8 (84.3)	84.8 (89.0)	84.4 (88.6)	90.8 (94.3)	89.7 (93.2)
1200	67.9 (71.5)	66.7 (70.3)	82.3 (85.6)	80.1 (83.4)	84.9 (88.5)	82.9 (86.5)	92.4 (95,7)	89.7 (93.0)
1700	62.3 (65.7)	59.7 (63.1)	76.4 (79.6)	72.8 (76.0)	80.6 (84.0)	77.5 (80.9)	84.2 (87.4)	80.4 (83.6)
2400	54.7 (58.7)	53.0 (57.0)	66.7 (70.7)	63.5 (67.5)	72.3 (76.3)	69.1 (73.1)	73.2 (77.2)	70.1 (74.1)
3200	59.2 (64.5)	55.9 (61.2)	6.92 (74.8)	63.9 (69.5)	75.2 (80.6)	70.6 (75.9)	77.4 (83.0)	72.5 (78.1)

TABLE NO. 5

(see Technical Report No. 202 — Table No. 3)

Commercial telephone receiving system of Great Britain

Value of the e.m.f. (expressed in db below 1 volt) applied at the input of the receiving system corresponding to the average threshold of hearing of the testing crew of the C.C.I.F. Laboratory (8th and 9th series of tests)

c/s	In room noise of 60 db				In absence of room noise			
	with feed current		without feed current		with feed current		without feed current	
	Value of e.m.f. at threshold				Value of e.m.f. at threshold			
	Ascending	Descending	Ascending	Descending	Ascending	Descending	Ascending	Descending
300	49.0 (54.2)	46.2 (51.4)	49.8 (55.0)	46.7 (51.9)	64.5 (69.7)	60.8 (66.0)	65.2 (70.4)	62.1 (67.3)
600	63.3 (68.0)	61.5 (66.2)	67.1 (71.6)	64.9 (69.4)	79.6 (84.3)	76.2 (80.9)	81.6 (86.1)	77.5 (82.0)
900	68.2 (72.1)	65.9 (69.8)	78.8 (82.3)	75.3 (78.8)	86.5 (90.4)	82.2 (86.1)	88.7 (92.2)	85.5 (89.0)
1200	67.2 (71.0)	64.2 (68,0)	80.1 (83.6)	77.1 (80.6)	87.0 (90.8)	83.8 (87.6)	90.6 (94.1)	88.3 (91.8)
1700	58.9 (62.5)	56.5 (60.1)	69.3 (72.9)	66.2 (69.8)	76.2 (79.8)	72.6 (76.2)	76.9 (80.5)	73.9 (77.5)
2400	55.0 (59.7)	51.4 (56.1)	61.8 (66.5)	57.0 (61.7)	66.8 (71.5)	62.3 (67.0)	67.6 (72.3)	62.0 (66.7)
3200	55.2 (61.2)	50.3 (56.3)	58.0 (64.2)	52.5 (58.7)	64.8 (70.8)	59.8 (65.8)	64.1 (70.3)	58.9 (65.1)

TABLE No. 6

(see Technical Report No. 215 — Table No. 3)

Commercial telephone receiving system of Great Britain

(System tested in the 8th and 9th series of tests)

Value of the e.m.f. (expressed in db below 1 volt) applied at the input of the receiving system corresponding to the average threshold of hearing of the testing crew of the C.C.I.F. Laboratory (8th and 9th series of tests)

c/s	In room noise of 60 db				In absence of room noise			
	with feed current		without feed current		with feed current		without feed current	
	Value of e.m.f. at threshold				Value of e.m.f. at threshold			
	Ascending	Descending	Ascending	Descending	Ascending	Descending	Ascending	Descending
300	51.8 (57.0)	50.7 (55.9)	53.9 (59.1)	52.6 (57.8)	71.0 (76.2)	68.1 (73.3)	72.5 (77.7)	70.6 (75.8)
600	65.2 (69.9)	63.6 (68.3)	69.2 (73.7)	66.2 (70.7)	84.3 (89.0)	82.3 (87.0)	87.9 (91.4)	85.7 (90.2)
900	71.6 (75.5)	68.5 (72.4)	81.1 (84.6)	76.9 (80.4)	91.4 (95.3)	87.9 (91.8)	93.2 (96.7)	91.9 (95.4)
1200	69.1 (72.9)	66.6 (70.4)	84.2 (87.7)	81.7 (85.2)	91·2 (95.0)	89.5 (93.3)	95.8 (99.3)	94.2 (97.7)
1700	60.9 (64.5)	57.4 (610.)	57.1 (75.1)	66·7 (70.3)	79.0 (82·6)	74.7 (78.3)	81.4 (85.0)	76.8 (80.4)
2400	55.6 (60.3)	51.8 (56.5)	63.0 (67.7)	58.8 (63.5)	37.1 (76.0)	66.5 (71.2)	72.6 (77.3)	66.8 (71.5)
3200	56.4 (62.4)	51.6 (57.6)	61.0 (67.2)	55.6 (61.8)	26.9 (75.2)	64.1 (70.1)	70.3 (76.5)	65.4 (71.6)

TABLE No. 7

(see Technical Report No. 215 — Table No. 4)

Commercial telephone receiving system of Italy

Value of the e.m.f. (expressed in db below 1 volt) applied at the input of the receiving system corresponding to the average threshold of hearing of the testing crew of the C.C.I.F. Laboratory (10th series of tests)

c/s	In room noise of 60 db				In absence of room noise			
	with feed current		without feed current		with feed current		without feed current	
	Value of e.m.f. at threshold				Value of e.m.f. at threshold			
	Ascending	Descending	Ascending	Descending	Ascending	Descending	Ascending	Descending
300	58.7 (64,0)	57.0 (62.3)	65.3 (69.6)	62.4 (66.7)	76.4 (81.7)	74.4 (79.7)	80.9 (85.2)	78.8 (83.1)
600	71.2 (74.8)	68.4 (72.0)	82.7 (85.7)	80.0 (83.0)	85.8 (89.4)	84.1 (87.7)	97.2 (100.2)	95.4 (98.4)
900	79.5 (82.6)	77.8 (80.9)	90.1 (92.4)	87.9 (90.2)	94.7 (97.8)	93.5 (96.6)	103.9 (106.2)	102.7 (105.0)
1200	78.2 (81.2)	76.4 (79.4)	87.9 (90.2)	85.7 (88.0)	94.1 (97.1)	92.5 (95.5)	102.8 (105.1)	100.8 (103.1)
1700	67.0 (70.1)	60.9 (64.0)	81.8 (84.5)	77.0 (79.7)	86.1 (89.2)	80.5 (83.6)	89.5 (92.2)	84.3 (87.0)
2400	61.2 (65.2)	56.3 (60.3)	72.6 (76.6)	66.4 (70.4)	76.2 (80.2)	71.9 (75.9)	78.6 (82.6)	73.8 (77.8)
3200	59.3 (64.6)	55.3 (60.6)	68.5 (74.1)	63.3 (68.9)	75.6 (80.9)	70.0 (75.3)	77.0 (82.6)	72.3 (77.9)

TABLE NO. 8

(see Technical Report No. 215 — Table No. 5)

Commercial telephone receiving system of Japan

Value of the e.m.f. (expressed in db below 1 volt) applied at the input of the receiving system corresponding to the average threshold of hearing of the testing crew of the C.C.I.F. Laboratory (10th series of tests)

c/s	In room noise of 60 db				In absence of room noise			
	with feed current		without feed current		with feed current		without feed current	
	Value of e.m.f. at threshold				Value of e.m.f. at threshold			
	Ascending	Descending	Ascending	Descending	Ascending	Descending	Ascending	Descending
300	60.7 (66.2)	59.1 (64.6)	65.4 (71.2)	62.6 (68.4)	81.0 (86.5)	79.9 (85,4)	81.4 (87.2)	78.9 (84.7)
600	75.7 (79.7)	72.3 (76.3)	81.1 (85.1)	76.2 (80.2)	93.0 (97.0)	91.0 (95.0)	95.5 (99.5)	93.3 (97.3)
900	79.2 (82.7)	74.9 (78.4)	87.6 (90.8)	84.1 (87.3)	97.4 (100.9)	95.6 (99.1)	102.2 (105.4)	98.3 (101.5)
1200	78.9 (82.6)	75.3 (79.0)	88.2 (91.4)	84.0 (87.2)	96.3 (100.1)	91.2 (94.9)	98.8 (102.0)	94.3 (97.5)
1700	68,8 (73.4)	63.8 (68.4)	77.9 (82.1)	73.5 (77.7)	84.4 (88.9)	80.9 (85.5)	85.8 (90.0)	82.4 (86.6)
2400	69.2 (75.2)	63·3 (69.3)	73.6 (79.7)	67.1 (73.2)	81.9 (87.9)	75.2 (81.2)	82,0 (88.1)	76.2 (82.3)
3200	69.0 (76.7)	64.0 (71.7)	72.9 (81.0)	67.2 (75.3)	79.2 (86.9)	74.1 (81.8)	81.5 (89.6)	74.9 (83.0)

TABLE No. 9

(see Technical Report No. 202 — Table No. 4)

Commercial telephone receiving system of Norway

Value of the e.m.f. (expressed in db below 1 volt) applied at the input of the receiving system corresponding to the average threshold of hearing of the testing crew of the C.C.I.F. Llaboratory (8th and 9th series of tests)

c/s	In room noise of 60 db				In absence of room noise			
	with feed current		without feed current		with feed current		without feed current	
	Value of e.m.f. at threshold				Value of e.m.f. at threshold			
	Ascending	Descending	Ascending	Descending	Ascending	Descending	Ascending	Descending
300	50.1 (53.9)	50.1 (53.9)	54.3 (57.5)	54.7 (57.9)	69.0 (72.8)	68.1 (71.9)	72.1 (75.3)	70.9 (74.1)
600	64.8 (67.9)	63.3 (66.4)	67.7 (70.7)	65.5 (68.5)	82.1 (85.2)	80.6 (83.7)	84.3 (87.3)	82.9 (85.9)
900	74.5 (77.8)	72.8 (76.1)	79.0 (82.0)	76.5 (79.5)	88.5 (91.8)	85.7 (89.0)	90.9 (93.9)	88.2 (91.2)
1200	75.5 (79.2)	74.2 (77.9)	83.0 (86.5)	81.4 (84.9)	90.9 (94.6)	89.1 (92.8)	93.8 (97.3)	92.6 (96.1)
1700	67.3 (71.8)	63.5 (68.0)	73.7 (78.2)	69.8 (74.3)	80.1 (84.6)	76.1 (80.6)	82.0 (86.5)	77.4 (81.9)
2400	58.0 (63.5)	55.4 (60.9)	63.4 (69.0)	59.1 (64.7)	69.6 (75.1)	65.6 (71.1)	70.9 (76.5)	66.7 (72.3)
3200	55.4 (62.0)	50.5 (57.1)	57.0 (63.7)	52.2 (58.9)	62.8 (69.4)	58.1 (64.7)	63.2 (69.9)	58.5 (65.2)

TABLE NO. 10

(see Technical Report No. 215 — Table No. 6)

Commercial telephone receiving system of Holland

Value of the e.m.f. (expressed in db below 1 volt) applied at the input of the receiving system corresponding to the average threshold of hearing of the testing crew of the C.C.I.F. Laboratory (10th series of tests)

c/s	In absence of room noise				In room noise of 60 db			
	with feed current		without feed current		with feed current		without feed current	
	Value of e.m.f. at threshold				Value of e.m.f. at threshold			
	Ascending	Descending	Ascending	Descending	Ascending	Descending	Ascending	Descending
300	53.8 (57.5)	51.0 (54.7)	55.6 (58.6)	52.8 (55.8)	70.8 (74.5)	67.6 (71.3)	72.3 (75.3)	69.7 (72.7)
600	67.8 (71.3)	63.8 (67.3)	71.4 (74.2)	66.6 (69.4)	80.9 (84.4)	77.0 (80.5)	85.2 (88.0)	80.5 (83.3)
900	72.7 (75.9)	65.4 (68.6)	78.4 (80.7)	71.4 (73.7)	82.5 (85.7)	75.9 (79.1)	87.1 (89.4)	80.3 (82.6)
1200	78.0 (80.9)	70.4 (73.3)	84.8 (86.9)	77.0 (79.1)	87.4 (90.3)	80.1 (83.0)	90.9 (93.0)	83.4 (85.5)
1700	72.6 (75.4)	66.5 (69.3)	81.9 (84.0)	74.9 (77.0)	84.0 (86.8)	78.2 (81.0)	86.9 (89.0)	80.7 (82.8)
2400	69.4 (72.4)	63.8 (66.8)	74.9 (77.7)	68.0 (70.8)	75.9 (78.9)	71.4 (74.4)	79.1 (81.9)	73.0 (75.8)
3200	67.7 (71.3)	59.5 (63.1)	69.3 (73.1)	61.0 (64.8)	72.2 (75.8)	65.6 (69.2)	72.3 (76.1)	65.0 (68.8)

Table No. 11

(see Table No. 1 of the document " C.C.I.F. — 1952/1954 — 4th S.G. — Document No. 25 *bis* ")

Commercial telephone receiving system of Holland

Value of the e.m.f. (expressed in db below 1 volt) applied at the input of the receiving system corresponding to the average threshold of hearing of the testing crew of the C.C.I.F. Laboratory (11th series of tests)

c/s	In absence of room noise				In absence of room noise			
	with feed current		without feed current		with feed current		without feed current	
	Value of e.m.f. at threshold				Value of e.m.f. at threshold			
	Ascending	Descending	Ascending	Descending	Ascending	Descending	Ascending	Descending
300	62.1 (65.8)	61.9 (65.6)	64.5 (67.5)	64.3 (67.3)	69.9 (73.6)	70.5 (74.2)	71.7 (74.7)	72.0 (75.0)
600	71.5 (75.0)	70.6 (74.1)	75.7 (78.5)	74.6 (77.4)	80.6 (84.1)	79.9 (83.4)	82.1 (84.9)	81.1 (83.9)
900	80.0 (83.2)	78.7 (81.9)	82.2 (84.5)	81.2 (83.5)	85.7 (89·9)	85.1 (88.3)	89.3 (91.6)	88.4 (90.7)
1200	81.5 (84.4)	80.1 (83.0)	85.4 (87.5)	84.3 (86.4)	87.8 (90.7)	87.0 (89.9)	90.5 (92.6)	89.4 (91.5)
1700	78.7 (81.5)	77.7 (80.5)	83.0 (85.1)	81.8 (83.9)	84.8 (87.6)	83.7 (86.5)	86.9 (89.0)	85.6 (87.7)
2400	69.3 (72.3)	67.3 (70.3)	71.9 (74.7)	69.3 (72.1)	73.8 (76.8)	71.8 (74.8)	76.0 (78.8)	74.1 (76.9)
3200	67.2 (70.8)	63.4 (67.0)	68.9 (72.7)	65.7 (69.5)	69.8 (73.4)	67.3 (70.9)	72.6 (76.4)	69.1 (72.9)

Table No. 12

(see Technical Report No. 215 — Table No. 1)

Commercial telephone receiving system of the Federal German Republic

Value of the e.m.f. (expressed in db below 1 volt) applied at the input of the receiving system corresponding to the average threshold of hearing of the testing crew of the C.C.I.F. Laboratory (10th series of tests)

c/s	In room noise of 60 db				In room noise of 60 db			
	with feed current		without feed current		with feed current		without feed current	
	Value of e.m.f. at threshold				Value of e.m.f. at threshold			
	Ascending	Descending	Ascending	Descending	Ascending	Descending	Ascending	Descending
300	57.8 (63.4)	56.5 (62.1)	62.3 (67.4)	60.6 (65.7)	79.3 (84.9)	78.3 (83.9)	80.1 (85.2)	78.2 (83.3)
600	67.7 (72.0)	55.7 (70.0)	72.6 (76.6)	70.3 (74.3)	90.3 (94.6)	87.4 (91.7)	91.6 (95.6)	89.1 (93.1)
900	75.1 (78.6)	72.2 (75.7)	85.9 (89.1)	82.9 (86.1)	99.2 (102.7)	95.2 (98.7)	98.3 (101.5)	95.6 (98.8)
1200	70.1 (73.3)	68.2 (71.4)	88.0 (91.1)	85.1 (88.2)	100.1 (103.3)	97·2 (100.4)	99.6 (102.7)	96.9 (100.0)
1700	74.2 (78.0)	71.2 (75.0)	85.1 (88.8)	82.4 (86.1)	92.6 (96.4)	89.5 (93.3)	93.6 (97.3)	89.8 (93.5)
2400	74.3 (79.1)	69.5 (74.3)	84.0 (89.0)	78.0 (83.0)	89.0 (93.8)	83.8 (88.6)	90.6 (95.6)	85.4 (90.4)
3200	76.0 (82.0)	71.3 (77.3)	81.0 (87.2)	75.9 (82.1)	87.8 (93.8)	82.8 (88.8)	90.3 (96.5)	83.9 (90.1)

TABLE NO. 13

(see Technical Report No. 215 — Table No. 7)

Commercial telephone receiving system of the Mexican Telephone Company

Value of the e.m.f. (expressed in db below 1 volt) applied at the input of the receiving system corresponding to the average threshold of hearing of the testing crew of the C.C.I.F. Laboratory (10th series of tests)

c/s	In room noise of 60 db				In absence of room noise			
	with feed current		without feed current		with feed current		without feed current	
	Value of e.m.f. at threshold				Value of e.m.f. at threshold			
	Ascending	Descending	Ascending	Descending	Ascending	Descending	Ascending	Descending
300	57.0 (59.8)	55.8 (58.6)	60.4 (62.8)	58.6 (61.0)	74.3 (77.1)	73.0 (75.8)	76.5 (78.9)	75.4 (77.8)
600	71.6 (75.2)	69.0 (72.6)	75.0 (78.3)	71.9 (75.2)	88.7 (92.3)	86.1 (89.7)	91.5 (94.8)	89.8 (93.1)
900	79.4 (82.8)	76.8 (80.2)	85.5 (88.7)	82.8 (86.0)	97.5 (100.9)	95.3 (98.7)	100.6 (103.8)	98.6 (101.8)
1200	76.9 (80.5)	73.4 (77.0)	88.5 (92.0)	85.3 (88.8)	96.6 (100.2)	92.7 (96.3)	100.5 (104.0)	97.4 (100.9)
1700	62.5 (66.2)	58.7 (62.4)	78.8 (82.4)	73.4 (77.0)	84.2 (87.9)	79.9 (83.6)	86.6 (90.2)	81.9 (85.5)
2400	65.3 (69.7)	60.3 (64.7)	75.0 (79.5)	68.9 (73.4)	79.4 (83.8)	73.3 (77.7)	80.3 (84.8)	75.4 (79.9)
3200	62.6 (68.3)	57.5 (63.2)	69.5 (75.3)	62.8 (68.6)	73.6 (79.3)	67.7 (73.4)	76.2 (82.0)	71.5 (77.3)

TABLE NO. 14

(see Technical Report No. 202 — Table No. 5)

Commercial telephone receiving system of Sweden

Value of the e.m.f. (expressed in db below 1 volt) applied at the input of the receiving system corresponding to the average threshold of hearing of the testing crew of the C.C.I.F. Laboratory (8th and 9th series of tests)

c/s	In room noise of 60 db				In absence of room noise			
	with feed current		without feed current		with feed current		without feed current	
	Value of e.m.f. at threshold				Value of e.m.f. at threshold			
	Ascending	Descending	Ascending	Descending	Ascending	Descending	Ascending	Descending
300	51.2 (54.3)	49.1 (52.2)	54.5 (56.8)	51.9 (54.2)	66.5 (69.6)	62.9 (66.0)	68.9 (71.2)	65.8 (68.1)
600	72.3 (76.5)	67.2 (71.4)	75.3 (78.4)	70.0 (73.1)	83.7 (87.9)	78.8 (83.0)	86.1 (89.2)	80.7 (83.8)
900	78.9 (83.2)	73.6 (77.9)	83.2 (86.5)	78.2 (81.5)	89.2 (93.5)	83.8 (88.1)	90.4 (93.7)	86.4 (89.7)
1200	77.8 (82.2)	72.0 (76.4)	82.5 (86.2)	76.7 (80.4)	85.7 (90.1)	80.5 (84.9)	91.0 (94.7)	84.6 (88.3)
1700	65.7 (70.4)	61.5 (66.2)	71.7 (75.9)	67.1 (71.3)	76.4 (81.1)	71.3 (76.0)	78.7 (82.9)	73.8 (78.0)
2400	63.0 (68.5)	57.2 (62.7)	63.7 (69.2)	59.2 (64.7)	70.3 (75.8)	64.1 (69.6)	70.3 (75.8)	63.7 (69.2)
3200	64.1 (70.6)	56.8 (63.3)	66.0 (72.8)	58.2 (65.0)	69.4 (75.9)	62.5 (69.0)	71.1 (77.9)	63.8 (70.6)

TABLE No. 15

(see Table No. 1 — Document " C.C.I.F. — 1952/1954 — 4th S.G. — Document No. 25 ")

Commercial telephone receiving system of Sweden

(System listed in the 8th and 9th series of tests)

Value of the e.m.f. (expressed in db below 1 volt) applied at the input of the receiving system corresponding to the average threshold of hearing of the testing crew of the C.C.I.F. Laboratory (11th series of tests)

c/s	In room noise of 60 db				In absence of room noise			
	with feed current		without feed current		with feed current		without feed current	
	Value of e.m.f. at threshold				Value of e.m.f. at threshold			
	Ascending	Descending	Ascending	Descending	Ascending	Descending	Ascending	Descending
300	61.3 (64.4)	61.8 (64.9)	62.3 (64.6)	62.3 (64.6)	73.0 (76.1)	73.2 (76.3)	74.7 (77.0)	74.6 (76.9)
600	76.6 (80.8)	74.8 (79.0)	79.5 (82.6)	67.5 (80.6)	84.8 (89.0)	84.0 (88.2)	88.1 (91.2)	86.7 (89.8)
900	80.2 (84.5)	77.8 (82.1)	84.8 (88.1)	82.5 (85.8)	87.0 (91.3)	85.2 (89.5)	91.0 (94.3)	89.5 (92.8)
1200	80.2 (84.6)	77.9 (82.3)	88.4 (92.1)	86.1 (89.8)	86.8 (91.2)	85.3 (89.7)	96.1 (99.8)	94.0 (97.7)
1700	70.5 (75.2)	66.8 (71.5)	82.4 (78.2)	69.9 (74.1)	75.8 (80.5)	72.1 (76.8)	77.9 (82.1)	74.4 (78.6)
2400	62.0 (67.5)	57.7 (63.2)	63.2 (68.7)	58.8 (64.3)	65.0 (70.5)	61.3 (66.8)	66.9 (72.4)	63.0 (68.5)
3200	64.0 (70.5)	59.7 (66.2)	64.4 (71.2)	60.3 (67.1)	65.7 (72.2)	62.4 (68.9)	67.8 (74.6)	63.6 (70.4)

TABLE No. 16

(see Technical Report No. 215 — Table No. 8)

Commercial telephone receiving system of Switzerland

Value of the e.m.f. (expressed in db below 1 volt) applied at the input of the receiving system corresponding to the average threshold of hearing of the testing crew of the C.C.I.F. Laboratory (10th series of tests)

c/s	In room noise of 60 db				In absence of room noise			
	with feed current		without feed current		with feed current		without feed current	
	Value of e.m.f. at threshold				Value of e.m.f. at threshold			
	Ascending	Descending	Ascending	Descending	Ascending	Descending	Ascending	Descending
300	55.4 (59.3)	53.2 (57.1)	62.0 (65.2)	60.5 (63.7)	73.4 (77.3)	71.1 (75.0)	76.0 (79.2)	73.8 (77.0)
600	65.5 (69.6)	62.6 (66.7)	74.6 (76.8)	71.8 (74.0)	85.5 (89.6)	82.9 (87.0)	90.4 (92.6)	87.9 (90.1)
900	68.3 (72.5)	65.6 (69.8)	78.8 (80.8)	75.0 (77.0)	85.1 (89.3)	81.1 (85.3)	88.2 (90.2)	84.8 (86.8)
1200	74.9 (79.1)	70.1 (74.3)	82.6 (84.6)	71.4 (73.4)	89.3 (93.5)	83.8 (88.0)	95.6 (97.6)	92.6 (94.6)
1700	70.4 (74.6)	65.3 (69.5)	80.0 (82.3)	74.2 (76.5)	80.0 (84.2)	77.2 (81.4)	86.1 (88.4)	80.7 (83.0)
2400	70.6 (74.9)	65.4 (69.7)	77.7 (80.8)	71.5 (74.6)	80.0 (84.3)	73.7 (78.0)	84.0 (87.1)	77.1 (80.2)
3200	66.6 (71.2)	63.1 (67.7)	78.0 (82.1)	72.7 (76.8)	82.5 (87.1)	79.5 (84.1)	84.7 (88.8)	81.0 (85.1)

Table No. 17

(see Table No. 2 of Document " C.C.I.F. — 1952/1954 — 4th S.G. — Document No. 25 *bis* ")

Commercial telephone receiving system of Switzerland

Value of the e.m.f. (expressed in db below 1 volt) applied at the input of the receiving system corresponding to the average threshold of hearing of the testing crew of the C.C.I.F. Laboratory (11th series of tests)

c/s	In room noise of 60 db				In absence of room noise			
	with feed current		without feed current		with feed current		without feed current	
	Value of e.m.f. at threshold				Value of e.m.f. at threshold			
	Ascending	Descending	Ascending	Descending	Ascending	Descending	Ascending	Descending
300	64.6 (68.5)	63.8 (67.7)	66.2 (69.4)	65.4 (68.6)	71.6 (75.5)	71.2 (75.1)	72.6 (75.8)	72.0 (75.2)
600	74.0 (78.1)	73.5 (77.6)	76.8 (79.0)	76.3 (78.5)	85.1 (89.2)	84.4 (88.5)	87.9 (90.1)	87.0 (89.2)
900	78.6 (82.8)	77.2 (81.4)	82.5 (84.5)	81.2 (83.2)	89.1 (93.3)	88.2 (92.4)	90.3 (92.3)	89.4 (91.4)
1200	83.1 (87.3)	81.1 (85.3)	86.8 (88.8)	84.7 (86.7)	91.6 (95.8)	89.9 (94.1)	93.0 (95.0)	91.5 (93.5)
1700	78.3 (82.5)	76.9 (81.1)	82.6 (84.9)	81.0 (83.3)	86.5 (90.7)	84.9 (89.1)	87.3 (90.0)	85.5 (87.8)
2400	75.3 (79.6)	73.0 (77.3)	78.2 (81.3)	75.5 (78.6)	80.6 (84.9)	78.7 (83.0)	81.4 (84.5)	79.9 (83.0)
3200	75.0 (79.6)	72.3 (76.9)	79.6 (83.7)	76.1 (80.2)	80.6 (85.2)	77.7 (82.3)	82.0 (86.1)	78.6 (82.7)

TABLE No. 18

(see Technical Report No. 215 — Table No. 9)

Commercial telephone receiving system of Czechoslovakia

Value of the e.m.f. (expressed in db below 1 volt) applied at the input of the receiving system corresponding to the average threshold of hearing of the testing crew of the C.C.I.F. Laboratory (10th series of tests)

c/s	In of 60 db room noise				In absence of room noise			
	with feed current		without feed current		with feed current		without feed current	
	Value of e.m.f. at threshold				Value of e.m.f. at threshold			
	Ascending	Descending	Ascending	Descending	Ascending	Descending	Ascending	Descending
300	52.9 (58.1)	50.6 (55.8)	55.5 (61.3)	54.5 (60.3)	72.8 (78.0)	70.0 (75.2)	74.2 (80.0)	73.1 (78.9)
600	64.0 (70.2)	62.0 (68.2)	72.7 (77.2)	71.3 (75.8)	84.1 (90.3)	82.5 (88.7)	89.7 (94.2)	88.8 (93.3)
900	65.8 (71.6)	65.0 (70.8)	81.1 (84.9)	79.8 (83.6)	90.2 (96.0)	89.2 (95.0)	98.1 (101.9)	87.8 (101.6)
1200	65.8 (71.0)	62.9 (68.1)	79.4 (82.4)	76.4 (79.4)	87.9 (93.1)	84.4 (89.6)	97.2 (100.2)	94.7 (97.7)
1700	65.9 (70.2)	62.7 (67.0)	75.3 (77.5)	71.7 (73.9)	78.3 (82.6)	74.7 (79.0)	83.1 (85.3)	78.9 (81.1)
2400	56.5 (60.2)	52.3 (56.0)	66.2 (68.5)	62.5 (64.8)	70.2 (73.9)	66.7 (70.4)	73.4 (75.7)	70.3 (72.6)
3200	67.8 (71.6)	64.0 (67.8)	71.5 (74.5)	69.7 (72.7)	77.7 (81.5)	73.6 (77.4)	79.8 (82.8)	75.5 (78.5)

TABLE No. 19
(see Technical Report No. 202 — Table No. 6)

Receiving system of the A.R.A.E.N.

Value of the e.m.f. (expressed in db below 1 volt) applied at the input of the receiving system corresponding to the average threshold of hearing of the testing crew of the C.C.I.F. Laboratory (8th and 9th series of tests)

c/s	In room noise of 60 db — Value of e.m.f. at threshold		In absence of room noise — Value of e.m.f. at threshold	
	Ascending	Descending	Ascending	Descending
300	48.3 (54.3)	45.5 (51.5)	62.5 (68.5)	60.0 (66.0)
600	60.5 (66.5)	57.5 (63.5)	77.2 (83.2)	72.8 (78.8)
900	65.8 (71.8)	61.9 (67.9)	81.2 (87.2)	77.1 (83.1)
1200	70.0 (76.0)	66.7 (72.7)	78.9 (84.9)	75.5 (81.5)
1700	74.6 (80.6)	69.6 (75.6)	80.1 (86.1)	75.1 (81.1)
2400	77.0 (83.0)	72.7 (78.7)	81.2 (87.2)	76.8 (82.8)
3200	77.9 (83.9)	71.7 (77.7)	79.6 (85.6)	74.3 (80.3)

TABLE No. 20
(see Technical Report No. 215 — Table No. 10)

Receiving system of the A.R.A.E.N.

Value of the e.m.f. (expressed in db below 1 volt) applied at the input of the receiving system corresponding to the average threshold of hearing of the testing crew of the C.C.I.F. Laboratory (10th series of tests)

c/s	In room noise of 60 db — Value of e.m.f. at threshold		In absence of room noise — Value of e.m.f. at threshold	
	Ascending	Descending	Ascending	Descending
300	54.4 (60.4)	52.2 (58.2)	71.9 (77.9)	71.0 (77.0)
600	64.8 (70.8)	60.6 (66.6)	80.5 (86.5)	77.8 (83.8)
900	70.0 (76.0)	66.0 (72.0)	92.6 (98.6)	80.7 (86.7)
1200	73.8 (79.8)	68.9 (74.9)	86.6 (92.6)	82.9 (88.9)
1700	76.2 (82.2)	70.9 (76.9)	84.4 (90.4)	78.5 (84.5)
2400	78.5 (84.5)	73.4 (79.4)	83.5 (89.5)	79.0 (85.0)
3200	81.1 (87.1)	74.4 (80.4)	85.6 (91.6)	80.2 (86.2)

TABLE No. 21

(see Table No. 2 of Document " C.C.I.F. — 1952/1954 — 4th S.G. — Document No. 25 ")

Receiving system of the A.R.A.E.N.

Value of the e.m.f. (expressed in db below 1 volt) applied at the input of the receiving system corresponding to the average threshold of hearing of the testing crew of the C.C.I.F. Laboratory (11th series of tests)

c/s	In room noise (type Hoth of 50 db)		In absence of room noice	
	Value of e.m.f. at threshold		Value of e.m.f. at threshold	
	Ascending	Descending	Ascending	Descending
300	55.2 (61.2)	55.5 (61.5)	66.5 (72.5)	66.7 (72.7)
600	66.9 (72.9)	66.3 (72.3)	79.5 (85.5)	79.6 (85.6)
900	74.6 (80.6)	74.4 (80.4)	83.0 (89.0)	83.3 (89.3)
1200	78.4 (84.4)	77.0 (83.0)	85.3 (91.3)	84.2 (90.2)
1700	78.3 (84.3)	75.9 (81.9)	84.1 (90.1)	81.5 (87.5)
2400	74.8 (80.8)	72.6 (78.6)	77.5 (83.5)	75.9 (81.9)
3200	78.7 (84.7)	76.0 (82.0)	81.2 (87.2)	78.5 (84.5)

TABLE No. 22

(see Table No. 3 of Document " C.C.I.F. — 1952/1954 — 4th S.G. — Document No. 25 *bis* ")

Receiving system of the A.R.A.E.N.

Value of the e.m.f. (expressed in db below 1 volt) applied at the input of the receiving system corresponding to the average threshold of hearing of the testing crew of the C.C.I.F. Laboratory (11th series of tests)

c/s	In room noise (type Hoth of 50 db)		In absence of room noise	
	Value of e.m.f. at threshold		Value of e.m.f. at threshold	
	Ascending	Descending	Ascending	Descending
300	59.6 (65.6)	59.6 (65.6)	67.8 (73.8)	68.6 (74.6)
600	69.7 (75.7)	68.7 (74.7)	78.0 (84.0)	77.2 (83.2)
900	75.5 (81.5)	74.3 (80.3)	82.5 (88.5)	82.4 (88.4)
1200	78.8 (84.8)	76.5 (82.5)	86.2 (92.2)	84.3 (90.3)
1700	78.0 (84.0)	74.6 (80.6)	83.5 (89.5)	80.1 (86.1)
2400	75.5 (81.5)	73.1 (79.1)	78.4 (84.4)	76.8 (82.8)
3200	80.5 (86.5)	77.2 (83.2)	83.8 (89.8)	83.4 (89.4)

Table No. 23

Value of the e.m.f. (expressed in db below 1 volt) applied at the input of the receiving system corresponding to the average threshold of hearing of the testing crew of the C.C.I.F. Laboratory (11th series of tests)

c/s	S.F.E.R.T. Receiving system : settings at zero				S.F.E.R.T. Receiving system : settings for " normal adjustment " *				S.F.E.R.T. Receiving system : settings at zero				S.F.E.R.T. Receiving system : settings for " normal adjustment " *			
	e.m.f. at threshold in room noise of 60 db								e.m.f. at threshold in absence of room noise							
	Receiver No. 22		Receiver No. 24		Receiver No. 22		Receiver No. 24		Receiver No. 22		Receiver No. 24		Receiver No. 22		Receiver No. 24	
	Ascending	Descending	Ascending	Descending	Ascending	Descending	Ascending	Descending	Ascending	Descending	Ascending	Descending	Ascending	Descending	Ascending	Descending
	db	db	db	db	db	db	db	db	db	db	db	db	db	db	db	db
300	66.4	64.0	63.4	62.9	62.7	60.3	63.2	62.7	78.3	76.6	75.0	74.5	74.6	72.9	74.8	74.3
600	71.6	71.4	67.9	67.8	67.9	67.7	67.7	67.6	85.4	85.2	82.1	81.4	81.7	81.5	81.9	81.2
900	83.1	81.0	75.7	74.9	79.4	77.3	75.5	74.7	93.0	92.3	91.3	90.2	89.3	88.6	91.1	90.0
1200	83.2	79.9	79.6	77.8	79.5	76.2	79.4	77.6	94.3	91.0	91.9	89.8	90.6	87.3	91.7	89.6
1700	82.9	80.7	79.9	78.0	79.2	77.0	79.7	77.8	90.2	88.5	87.9	85.6	86.5	84.8	87.7	85.4
2400	75.6	73.2	74.9	72.7	71.9	69.5	74.7	72.5	80.4	78.3	80.3	77.6	76.7	74.6	80.1	77.4
3200	72.2	68.1	72.2	69.5	68.5	64.4	72.0	69.3	78.4	75.3	77.4	74.5	74.7	71.6	77.2	74.3

* These values are obtained from those mentioned in the columns " S.F.E.R.T. Receiving system : settings at zero ", corrected by −3.7 db (in the case of receiver No. 22) and by −0.2 db (in the case of receiver No. 24). These corrections are obtained from results of periodic calibrations of the S.F.E.R.T. using the technique specified for this calibration).

ANNEX 5
(to Question No. 7)

New method to be used by the American Telephone and Telegraph Company for evaluating transmission performance in terms of objective measurements

Introduction

In our response to question No. 6 (S.G. 4 Class B — non-urgent) dated November 1952, the American Telephone and Telegraph Company indicated that they were investigating a new method of evaluating overall transmission performance ratings in terms of objective measurements. Also during the Study Group Meetings last autumn the A.T.T.Co. were asked to keep the C.C.I.F. informed regarding progress in this matter.

The A.T.T.Co. have very recently arrived at a definite conclusion regarding this new method of rating and are now in the process of revising their transmission data on subscribers' loops and telephone sets to fit in with it.

The method is described in more detail in the attached memorandum but in simple terms it is that the transmission loss of an overall connection is the number of db corresponding to the ratio of *(a)* the acoustic speech pressure (suitably weighted) delivered by the telephone receiver to the ear of a listener, to *(b)* the acoustic speech pressure (also suitably weighted) at the lips of a talker. If, for example, the acoustic speech pressure at the listener's end were the same as the acoustic speech pressure at the talker's end, the overall loss would be 0 db ; if the ratio were one-half, the loss would be 6 db, etc.

In addition to rating the overall performance of telephone connections, this new scheme is also applicable to rating individual parts of a connection : for example, the transmitting or receiving efficiency of a subscriber's telephone or of the combination of his telephone and the loop serving him.

The adoption of such a plan in the Bell System has been facilitated by the fact that in most cases the frequency characteristic of overall transmission (including telephone sets) is now more or less " flat " over a reasonably wide band and that the sets are practically all anti-side tone, so that loudness alone is a reasonably good measure of transmission performance. These cases where this is not so can be taken care of by suitable corrections for frequency or other distortion, noise, etc.

Among the advantages that seen in this scheme, at least under the conditions existing in the U.S.A. are the following :

1. It is relatively easily understood since it is based on " loudness " which is a well known concept.

2. The numbers used (whether they be associated purely with acoustic output and input, or with any combination of acoustic and electrical outputs and inputs) have the same general significance as the numbers used in purely electrical measurements ; i.e. a positive number means an actual transmission loss and a negative number an actual transmission gain. This eliminates the need for a " reference " system based on the concept of quantities starting from some arbitrary " zero ".

3. When we have developed the proper testing instrumentalities and techniques, we will be able to use the same data for maintenance as for engineering. This has never been possible heretofore.

As this scheme develops further the C.C.I.F. will be kept advised regarding progress

Memorandum

This memorandum outlines the definitions which are to be used as a basis for rating transmission performance from the standpoint of loudness.

Strictly speaking, loudness is a subjective factor which can be measured only by the composite judgment of number of human observers. As used here, however, loudness refers to objective measurements which approximate but do not always duplicate true loudness determinations. However, in view of the wide range of conditions encountered in practice, the approximation is sufficiently good for all practical purposes.

The basic definition covers the rating of overall telephone connections. In addition, it is necessary to establish definitions covering the rating of the transmitting, receiving and connecting portions of telephone connections in a manner consistent with the overall definition. For instance, suppose an overall telephone connection, in its simplest form, consists of two telephone sets connected back to back. It would be desirable to have the transmission rating for the transmitting telephone set, adeed to that of the receiving telephone set, exactly equal to the transmission rating of the overall connection. This is not possible under all conditions (for instance, where different types of sets are involved) without corrections for reflection losses. It is necessary to specify under what conditions the sum of the component ratings is equal to the overall rating ; reflection loss corrections for other conditions then become self-evident. The definitions which follow are consistent in the above sense.

It should also be pointed out that the following definitions apply to loudness effects only, and are apart from such subjective effects as those caused by distortion, noise and sidetone, which cannot be taken account of adequately by presently available objective measurement methods. In cases where such objective effects are of importance, they will be added as transmission penalties to the loudness transmission ratings to obtain the aggregate subjective ratings.

The definitions are based on the use of speech, or an equivalent complex test tone, as a source of acoustic energy, and measurements of voltage or sound pressure made by an indicating meter with suitable frequency weighting networks to simulate the loudness perception of the human ear.

Overall loudness rating. — A transmission rating of zero decibels loudness transmission is applied to an overall telephone connection in which the output acoustic speech pressure delivered by the telephone receiver to the ear of a listener is equal to the input acoustic speech pressure at the lips of a talker. During the measurement of output pressure, the transmitter of the talking telephone set is placed in the modal position with respect to the sound source. If S_L is the output pressure at the listening end in microbar (dynes per square centimeter) or millibars (1000 dynes per square centimeter) and S_T his the corresponding output pressure at the talking end of any overall telephone connection, the transmission loss, or rating, of the connection, R_O, is

$$R_O = -20 \log_{10} \frac{S_L}{S_T} \text{ decibels} \tag{1}$$

Thus losses are defined by positive and gains by negative numbers.

Loudness rating of transmitting components. — A transmitting telephone set has a transmission rating of zero decibels when the voltage (in volts) it delivers accross a 900 ohms resistive load is equal to the pressure (in millibars) at the talker's lips. As in the case of overall measurements, during the output measurement the transmitter must be in the modal position with respect to the sound source. The loss is defined above by a voltage-pressure ratio rather than by a power ratio in order to be consistent with the definitions of rating of receiving telephone sets and overall ratings, as will be discussed later. According to the above definition, the transmission rating R_T of any telephone set when transmitting is therefore :

$$R_T = -20 \log_{10} \frac{V_T}{S_T} \text{ decibels} \tag{2}$$

where V_T is the voltage accross the load and S_T is the talking pressure in millibars.

Since the transmitting efficiencies of commercial telephone sets with carbon transmitters vary with the direct current flowing in the transmitter, it is necessary to specify a fixed value of line current when expressing the transmission rating of a transmitting telephone set. For the present the value specified is 100 milliamperes, which represents nearly the maximum direct current obtainable on short loops, although experience may show that another value may be more suitable. In this case the value specified can be changed without in any way affecting the definition of the transmitting set rating. Any departure from 100 milliamperes in a commercial telephone connection causes a current supply loss, which is added to the transmission rating of the transmitting telephone set to obtain the transmitting conversion loss. The sign of the transmitting current supply loss will usually be positive for currents less than 100 milliamperes, and negative for currents greater than 100 milliamperes.

Transmitting loop losses can be defined in the same way as the rating of a transmitting telephone set. The loop may be expressed by equation (2) if the 900 ohms resistive load is at the output (central office end) of the loop instead of at the output of the transmitting telephone set. In this case the rating of the loop is equal to the sum of the rating of the transmitting telephone set, the transmitting current supply loss, and the insertion loss of the subscriber line between the impedance of the telephone set and the 900 ohms termination. The latter is called the subscriber line loss.

Loudness rating of receiving components. — In order to be consistent with the foregoing definitions for transmitting components and for overall connections, the rating of a receiving telephone set has a loudness transmission rating of zero decibels when the output acoustic speech pressure (in millibars) delivered by the receiver to the ear of a listener, is one half the open circuit voltage (in volts) of a 900 ohms resistive source which energizes the set as a lead. The transmission rating, R_L, of any telephone set when receiving, then, is :

$$R_L = -20 \log_{10} \frac{S_L}{\frac{V_W}{2}} \text{ decibels} \tag{3}$$

where S_L is the listening pressure in millibars and V_W is the open-circuit voltage of the 900 ohms source.

As in the case of rating transmitting sets, a current supply of 100 milliamperes is specified when expressing the transmission rating of a receiving telephone set, and departures from this value may cause a receiving current supply less in telephone sets with current controlled equalizers. The sum of the rating of the receiving telephone set and the receiving current supply loss is the receiving conversion loss.

Equation (3) also expresses the transmission rating of a receiving loop if the 900 ohms source is applied to the input (central office end) of the loop instead of the receiving telephone set. The rating of the loop, so obtained, is equal to the sum of the rating of the receiving telephone set, the receiving current supply loss, and the insertion loss of the subscriber line between 900 ohms and the impedance of the telephone set, that is, the receiving subscriber line loss.

Discussion of definitions. — As already mentioned, the basic reference for rating transmission is taken as equal output and input acoustic speech pressures in an overall telephone connection. Pressure, rather than power, was chosen for two reasons. In the first place acoustic power is very difficult to measure. Secondly, the ear appears to be a pressure sensitive, rather than a power absorbing device, in the same way that a vacuum tube is considered to be voltage operated, rather than power absorbing. When a telephone receiver is held close to the ear, the acoustic impedance is largely reactive. The real part of the acoustic impedance is chiefly due to the leakage path between the receiver cap and the ear. Consequently the acoustic power is dissipated mostly in the open air by way of the leakage path. So far as hearing is concerned, it makes much more sense to talk of acoustic pressure than acoustic power, for a power rating is a measure of the merit of a receiver used as a loudspeaker instead of as a receiver. For this reason the definitions for rating overall connections, and transmitting and receiving telephone sets are in terms of acoustic pressure and electrical voltage, instead of power.

In the overall telephone connection consisting of two telephone sets connected to each other by an hypothetical amplifier (to avoid interaction effects) it will be recognized that there is latitude, numerically, in establishing the division of overall rating into the respective ratings of transmitting and receiving components. The choice is an arbitrary one, provided the two always add up to the overall rating. We could measure the voltage in millivolts instead of volts, and the pressure in microbars or even in atmospheres instead of millibars. The numerical values of the ratios of voltage to pressure or pressure to voltage depend on the units chosen. The ratio of voltage in volts to pressure in millibars (and vice versa) was selected for two reasons. First, these units are more familiar to non-technical people than other units which might be used : everyone recognizes volts, and millibars also are not unfamiliar, since they are the units which appear on the daily weather map to designate atmospheric pressure. Secondly, the range of numbers for transmitting and receiving ratings of commercial telephone sets is appropriate. Transmitting ratings are in general negative and receiving ratings positive because of this choice of units. This is consistent with the fact that carbon transmitters have long been known produce gain, and electromagnetic receivers loss, in converting between acoustic and electrical energy.

Question No. 8.

(4th Study Group in co-operation with the 3rd S.G.) (Category B) [urgent] (continuation of Question No. 8 studied in 1952/1954).

Administrations are requested to send to the Secretariat of the C.C.I.F., before 1st October 1955, the results of the experience they have acquired in applying to their national transmitting and receiving systems the rule given below ".

Provisional rule adopted by the XVIIth Plenary Assembly of the C.C.I.F.

The XVIIth Plenary Assembly adopts as a provisional rule the following text, which replaces the corresponding passages of the *Yellow Book.* (Vol. III *bis*, pages 23 to 26 and Vol. IV, pages 59, 60 and 65.) This text should not yet be considered as a recommendation, but only as a rule that Administrations and Private Operating Agencies are asked put to trial for a year, after which time they will inform the Secretariat of the C.C.I.F. of the results obtained. The Secretariat can then circulate, by post, this information to all the members of the I.T.U. and this text will become a recommendation if, in its application, it has not given rise to serious objections.

1st Part. — Telephony

Section 1. — GENERAL CHARACTERISTICS OF INTERNATIONAL CONTINENTAL TELEPHONE CALLS AND OF INTERNATIONAL CONTINENTAL TELEPHONE CIRCUITS

1.1. *General characteristics of the overall international telephone call or of the continental section of an international intercontinental telephone call.*

1.1.1. *Reference equivalents.*

Yellow Book, Vol. III bis, p. 23-24

Practical limits for the reference equivalent between two subscribers, the reference equivalent for the national sending system and the reference equivalent of the national receiving system

In any international telephone call between two subscribers situated in the interior of the same continent the reference equivalent between the two subscribers must not exceed 4.6 nepers or 40 decibels.

The reference equivalent of the national sending system (as considered from the ends of the international circuit) must not exceed 2.1 nepers or 18.2 decibels.

The reference equivalent of the national receiving system (as considered from the ends of the international circuit) must not exceed 1.5 nepers or 13 decibels.

If a gain is introduced in the international exchange (for example by the insertion of a repeater to compensate for the attenuation in the circuit between the international exchange and the last trunk exchange), this gain will be included in the above mentioned reference equivalents for the national systems.

If, in the case of certain connections, the nominal equivalent referred to above of the international circuit, is reduced by a certain quantity in the international exchange concerned, this reduction will be considered as being equivalent to a corresponding gain made to the national systems.

Note 1. — Efforts should so be made that the maximum limit of 4.6 nepers for the reference equivalent between the two subscribers in any international call whatsoever, be an absolute upper limit, including therein variations of all kinds, it should thus include both variations with time and tolerances with respect to their nominal values, of the reference equivalents of lines and apparatus. In this connection, Administrations and Private Operating Agencies must take account of the fact that it is possible to have variations (within an interval of 0.35 nepers or decibels) of the values or reference equivalents measured at the C.C.I.F. Laboratory, but it is not considered, for the moment, that any tolerance can be specified for the possible variations due to these causes in the elaborations of plansf or national telephone networks.

Note 2. — The limiting transmission conditions indicated above only concern the reference equivalent (4.6 nepers for the whole transmission system) and do not take any account of the transmission impairment due to the effects of noise or bandwidth limitation (see Section 1.1.3 below).

*Practical limits for the reference equivalent between two operators or between an operator and a subscriber **

Yellow Book, Vol. III *bis*, p. 25-26

In an international telephone call, the reference equivalent between two operators or between an operators and a subscriber should not exceed the values contained in the following table :

Calls between two operators		Calls between an operator and a subscriber			
Reference equivalent of the connection between two operators		Reference equivalent of the connection between an operator and a subscriber situated at the same end of the international line		Reference equivalent of the connection between an operator and a subscriber situated at the two extremities of the international line	
Subscriber's line disconnected	Subscriber's line connected	International circuit disconnected	International circuit connected	Subscriber's line disconnected	Subscriber's line connected
2.5 nepers or 21.8 decibels	3.3 nepers or 28.7 decibels	2.55 nepers or 22.2 decibels	2.95 nepers or 25.7 decibels	3.55 nepers or 30.9 decibels	3.95 nepers or 34.4 decibels

*Note **. — To assure themselves that the limits shown concerning the reference equivalents are not exceeded Administrations and Private Operating Companies can use various methods. For example, artificial units can be made representing respectively the principal combinations of subscriber's commercial telephone sets, subscriber's lines, junction lines and apparatus of local and trunk exchanges, each of these artificial units representing a complete national sending system or a complete national receiving system which are compared, in a voice-ear test, with the Master Reference System (S.F.E.R.T.) without distortion or with a Working Standard System which has previously been compared with the S.F.E.R.T. The operations can be restricted to the measurement of the reference equivalent of the subscriber's telephone set under certain specified conditions ; to this value of reference equivalent is added the factory acceptance tolerance for the subscriber's telephone set considered, the image attenuation (calculated or measured at 800 c/s) of the subscriber's lines, junction lines and circuits connecting this telephone set to the international exchange,

* These passages have been deleted in the transmission Instructions of the General Trunk Interconnection Programme 1954/1958.

and the composite attenuations (measured or calculated at 800 c/s on a pure resistance of 600 ohms) of the apparatus of telephone exchanges situated on the connection between this telephone set and the international exchange (including the apparatus of the international exchange). But in any case, it is necessary to check the results of these calculations by means of a voice-ear test carried out on the artificial units representing the most typical complete national sending and receiving systems.

1.1.2. *Transmission performance ratings* *.

(a) *Definitions of the transmission performance rating and the articulation reference equivalent (A.E.N.)*

Articulation reference equivalent (A.E.N.) (G.B.) [Equivalent articulation loss (Am)].

If articulation measurements are made under specified conditions alternately on a telephone system and on the " Reference system for the determination of the Articulation Reference Equivalent (A.R.A.E.N.) with different values of line attenuation up to the point where values of articulation on both systems are substantially reduced, then the results of these tests may be recorded in the form of curves showing the variation of sound articulation with attenuation. The value A_1 of the attenuation of the system under test and the value A_2 of the attenuation of the A.R.A.E.N. at a fixed valu of 80% sound articulation can then be determined.

(A_2-A_1) is by definition equal to the articulation reference equivalent (abbreviated to A.E.N.).

Transmission Performance Rating (relative to S.R.A.E.N.).

The value (in decibels or in nepers) of the additional attenuation which must be inserted in the Reference System for the determination of A.E.N. values (S.R.A.E.N.) or which must be taken from the system in order to obtain equal transmission performance when the apparatus under consideration is used to replace the whole, or the appropriate part, of the reference circuit. It is agreed on the international plan to determine this equality of transmission performance on the basis of articulation tests.

(b) *Calculation of the transmission performance rating of a national sending or receiving system.*

The nominal transmission performance rating of a national sending or receiving system is the sum of the following quantities :

(1) the nominal transmission performance rating of the local system (average value in service),
(2) the nominal transmission performance rating of the connection between the local exchange and the international exchange (average value in service).

1. When it is only desired to check whether a national sending or receiving system satisfies the limits fixed for the international service, § *d* below, the transmission performance rating of the local system may be identified with the A.E.N. value for this system (see the note below).

The nominal transmission performance rating for the local system considered is then equal to the A.E.N. value (articulation reference equivalent) of the system composed of a typical telephone set (i.e. the average value in service for the type of telephone set considered) connected by means of an artificial line (representing the subscriber's line actually used) to a typical local exchange feeding bridge. This quantity is itself equal to the A.E.N. value determined at the C.C.I.F. Laboratory, diminished by a correction if the subscriber's line actually used is less unfavourable than that which was submitted to the C.C.I.F. Laboratory.

* Questions Nos. 9, 10, 10 *bis* and A of S.G. 4.

2. The average transmission performance rating of the connection established between the local exchange and the international exchange is equal to the sum of the following numbers :

— the equivalent of the trunk circuits between the last trunk exchange and the international exchange, measured at 800 c/s increased by the impairment due to bandwidth limitation (see § 1.1.3 below) when these circuits present an attenuation distortion greater than that allowed by the C.C.I.F. recommendations (see Section 1.3.2 below).

— the average transmission performance rating for the junction circuits given by the following expression :

$$i = K \times L$$

where : i = average rating in decibels or nepers,
L = length of the junction circuit in kilometers,
K = a coefficient which depends on the type of junction circuit considered, in nepers per kilometre or in decibels per kilometre (see the note thereafter).

— the average insertion rating of each switching centre (exchange). The rating corresponding to the insertion of an electric circuit element, which, in conformity with C.C.I.F. recommendations effectively transmits the frequency band 300-3400 c/s can be calculated by taking the arithmetical mean of the 4 values of insertion loss (or gain) of the element considered as measured at 500, 1000, 2000, 3000 c/s and expressed in decibels or nepers. While awaiting a more precise value (or values) for this rating which will result from measurements which each Administration can carry out on this subject, a provisional value will be adopted of 1.0 db for each exchange included in the connection.

Note 1. — Circuit noise which remains within the limits fixed by the C.C.I.F. recommendations is not taken into consideration.

Note 2. — The combined attenuation of the lines connecting the international exchanges with the local exchanges should be such that the reference equivalent of the national sending system and the reference equivalent of the national receiving system lie within the limits considered as compatible with good telephone transmission.

Note 3. — For plans for future networks, the lines connecting the international exchanges with the local exchanges should be able to effectively transmit the frequency band from 300 to 3400 c/s.

The attenuation distortion of these lines connecting the international exchanges with the local exchanges ought not to increase appreciably the attenuation distortion of the international circuit ; hence, in the case of loaded lines, a sufficiently high cut-off frequency should be chosen.

Note 4. — At it has been agreed, on the international plan, to evaluate transmission performance ratings by articulation measurements, the following considerations apply to the relation between the transmission performance rating and the A.E.N. (for sending and for receiving) for a commercial telephone system.

NOTE

Relation between the transmission performance rating and the A.E.N. value (for sending and receiving) for a commercial telephone system ***Yellow Book,*** **Vol. VI, p. 65**

The variation of the reference equivalent of the side tone path of a telephone set affects both the sending and receiving efficiencies of this set. The resultant effect on the " transmission performance rating " of a symmetrical telephone system, presenting the same conditions of subscriber's line and room noise at both ends, is approximately equal to the sum of the separate effects on sending and receiving. The A.E.N. measuring technique includes the direct measurements of the effect on receiving for the level of room noise used in the tests, since the effect at the receiving end is due to the masking, of the received speech sounds, caused by the room noise reaching the telephone receiver over the side tone path.

However, the effect at the sending end is due to the fact that a variation of the reference equivalent of the side tone influences the subscriber's speech power. The measurement of A.E.N. values involves the use of a constant speech volume and, consequently does not take account of this effect.

In principle, corrections should be made to the measured A.E.N. values to take account of the effects which occur in service due to departure from the conditions specified for the determinations of these A.E.N. values. However, when it is only a question of evaluating the transmission performance of commercial telephone connections of which the characteristics correspond to the worst transmission performance allowed in service, the small differences which occur by reason of different sending end sidetone conditions can at present be neglected. It has been agreed to define arbitrarily and provisionally that the correction due to the effect of side tone at the sending end is to be zero in the case of transmission conditions corresponding to the limit admissible in the international telephone service.

Administrations and Private Operating agencies who wish to establish transmission plans for their national network, on the basis of transmission performance ratings will find in Annex 2 of the book of Annexes to Vol. IV of the *Green Book* indications of the corrections to be made to A.E.N. values to take account of side tone at the sending end.

(c) *Determination of A.E.N. values.*

The reference system for the determination of A.E.N. values (S.R.A.E.N.) and the method of determination of A.E.N. values of commercial telephone systems in the C.C.I.F. Laboratory are described in Sections 3.1.3 and 3.1.4 of Vol. IV of the *Green Book.*

(d) *Limits for the transmission performance rating between two subscribers, the transmission performance rating of the national sending system and the transmission performance rating of the national receiving system.*

* Administrative and telephone operating agencies are asked to try the following rule, and to inform the *C.C.I.F. Secretariat, before 1 October 1955,* if they find no difficulty in applying it to the national network.

The C.C.I.F. Secretariat will acquaint all Members and Associate Members of the I.T.U. with the outcome of this inquiry and will ask them whether, in view of the outcome, the rule could not be made into a final recommendation.

It is very desirable that, for 90% of international calls, the nominal total transmission performance rating from subscriber to subscriber does not exceed 49 decibels (5.65 nepers). Provisionally this limit may be subdivided in the following manner :

For 90% of international calls :

— the nominal transmission performance rating of the national sending system must not exceed 24 decibels (2.77 nepers),

— the nominal transmission performance rating of the national receiving system must not exceed 18 decibels (2.07 nepers).

It is assumed in the above that the transmission performance rating of the international circuit does not exceed 0.8 nepers or 7 decibels. This transmission performance rating is equal to the nominal equivalent of the circuit at 800 c/s (as defined in Sections 1.1.1 above and 1.3.1 below), correction being made if necessary for impairment (see section 1.1.3 below). This limit does not take account of the variations in the equivalent of the international circuits, with respect to its nominal value, as a function of time.

Note 1. — The limits (24 decibels and 18 decibels) for the national systems, at the sending and receiving ends, do not include the probable variations, as a function of time, of the equivalents of the trunk circuits which enter into the composition of the national system.

Note 2. — These limits apply to A.E.N. values deduced from values determined, for a local system, at the C.C.I.F. Laboratory as indicated in Section 3.1.4 of Vol. IV of the *Green Book* with, in particular, a room noise at the receiving end of 60 decibels for the commercial systems and an electrical background noise (of a psophometric e.m.f. of 2 millivolts) injected at the input to the receiving system of the A.R.A.E.N.

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* Provisional text, which will be reviewed in October, 1955 after the results of the enquiry.

NOTE

Average rating of junction lines

A junction line can be considered as a quadripole inserted between the impedance of the first trunk circuit, seen at the manual or automatic trunk exchange, and the impedance of the local system (feeding bridge plus subscriber's line plus subscriber's apparatus).

For a given frequency, the loss introduced by such a line is then represented by its " composite attenuation " * which is the sum of the attenuation of the line itself and of other terms representing all the effects due to reflections caused by mismatch between the impedance of the line and the impedance of the terminations which are mentioned above.

According to the work of the British Administration, the rating corresponding to reflexions can be represented by the arithemtic mean of the reflexion losses measured at the frequencies 500, 1000, 2000, and 3000 c/s.

Moreover the transmission performance rating of an unloaded line is measured by its attenuation at 1500 c/s (C.C.I.F. — 1950/51 — 4th S.G. — Document No. 26, Annex 1 to reply to question No. 13) and this attenuation is practically equal to the arithmetic mean of the attenuations at the four stated frequencies **.

Thus the rating of the junction line can be obtained directly, including both the effect due to its own attenuation and the effect of reflections, by taking the arithmetic mean of the composite attenuations measured at the four stated frequencies.

Given that the impedance of local systems is a very variable quantity, no unique value of average rating for a junction line can be established, but only an average value, obtained by taking the arithmetic mean of several values of the rating, measured with several conditions of termination (see C.C.I.F. — 1952/54 — 4th S.G. — Document No. 32, Annex).

For each type of junction line (defined by the electrical characteristics of the line), the average rating is proportional to the length of the line (see the Document No. 32, quoted) ; the coefficient of proportionality can easily be determined when 3 of 4 values of the said rating are available. This function has the form

$$i = K \times L \qquad (1)$$

where : i = average rating in decibels or nepers.
L = length of junction line in kilometers
K = coefficient depending on type of line, in decibels per kilometer or in nepers per kilometer.

To determine, once and for all, the different values of the coefficient K the composite attenuation of three or four different lengths can be measured of each type of junction line used in any particular network (possibly represented by artificial lines) ; to this end the technique described in the said Document No. 32 can be used (see also Annex 2 to Question No. 10 in Volume I *ter* of the C.C.I.F. *Yellow Book*, page 400) and one of the methods of measuring composite attenuation described in Volume IV of the C.C.I.F. *White Book*, page 62.

Relation (1) then allows the calculation of the value of the average rating for all lengths and all types of junction line incorporated in the national network considered.

1.1.3. *Transmission impairments.*

(a) *Transmission impairment due to the limitation of the frequency bandwidth effectively transmitted by the trunk circuit.*

Observations of repetitions during conversations have been made in the United States of America and measurements of articulation have been made in different national laboratories as well as at the Laboratory of the C.C.I.F. From the results obtained the mean

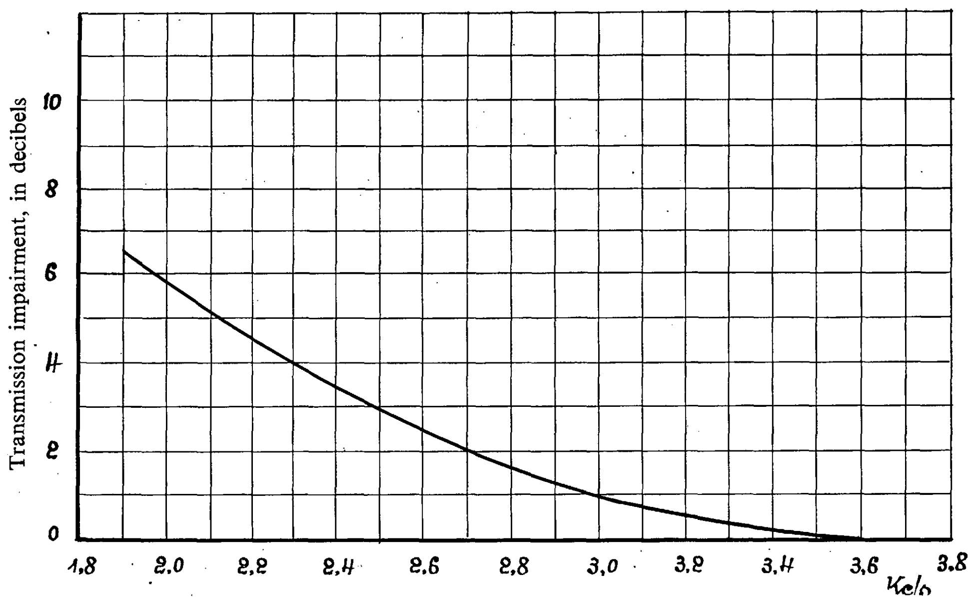
* In practice, the insertion loss can be used instead of the composite attenuation.

** The attenuation of an unloaded cable circuit is proportional to the square root of the frequency. The frequencies 500, 1000, 2000, and 3000 c/s are in the ratios 1, 2, 4, 6 and their square roots in the ratios 1, 1.41, 2, 2.48 the arithmetic mean of which is 1.72, very near to the square root of 3 ; thus this mean coresponds to a frequency of $3 \times 500 = 1500$ c/s.

curve of Figure 1 has been drawn giving the transmission impairment caused by the limitation of the frequency bandwidth effectively transmitted by the trunk circuit.

The equation to this curve is $y = 2\,(3.7 - f)^2$, where y is the transmission impairment (in decibels) due to the limitation of the frequency bandwidth effectively transmitted, and f is the frequency (in kc/s) for which the equivalent of the circuit exceeds its equivalent a 1000 c/s by 10 decibels.

Note. — Transmission impairments due to the limitation of the frequency bandwidth effectively transmitted, which occur in the various parts of a telephone connection considered separately are not additive. The total impairment due to the limitation of the frequency bandwidth effectively transmitted for a complete telephone connection is not greater than the impairment due to that part of the connection which causes the greatest reduction of the frequency bandwidth effectively transmitted.



The frequencies shown on the abscissa are the maximum frequencies effectively transmitted according to the definition adopted in the United States of America, i.e. those for which the attenuation is greater by 10 decibels than the attenuation at 1000 c/s

FIGURE 1. — *Transmission impairment due to limitation of the frequency bandwidth effectively transmitted*

(b) *Transmission impairment due to circuit noise.*

This question is under study by the C.C.I.F.

Pending the results of this study it is pointed out that Annex 3 of the Book of Annexes to Vol. IV of the *Green Book* gives information on a method of evaluation of the " transmission impairment due to circuit noise " *.

(c) *Transmission impairment due to room noise.*

The method of measuring A.E.N. values includes the effect of 60 db room noise (Hoth spectrum) ** at the receiving end, and Annex 4 (of the Book of Annexes to Vol. IV of the *Green Book*) gives information of the method of evaluation of the " transmission impairment due to room noise " used in the U.S.A. ***.

* This annex reproduces paragraphs 2 and 3 on pages 133 to 138 of the *Yellow Book*, Vol. VI. in full.

** Some details on room noises are given in § *(c)* of Section 1.3 of Vol. IV of the *Green Book*

*** This annex reproduces pages 144 and 145 of the *Yellow Book*, Vol. VI.

Question No. 9.

(4th Study Group in co-operation with the 3rd S.G.) (Category B) [urgent] (new question).

What are the limits applied by your Administration, to the junction and trunk networks of your country in order to ensure satisfactory quality for national calls, it being understood that the recommendation of the C.C.I.F. relating to reference equivalent and the rule relating to transmission performance rating are satisfied for international calls ?

Note. — The object of the C.C.I.F. recommendations is to ensure satisfactory quality on international calls in which different national systems are involved and where the recommended limits are reached, it being understood that in each country the network has been designed so as to ensure satisfactory quality for national calls. This question has been set so as to provide Administrations who are developing their national telephone service, with information on the best method of arranging their network.

Question No. 10.

(4th Study Group in co-operation with the 3rd S.G.) (Category A 2) [urgent] (new question).

Considering that the improvement in efficiency of modern typetelephone instruments is liable to increase the disturbance due to crosstalk and the overloading of the repeaters of carier systems with many circuits particularly in the case of subscribers connected to a trunk exchange by electrically short lines.

What limits should be fixed for the sensitivity which should never be exceeded by local sending and receiving systems ?

Note. — The 3rd Study Group will give to the 4th Study Group any information which may be necessary for the study of this question.

Question No. 10 bis.

(Category A 1) [urgent] (new question).

The shape of the sensitivity/frequency-characteristic of a sending system having a carbon microphone depends on the method used for measurement.

What details should be specified in the description of the recommended method ?

Note. — The reply to this question will complete and make precise the reply that the 4th S.G. can make to Question No. 10.

Question No. 11.

(Category B) [non-urgent] (continuation of Question No. 11 studied in 1952/1954).

Collection of information concerning the application of statistical methods to the control and direction of subjective tests.

Note. — The method of statistical analysis which was used by the C.C.I.F. Laboratory during the 8th and 9th series of experiments is described in pp. 84-86 of Volume IV of the *Yellow Book* of the C.C.I.F. (Paris, 1949).

Note 2. — The method of statistical analysis which was used in the 10th series of experiments of the C.C.I.F. Laboratory is described in the document of experiments of the C.C.I.F. Laboratory ". This text also appears in the 3rd part of Volume VI of the *Yellow Book* of the C.C.I.F. (Florence, 1951).

Question No. 12.

(Category B) [non-urgent] (continuation of Questions Nos. 12 and 13 studied in 1952/1954).

What general characteristics and corresponding tolerances should be fixed for artificial voices, mouths and ears ?

Note 1. — When this documentation upon the existing apparatus has been collected, it would be desirable, if possible, to study the essential clauses of a specification for the provision of an artificial voice, mouth and ear.

Note 2. — When the essential electro-acoustic characteristics of an artificial voice, mouth and ear have been standardized, rules should be formulated for the objective determination of " sensivity-frequency " characteristics (response curves) of subscriber's telephone apparatus by means of this artificial voice, mouth and ear.

Note 3. — While awaitig the general standardization of an artificial ear the C.C.I.F. has defined a " reference artificial ear " (see the Annex below).

ANNEX

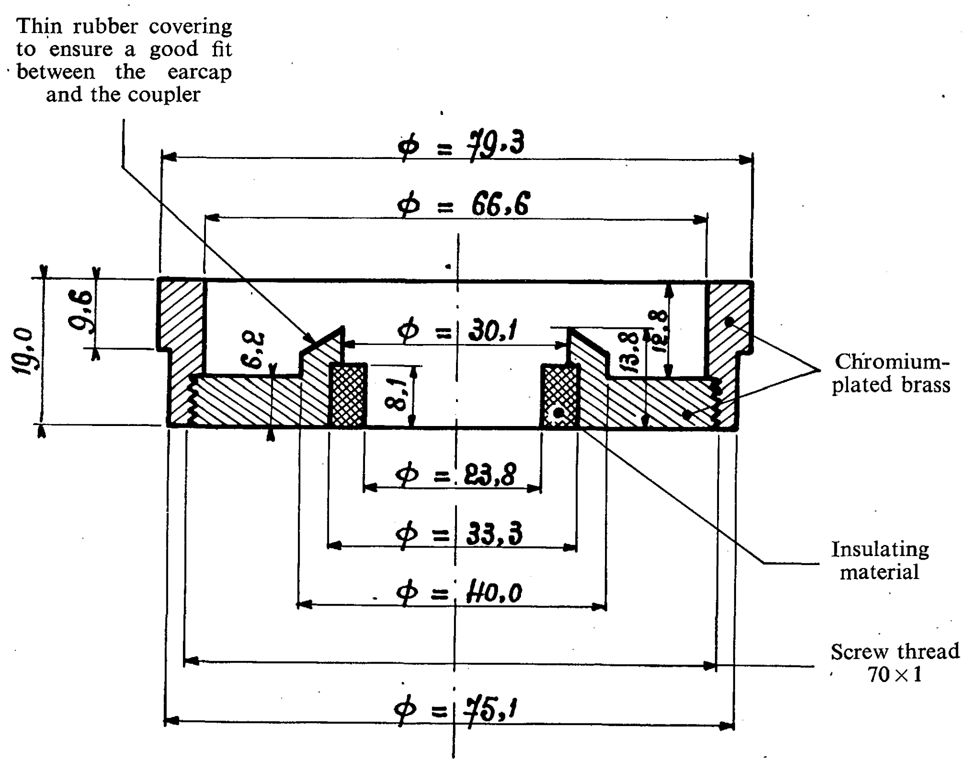
(to Question No. 12)

Reference artificial ear provisionally chosen by the XVIIth Plenary Assembly of the C.C.I.F.

The XVIIth Plenary Assembly of the C.C.I.F. has taken a provisional decision on the choice of a reference artificial ear to be used by Administrations and Private Operating Agencies participating in the work of the C.C.I.E., as well as for the C.C.I.F. Laboratory, while waiting for the International Standards Organisation or the International Electrotechnical Committee to standardise an artificial ear of more general use.

The object of this decision was simply to permit comparison between the results of objective measurements made on telephone receivers in the C.C.I.F. Laboratory and in the national laboratories. Since it was a provisional decision, the simplest procedure was to take as a reference artificial ear one that had the simplest construction and which had been the subject of a detailed specification. It was therefore decided to adopt the artificial ear used in the United States of America and in many other countries of the world by telephone Administrations and by manufacturers. It is pointed out that with this artificial ear, certain precautions must be taken in the application of telephone receivers whose ear-caps are of small diameter and which are relatively flat.

The exact dimensions of the reference artificial ear used in the C.C.I.F. Laboratory are defined in the Figure above, where it will be found that no indication has been given of the slope of the inclined surfaces against which the ear-cap of the telephone receiver being measured is applied. Administrations who wish to do so may, without objection, alter this slope to ensure a better fit on this artificial ear, for the receiver that they use. Evidently, all the dimensions which determine the volume of air included between the artificial ear itself and the plane of separation of the telephone receiver having been fixed, the total volume included between the artificial ear itself and the receiver ear-cap varies according to the type of receiver employed and is not maintained at the constant value of 6 cm^3 laid down in the American standard Z.24.9.1949. By way of information those passages of that standard which are not in contradiction with the definition of the artificial ear used by the C.C.I.F. are reproduced on pages 24 to 38 of the Document " C.C.I.F. — 1952/1954 — 4th S.G. — Document No. 59 ".



Note. — All dimensions are given in millimetres.

C.C.I.F. Reference artificial ear

Question No. 13.

(Category B) [non-urgent] (continuation of Question No. 14 studied in 1952/1954).

Collection of information :

1. On the effects which the non-linear distortion of a subscriber's telephone apparatus has on the quality of telephone transmission.

2. On methods of measuring the non-linear distortion of subscriber's telephone apparatus, and :

3. On the effects of carbon microphone noise in subscriber's telephone apparatus on the quality of telephone transmission.

Note. — The documentation collected up to the present time forms the subject matter of the Annexes 1, 2 and 3 below.

ANNEX 1

(to Question No. 13)

Important contributions to the study of this question have been made by the German and British Administrations in particular.

The German Administration has gone deeply into the question of the impairment of transmission quality due to the non-linear distortion of microphones. As the carbon microphone has, in addition to its non-linear distortion, a very pronounced frequency distortion, the first necessity was to ascertain the effect of this frequency distortion. For that purpose a filter network was constructed, reproducing te frequency distortion of the carbon microphone. This filter network was inserted after the condenser microphone of the reference system for telephone transmission ; this condenser microphone itself had neither non-linear distortion nor frequency distortion. It was thus possible to determine the impairment of articulation due to the frequency distortion. To study the effect of non-linear distortion on articulation, another device was inserted after the condenser microphone and the filter network reproducing the frequency distortion of a carbon microphone ; this device introduced a measurable non-linear distortion in the form of an amplifier valve in which the polarization voltage of the grid was varied (the coefficient of harmonic distortion was measured by Küpfmüller's bridge).

For information it may be stated that the impairment of articulation due to frequency distortion was, in a given case, 4%, whilst the impairment of articulation due to non-linear distortion was about 10% (see document " C.C.I.F. 1935/1936 — Transmission — Document No. 17 ").

The German Telephone Administration, in the course of more recent researches, obtained the dynamic characteristics of carbon microphones (relation between the acoustic pressure on the diaphragm and the e.m.f. furnished by the microphone), by means of a cathode ray oscillograph (Braun tube). The characteristics obtained in these researches had the shape of loops, the incurvation of which was more marked according to the amount of acoustic pressure applied.

In consequence of tests made by the British Telephone Administration, the following different factors have been considered :

1. *Amplitude effect.* — The operating characteristics of the microphone at various frequencies vary as a function of the acoustic pressure applied to the diaphragm ; they depend also on the intensity of the feed current.

2. " *Flutter* " *effect.* — If two sinusoidal waves are applied simultaneously to the diaphragm of the microphone, the efficiency of the microphone for one of these waves depends also on the characteristics of the other.

3. *Production of harmonics.* — The second harmonic appears practically independent of acoustic pressure on the microphone diaphragm, and of frequency. Nevertheless, it is not yet known whether this second harmonic depends on the feed current. It is thought that this harmonic might be used as a criterion of non-linear distortion. It should also be pointed out that no well-defined relation has been found between the intensity of this second harmonic and the magnitude of differential sounds.

4. *Production of sub-harmonics.* — The production of sub-harmonics has been observed when amplitude of acoustic pressure applied to the microphone diaphragm has been higher than a certain value.

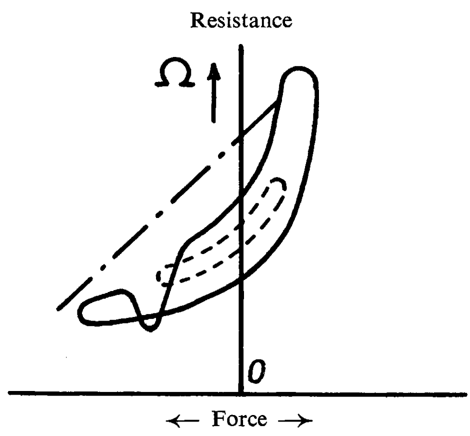
5. Articulation tests analogous to those carried out by the German Administration have also been undertaken. An electrodynamic microphone was chosen which, for a given acoustic pressure, has the same operating characteristics at different frequencies as the carbon microphone utilized. A very great improvement in articulation was observed with the electro-dynamic microphone, in which there is no non-linear distortion.

Although the variation in resistance of the carbon microphone may have a certain relation to the non-linear effect (notably amplitude effect), it does not appear that the variation of resistance can be taken as a criterion of non-linearity.

A further contribution has also been made by Dr. Sutton. In particular, he has presented formulae relating the operating characteristic at various frequencies to the electro-acoustic-mechanical parameters of the microphone.

Thus, given the characteristics of a microphone, it is possible to plot its operating curves at various frequencies or, given these curves, to ascertain its parameters. The calculated results have been found to agree very well with those ascertained by experiment.

In a later study, Dr. Sutton has investigated the causes of non-linearity in the carbon microphone. He, first of all, inquired whether transitory phenomena in the vibrating portions of the microphone might be the cause, but it was ascertained that the effects of these were negligible. He then investigated whether the mechanical construction of the microphone housing or other metal parts had any effect, but results were again negative. Tests were than carried out on the transmitter inset itself. When the acoustic pressure is increased, whilst remaining within the limits encountered in a normal conversation, a certain pressure value is found, above which a " rebound " effect is produced, resulting in a very recognizable sound. This proves the existence, within the normal limits of acoustic pressure



· — · — · — Ideal line
———— Curve *with* a " bend " for high values of mechanical force
— — — — Curve *without* a " bend " for low values of mechanical force

FIGURE 1

encountered in telephony, of a critical value of acoustic pressure. With the aid of a cathode ray oscillograph, a curve was traced showing the variation in electrical resistance of the transmitter inset as a function of the steady sinusoidal mechanical force applied to the diaphragm of the microphone (Figure 1).

Further, in view of the assembly used, the relation given in the two scales hereunder was found to exist between this force and the corresponding acoustic pressure.

It will be noted that the curve shows a very distinct " bend " for all values of acoustic pressure above the critical pressure. The curvature and slope of this characteristic explain the various non-linear effects observed in a microphone.

During tests on the cathode ray oscillograph screen, the lower part of the curve was extremely stable. The upper part, corresponding to the low pressures where non-linearity is serious, was in constant agitation indicating great instability in the transmitter inset*.

By displacing in a magnetic field a coil fixed to the diaphragm a voltage is obtained proportional to the speed of the diaphragm. By applying this voltage to an integrating electrical device, another voltage can be obtained, proportional to the displacement of

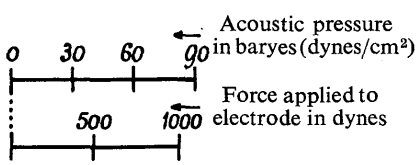


FIGURE 2

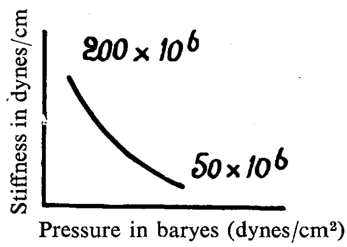


FIGURE 3

the diaphragm. By applying this latter voltage to one of the pairs of plates of a cathode ray oscillograph, and by applying to the other pair a voltage proportionate to the mechanical force exerted on the diaphragm, a fresh curve is obtained, and it is observed that this latter exactly coincides with the first curve obtained.

There is therefore no phase displacement between the movement of the diaphragm and the variations in the resistance of the transmitter inset, at the frequencies used in these tests.

Moreover, from Dr. Goucher's work relating to a single contact between a carbon granule and a smooth (plane) electrode, it is possible to determine for a given transmitter inset the curve of mechanical stiffness of the granules in dynes per sq. cm, as a function of the acoustic pressure applied to the diaphragm expressed in bars.

The curve shown above is obtained, and its incurvation partly explains the non-linear effect. Summing up, therefore, it appears that this non-linear effect is due to two main causes :

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* It is true that in the higher part of the curve the alternating force is large, but it acts in opposition to the static pressure on the granules ; consequently the resultant force is small. On the other hand, the alternating force in the lower parts of the curve acts in the same directions as the static pressure on the granules, and the resultant force is therefore large. On the above diagram, the alternating force only is used in the abscissae, and not the static pressure on the granules, which is always present.

1. The mechanical " rebound " of the diaphragm when the acoustic pressure, whilst remaining within the ordinary limits encountered in telephony, reaches or exceeds a certain critical value, and
2. The variation of the mechanical stiffness of the granules as a function of the acoustic pressure applied.

Likewise, Dr. Hartmann has recalled that attempts to predetermine by calculation the production of harmonics in carbon microphones have never been satisfactory when " univocal " functions were assumed. There has never been any acceptable agreement between the calculated results and measurements of commercial carbon microphones. He has also drawn attention to the existence in carbon microphones of an " operating threshold ". In addition to the mechanically stable operating zone and the unstable operating zone, there is also, within the range of variable pressure encountered in practice, a first zone of non-operation of the microphone. In Germany, particular attention has been paid to the study of the production of differential sounds by Messrs. von Braunmühl and Weber's method, *i.e.* by applying two sinusoidal waves of different frequency to the microphone. It has been observed that no definite relation exists, on the one hand between the amplitude of the differential sounds and the amplitude of the harmonics, and on the other hand between the magnitude of these differential sounds and the reduction of transmission quality observable by the ear.

Finally, the S.F.E.R.T. Laboratory carried out during 1936 and 1937 a series of experiments on the subject of non-linear distortion, using German, British, French and Swedish microtelephone sets. It is desirable that these sets should be physically tested by the respective Administrations concerned, with a view to determining the magnitude of the following values, which may be taken into consideration as a criterion of non-linearity :

1. They should determine the percentage ratio of the square root of the sum of the squares of the amplitudes of the harmonics and sub-harmonics at the microphone output, and the effective value of the fundamental, also measured at the microphone output. This value gives the effect of harmonic distortion. The test should be made with a sinusoidal wave applied to the microphone as follows :

(a) The source of sound is a loudspeaker placed in a room where reverberation is small, or in front of an open window.

(b) The coefficient of harmonic distortion in the loudspeaker, for measuring purposes and for the various sounds and intensities used, should be less than 1 %.

(c) The microphone is placed 3 cm in front of the plane of the base of the loudspeaker cone, the microtelephone set of which it forms part being turned the same way as for telephonometric measurement (see *White Book*, Vol. IV, pages 187 and 188). The axis of the loundspeaker from which sounds are obtained should coincide with that of the guard ring on the microtelephone set.

This relatively short distance of 3 cm is intended to reduce the effects of reflection, and to make it possible to obtain relatively high pressure values without overloading the loudspeaker.

(d) The acoustic pressures to which reference is made are, by convention, those which would actually exist on the diaphragm of a condenser microphone having the same geometrical characteristics as the S.F.E.R.T. microphone, with the plane of its base parallel to that of the loudspeaker cone, and situated 3 cm from the latter, and its axis coinciding with that of the loudspeaker. To determine pressures by this method, the condenser microphone should be substituted for the microtelephone set. The plane of the base of the condenser microphone and its axis coincide respectively with those of the guard-ring on the microtelephone set. Pressure on the diaphragm of the microtelephone set is not directly known, and depends on the form and construction of the latter.

(e) Effective pressures on the diaphragm of the condenser microphone should be successively equal to 5, 11 and 60 baryes* (these pressure values correspond approximately to the three volumes used in the S.F.E.R.T. Laboratory for the 4th series of experiments regarding the effect of non-linearity in the microphone upon articulation).

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* barye = dyne/cm^2

f) Measurements should be made for the pressure values indicated above, and for frequencies stepped by 100 c/s, between 700 and 1500 c/s. The value characterizing the non-linear distortion of the microphone for the pressure considered will be defined by taking the mean of the nine values thus obtained.

(g) The coefficient of harmonic distortion (defined on page 62 of Vol. I *bis* of the *White Book*) is deduced from the result of a measurement taken in accordance with the method indicated in the *White Book*, Vol. IV, page 164.

2. After study of the operating characteristics at the various frequencies, measurements will be made of the absolute sinusoidal efficiency of the microphone at a frequency corresponding to the highest peak in the characteristics for the frequency band effectively transmitted. The results will be presented as a curve, the abscissae for which will be the relative values of acoustic pressure expressed in decibels with regard to 1 barye, and the ordinates the absolute efficiencies expressed in decibels with regard to 1 volt per barye.

3. It would also be interesting, if the above-mentioned Administrations can do this, to obtain information on the dynamic characteristics of the microphone : the relation between the instantaneous resistance of the microphone and the instantaneous E.M.F. wich it produces. These tests would be made under steady sinusoidal conditions at the chief resonant frequency, in the frequency band transmitted.

All these tests will be made on commercial microtelephone sets as similar as possible to those sent to the S.F.E.R.T. Laboratory.

ANNEX 2

(to Question No. 13)

Some time ugo, the German Administration, undertook a thorough investigation of the question of non-linear distortion of telephone transmitters *. It was found from this investigation that there are two causes of non-linear distortion.

1. The stiffness of the carbon granules depends on the amplitude of vibration and
2. The contact resistance of the carbon granules depends on the contact pressure.

The variation of stiffness as a function of the amplitude of vibration is of prime importance for the non-linear effect of the carbon microphone. It produces the harmonics and, if they are present, the sub-harmonics. The principle harmonic appears strongly at frequencies one half and one third that of resonance. When the amplitude of the fundamental frequency reaches a certain value, sub-harmonics can also be produced, and very strongly in the case of a frequency which is about to twice the frequency of resonance.

Moreover, the variation of stiffness as a function of amplitude involves, in proportion as the amplitude increases, a sharp decrease of the frequency of resonance, and a change of the sensitivity of the microphone ; that is to say that first the sensitivity of the microphone increases with the sound pressure and then it decreases when the sound pressure reaches high values.

In the case where the coefficient of distortion of a microphone is measured as a function of the displacement of the diaphragm it is seen to be nearly analogous to measurement at different frequencies, if large amplitudes of displacement of the diaphragm are excluded. This shows the non-linear reaction of the microphone is essentially controlled by the displacement of the diaphragm.

It two sounds are applied simultaneously to the microphone, instead of one sound, not only are harmonics produced but also a spectrum of sum and difference frequencies. The amplitudes of the sum and difference components depend on the ratio of the frequencies

* K. BRAUN (T.F.T.), Band 27 (1938), pages 395-404. — K. BRAUN (T.F.T.), Band 28 (1939), pages 115-120.

of the two applied sounds. The main difference sound of the two exciting sounds appears most strongly when the difference of frequency of these two sounds is about equal to the frequency of resonance. Similarly the sum component appears most strongly when the sum of the frequencies of these two sounds is equal to the frequency of resonance.

Besides the appearance of this spectrum, the sensitivity again varies as a function of the two fundamental components, that is to say that the sensitivity for one sound changes when the second sound is applied.

The non-linear distortion of a good-quality telephone receiver can be neglected by comparison with that of the microphone. That is why attention need be given only to the characteristics of the non-linear distortion of the microphone.

The Administration of the Federal German Republic has continued its investigations of carbon microphones. From these investigations it is found that if sound is applied to a microphone, noise voltages are produced, as well as the harmonics and combination frequencies. These additional voltages can be observed with a cathode-ray oscilloscope if the characteristic curve of a microphone is traced with a pure tone applied to the microphone. With unstable microphones the characteristic curve does not remain steady, moreover it is not constant and has irregularities. To a listener these phenomena of instability, are found to have a strongly detrimental influence on the quality of the microphone. The equipment including a cathode ray oscilloscope is not very convenient for making quantitative measurements.

The method of M. K. Braun for measuring the parasitic modulation voltages lends itself to this end. A sound whose frequency varies between 200 and 4000 c/s to replace the voice spectrum is applied to the microphone inset and measurement is made, at the output of a high-pass filter whose cut-off frequency is 5000 c/s, of non-linear components and components of additionally excited parasitic voltages present outside the spectrum of the variable-frequency sound. Using this method with a suitable voltmeter, e.g. a psophometer, variations of the carbon microphone which often occur in a spontaneous manner can be easily observed. This is especially suitable in the case of measurements of a large number of microphones.

It is found from the results of measurements that in general, the parasitic modulation voltage increases when the sensitivity of the carbon microphone increases. To obtain a relation between the alternating voltage of the microphone and the parasitic modulation voltage it is preferable to show their ratio as the difference of the logarithmic values of the two measured voltages. This value can vary between about 2 and 4 nepers according to the quality of manufacture and extent of use. Given that the sensitivity of the microphone does not vary too much in relation to the permitted tolerances of the referenc equivalent for sending, it is generally sufficient to determine a maximum admissible value for the parasitic modulation voltage. It is found from measurements, checked by subjective tests, that a value of about 20 mV can be permitted for a parasitic modulation voltage. This value is arrived at when the voltage is measured at the ouput of a high-pass filter whose cut-off frequency is 5000 c/s.

Based on these investigations, the Federal German Republic can give the following replies :—

(a) Non-linear distortion is not, by itself, sufficient for showing up the instability of the characteristics of a telephone transmitter, because it does not take account of the service noise of the microphone. For determining the whole distortion, that is to say the non-linear distortion and the instability distortion, it is recommended that the parasitic modulation voltage be measured.

(b) The parasitic modulation voltage can be measured by applying to the microphone a sound whose frequency varies between 200 and 2400 c/s to replace the voice spectrum, and by measuring a portion of the additionally excited oscillation through a suitable filter, e.g. high-pass with a cut-off frequency of 5000 c/s.

(c) Parasitic modulation voltages up to about 20 mV have no substantial effect on the transmission performance of carbon microphone.

ANNEX 3

(to Question No. 13)

Results of tests conducted by the Telephone Administration of the Federal German Republic on non-linear distortion in subscriber's telephone apparatus

The method employed in these tests is represented schematically, in Figure 1.

A sound of frequency variable between 200 and 4000 c/s is applied to the microphone capsule and the additional voltage which appears outside the band of frequencies of the variable frequency sound, is measured as a parasitic modulation voltage at the output of a high-pass filter of cut-off frequency 5000 c/s (see Figure 2). Figure 3 shows the variation of the modulation voltage as a function of the number of conversations for two different types of microphones. For comparison this figure also shows for one type of microphone the noise voltage in the quiet condition, which is much smaller than the parasitic modulation voltage. Figure 4 shows the statistical distribution of parasitic modulation voltage for almost new microphones and for microphones which have been used a great deal.

The investigation has been broadened in that the noise while in use has been measured as a parasitic modulation voltage in the band of frequencies transmitted by the microphone as a function of the excitation frequency. For this purpose, the microphone, without mouthpiece, was excited by a sinusoidal sound of about 11 dynes per square centimeter. To eliminate the exciting frequency f and the harmonics produced in the microphone, a band-pass filter has been inserted at the output of the feeding bridge of the telephone apparatus, the band of the filter being such as to transmit only those components of the noise voltage between f and $2f$. This voltage was measured as a parasitic voltage and referred to a bandwidth of 400 c/s. Figure 5 shows the results obtained for two different microphones. For comparison the results obtained with a bad microphone (Microphone Capsule 1) have also been included. The full curve shows the " sensitivity-frequency " characteristics of the microphone ; this shows the useful voltage produced when the microphone is excited with a constant acoustical pressure of variable frequency. The dotted curve shows the parasitic modulation voltage produced by a sinusoidal sound. It has fundamentally the same shapes as that of the " sensivity-frequency " characteristic but the peaks and troughs are much greater. Near the frequency of resonance the ratio of the useful voltage to the parasitic modulation voltage produced by a sinusoidal sound can be very small if the microphone is a bad one. Noise can then represent a serious degradation. For this reason very marked resonances when carbon microphones are used can have an adverse effect not only upon the " sensivity-frequency " characteristic but also on that of the noise voltage.

For comparison the noise under quiet conditions has been measured in the whole frequency band of the instrument used for measurement of the parasitic voltage. The noise voltage under quiet conditions varies, according to the quality of the carbon microphone, between a lower and an upper value, and so the two values have been recorded ; the ratio of these two values becomes smaller as the microphone is more stable. Furthermore the parasitic modulation voltage above 5000 c/s has also been recorded, measured with a sound of frequency variable between 200 and 4000 c/s. For the two microphones, the ratio of the maximum noise voltage under quiet conditions and the parasitic modulation voltage is about 20 decibels. The parasitic modulation voltage can therefore be used as a criterion of noise voltage under quiet conditions.

The part of the noise voltage under working conditions which falls in the band of frequencies transmitted by the microphone is a controlling factor in loss of articulation. To enable this part to be determined the components of the parasitic voltage in the band of frequencies 300 to 3400 c/s and in the band of frequencies above 5000 c/s have been measured for the maximum noise voltage under quiet conditions, which is approximately equal to the parasitic modulation voltage. The ratio of these two voltages depends upon the shape of the noise spectrum. The more unstable the microphone the more the lower frequencies are represented. In general the parasitic modulation voltage for the frequency band 300 to 3400 c/s is about 1.3 to 4 times greater than the parasitic modulation voltage above 5000 c/s, but it can have still more unfavourable values.

Nevertheless, when a sound is applied to a microphone, the ratio of the useful voltage due to the parasitic modulation voltage above 5000 c/s is about 17 to 34 decibels and so the ratio of speech to noise voltage under working conditions can, in the case of bad microphones, be less than 17 decibels which would considerably reduce the articulation. For carbon microphones which have been used a great deal, the loss of articulation can consequently be partly due also to the noise voltage under working conditions.

It is therefore important to determine the noise voltage under working conditions of carbon microphones and to set maximum values for it. The method using the parasitic modulation voltage which is described above is particularly suitable for this purpose.

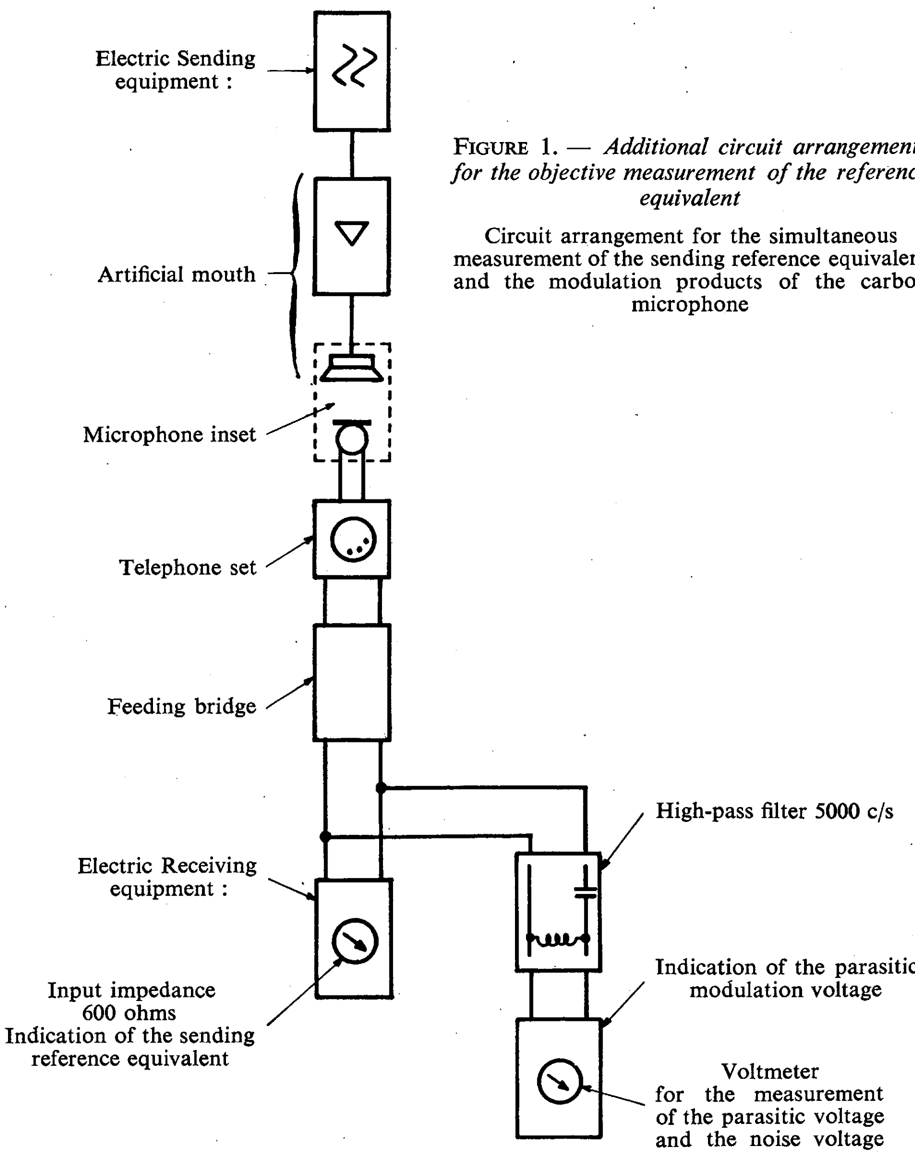


FIGURE 1. — *Additional circuit arrangements for the objective measurement of the reference equivalent*

Circuit arrangement for the simultaneous measurement of the sending reference equivalent and the modulation products of the carbon microphone

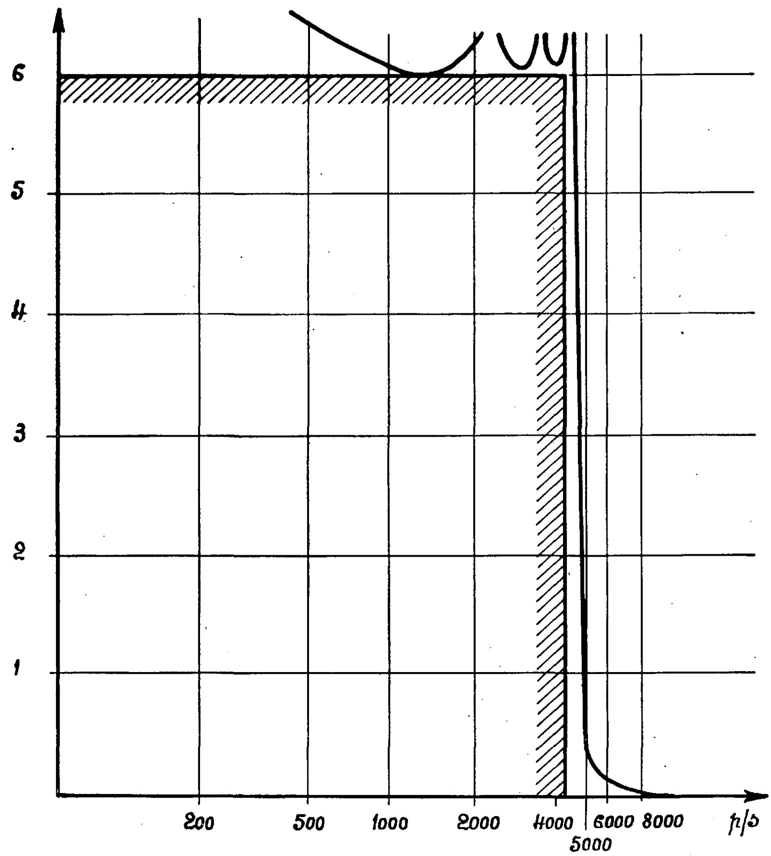


FIGURE 2. — *Composite attenuation of the 5000 c/s high-pass filter*

$$\alpha_{loss} = ln\ \frac{U\ \text{speech}}{U\ \text{loss}}$$

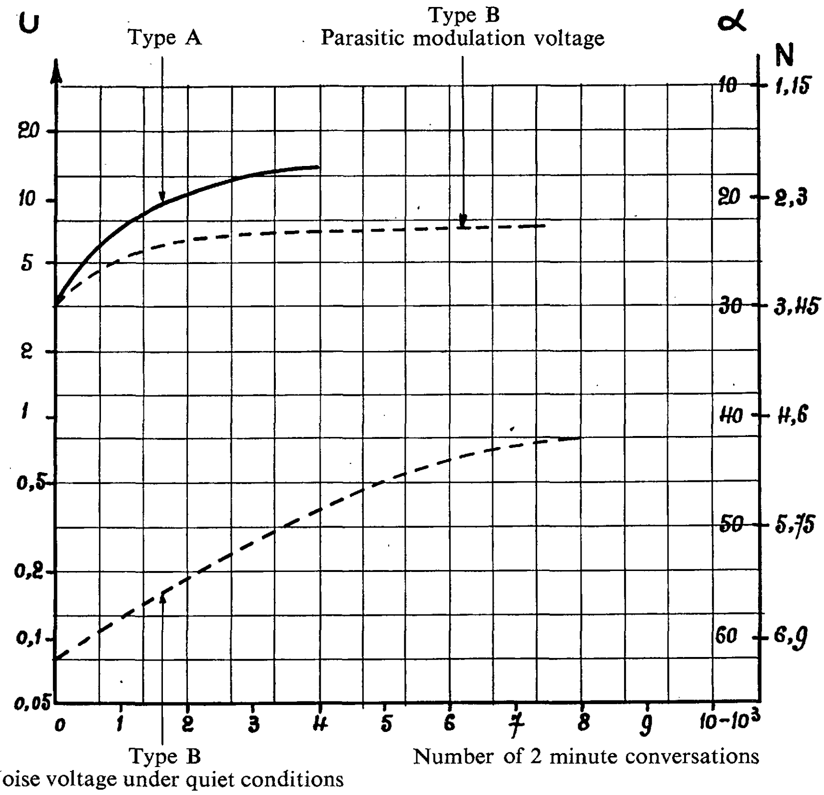


FIGURE 3. — *Parasitic modulation voltage and noise voltage under quiet conditions*

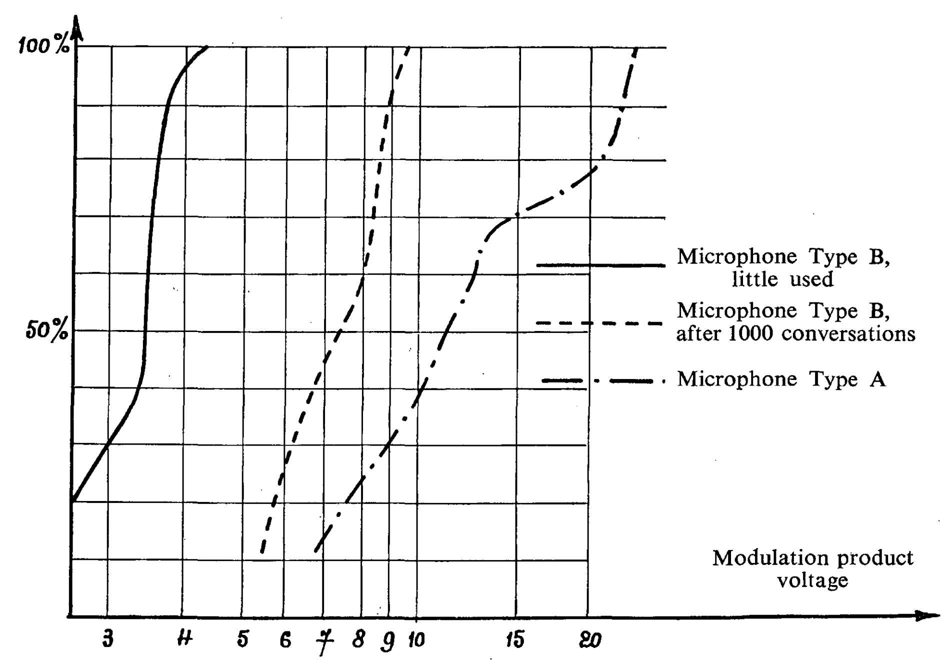
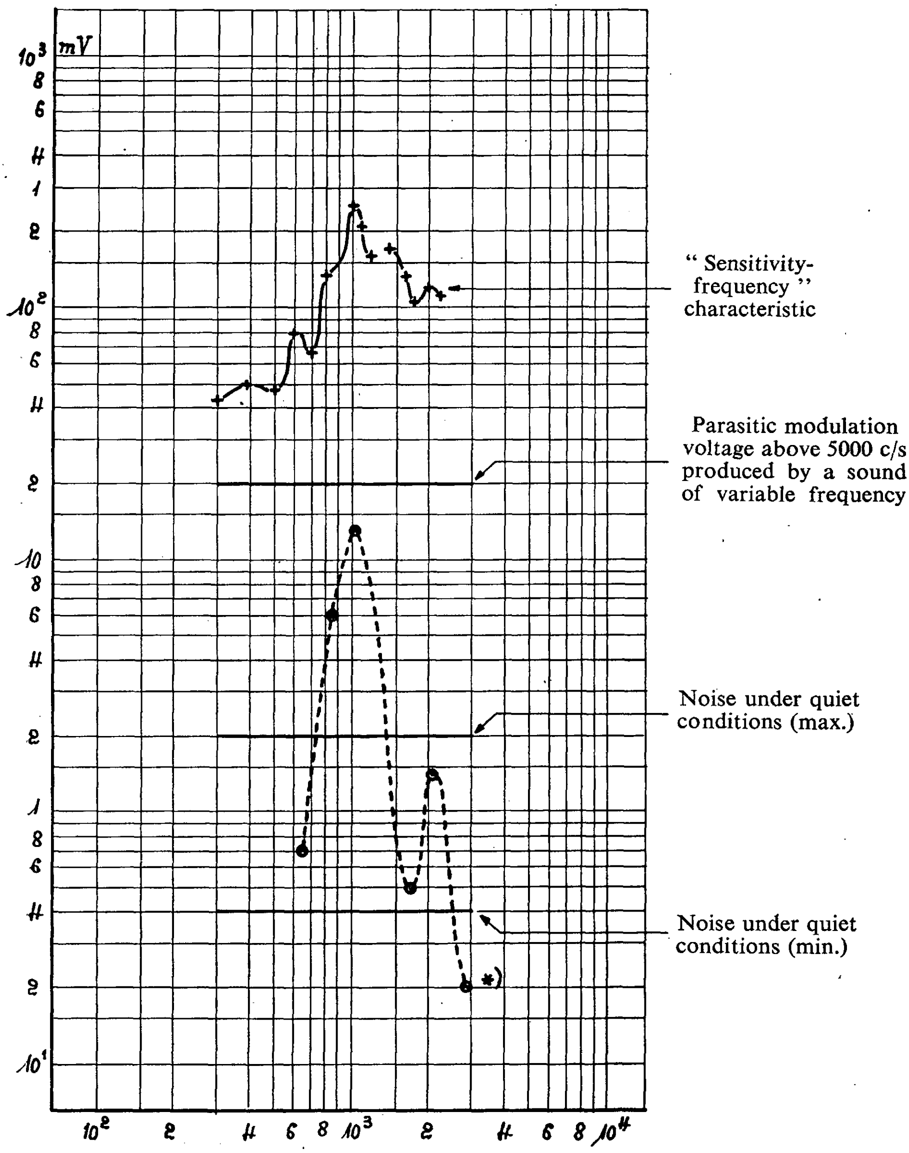
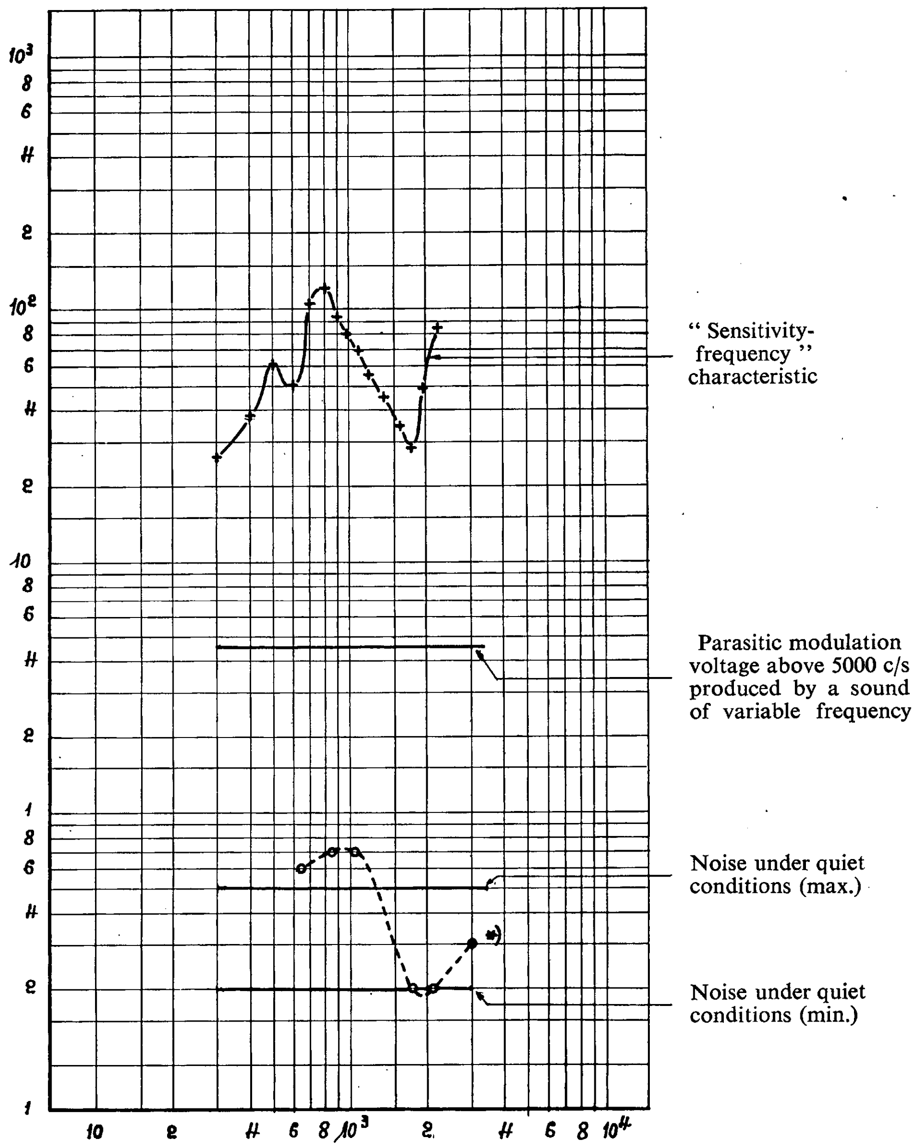


FIGURE 4. — *Statistical distribution of the parasitic modulation voltages of telephone transmitters, measured at the output of the apparatus*



* Ten times the parasitic modulation voltage due to a sinusoidal tone, referred to a bandwidth of 400 c/s between the sound and its octave

FIGURE 5 *a*. — *Transmitter inset 1*



* Ten times the parasitic modulation voltage due to a sinusoidal tone, referred to a bandwidth of 400 c/s between the sound and its octave

FIGURE 5*b*. — *Transmitter inset 2*

Question No. 14.

(Category A 1) [urgent] (continuation of question No. 16 studied in 1952/1954)

Arrangement of accomodation reserved for the C.C.I.F. Laboratory in the new building of the International Telecommunication Union at Geneva.

Question No. 15.

(Category B) [non-urgent] (continuation of Question No. 17 studied in 1952/1954)

Administrations and private operating companies are asked to send to the Secretariat of the C.C.I.F. a bibliography of all publications (in their own language) which they consider as presenting a general interest in the study of the subjects concerning the 4th Study Group of the C.C.I.F.

Supplementary Question A.

(Category A 2) [urgent] (new question)

Should the conditions of positioning of the handset during A.E.N. sending measurements at the C.C.I.F. Laboratory be revised ?

If so, how should the position of the handset be specified precisely, taking into account the normal method of use of inset microphones in telephone service ?

Supplementary Question B.

(Category A 2) [non-urgent] (new question)

What conditions should be satisfied (from the point of view of telephone transmission) by subscribers' telephone stations which may be used for international calls and which include loudspeakers or broadcasting type microphones with amplifiers ?

Note. — This relates to the revision of pages 53 to 62, Vol. V of the *Yellow Book.*

SUMMARISING TABLE

Of questions the study of which the 4th Study Group should undertake or continue in 1955, 1956 and 1957

Question No.	SUBJECT MATTER, IN BRIEF	CATEGORY	STUDY GROUP (other than 4th S.G.) or international organisations interested	REMARKS
1	Methods of reading a volume meter	A 1	3rd and 5th S.G.	Non-urgent (old Question No. 1 continued)
2	Measurement and limits of reference equivalent for side-tone	B		Non-urgent (new question)
3	Measurement of clicks	A 1	3rd and 8th S.G.	Non-urgent (New question)

Question No.	SUBJECT MATTER, IN BRIEF	CATEGORY	STUDY GROUP (other than 4th S.G.) or international organisations interested	REMARKS
4	Correction of psophometric readings to take account of type of noise	A 1	1st and 3rd S.G	Urgent (old Question No. 4 continued)
5	Permissible value of noise reproduced by a subscriber's receiver	A 1		Urgent (old Question No. 5 continued)
6	Variation of signal-to-noise ratio in an international call	A 2	3rd and 5th S.G.	Urgent (Question No. 6 of 5th S.G. and Question No. 23 of 3rd S.G.)
7	Determination of transmission performance ratings from objective measurements	A 1		Urgent (old Question No. 7 continued)
8	Experience obtained of a provisional rule concerning transmission performance ratings of national systems	B	3rd S.G.	Urgent (old Question No. 8 continued)
9	Limits applied in national trunk and junction networks	B	3rd S.G.	Urgent (new question)
10	Limits for the efficiency of local systems	A 2		Urgent (new question)
10 *bis*	Measurement of sensitivity of a carbon microphone	A 1	3rd S.G.	Urgent (new question)
11	Statistical methods of controlling subjective tests	B		Non-urgent (old Question No. 14)
12	Artificial voices, mouths and ears	B		Non-urgent (old Questions Nos. 12 and 13 continued)
13	Non-linear distortion of telephone apparatus	B		Non-urgent (old Question No. 14 continued)
14	C.C.I.F. Laboratory premises	A 1		Urgent (old Question No. 16 continued)
15	Bibliography	B		Non-urgent (old Question No. 17 continued)
A	Positioning of handsets in A.E.N. measurements	A 2		Urgent (new question)
B	Loudspeaker telephones	A 2		Non-urgent (new question)

LIST OF QUESTIONS

concerning radiotelephone circuits, radio-relay links and connections with mobile telephone stations the study of which is to be undertaken or pursued by the 5th Study Group of the C.C.I.F. during 1955, 1956 and 1957

I. — QUESTION CONCERNING MOBILE RADIO-TELEPHONE STATIONS

Question No. 1.

(5th Study Group in co-operation with the 8th S.G. of the C.C.I.F. and with the C.C.I.R.) (Category A 2) [non urgent] (continuation of Question No. 1 of the 5th Study Group studied in 1952/1954)

What method of signalling is to be recommended for telephone links between mobile radio-telephone stations and international telephone lines when these mobile radio-telephone stations may be called in order to communicate with land stations of several countries ?

Note 1. — The signalling systems at present in use in various countries are described in the Annex which follows.

Note 2. — When considering the case of cars, trains and ships (on rivers and in coastal waters), the band of frequencies effectively transmitted should be taken into consideration.

ANNEX

(to Question No. 1)

Signalling systems employed in various countries for connections between mobile stations and the public telephone network

AUSTRIA

The signalling equipment should be placed in the telephone exchange of the public telephone network to which the fixed transmitter is connected, and the receiving equipment installed in a convenient locality near the exchange. It should be capable of transforming to high frequency, and vice-versa, all the low frequency signals required for setting up and closing down a call, as well as for costing the duration of a call.

Calling using equipment with a single radio channel. — Calling a mobile station should be carried out by the selection of a calling number assigned to the vehicle. At the instant when an operator (or a subscriber) of the public telephone network occupies the radio channel considered, all the mobile stations should first be blocked in order to establish the call by sending the carrier frequency. The blocking should be effective at the end of a delay of 250 milliseconds, more or less, after the emission of the carrier frequency has commenced. Then all the mobile stations should be prepared for the reception of the dialling impulses by the emission of a preparatory selection signal. Finally the train of dialling impulses is transmitted, by which the bell is rung only in the mobile station appropriate to the dialled number.

The number of called vehicles should amount to about thirty.

The delay in operation of the equipment, controlled by the carrier frequency in the mobile stations, should be chosen in such a way that the suppression of the carrier for short intervals during the emission of dialling impulses by vehicles does not release the fixed receiving equipment.

Calling using equipments with several radio channels. — A special additional device, completing the signalling equipment, has to seek the called subscriber after having seized the transmitter of a free radio channel, the consequent emission of dialling impulses having to perform the same functions as in the case of a single radio channel.

The reply to the call should arrive within a delay of 60 seconds, if not the connection is interrupted by a timing device in the signalling equipment. The calling lamp indicator continues to glow in the mobile stations to indicate to the traveller in the vehicle that the call has not been completed.

At the instant when the called vehicle replies to the call, the lifting of the telephone receiver should establish the completion of the circuit to the telephone exchange and start the charging device.

By replacing the telephone receiver, the vehicle station should likewise be able to free the connection at any time.

The calling of a switching exchange or any subscriber's station on the telephone network from a mobile vehicle station should be carried out by lifting the telephone receiver, the radio channel being free.

The signalling equipment should be prepared by the emission of a seizing pulse, on the reception of the call, in the case of a manual exchange, and on the reception of dialling impulses in the case of automatic selection of the desired telephone station ; the transmitter of the fixed station should block all the other mobile stations. The blocking should be effective at the end of 250 milliseconds or more.

In any case, the wanted station should be ready to receive calls emanating from the fixed transmitting and receiving equipment.

The duration of the conversation should be limited to 3 or 6 minutes.

By the replacement of the telephone receiver in the mobile station, a release signal should be emitted and should cause the interruption (manually or automatically) of the connection in the signalling equipment. During the release time, the signalling equipment should be blocked from other demands.

The blocking of other stations not taking part in a conversation or in the establishment of a connection should be complete as far as possible. Unauthorised overhearing or mutual interference between conversations should certainly be avoided.

BELGIUM

In the Belgian inland mobile radio-telephone service, the " non-engaged " condition is indicated by the *absence* of a carrier-wave radiated by the base station ; this absence has the result of putting in a waiting condition all the mobile stations. The *presence* of this carrier wave consequently blocks all the mobile stations except that concerned in the communication in progress.

FEDERAL GERMAN REPUBLIC

In the mobile service stations with selective calling, the " non-engaged " ready-for-use condition is indicated by the emission of a signalling frequency (the frequency of 2800 c/s is used in this connection). The mobile station calls the fixed station by the emission of a signalling frequency (in practice 1750 c/s).

SWEDEN

The Swedish Administration considers that § 5 on page 216 of Volume III *bis* of the *Yellow Book* should be modified as follows :

" 5. That when it is a question of communication between mobile radiotelephone stations and the public telephone network, by automatic means and through the intermediary, in the first place, of the inland stations of the country concerned, the voice-frequency signals employed on the radio-telephone link should not be liable to cause interference on the international channel used for the telephone communication concerned."

II. — QUESTIONS CONCERNING RADIO RELAY LINKS, TO BE STUDIED BY THE C.C.I.F. IN COOPERATION WITH THE C.C.I.R.

Question No. 2.

(5th Study Group in co-operation with the 3rd S.G. of the C.C.I.F. and with representatives of the C.C.I.R.) (Category A 2) [urgent] (continuation of Question A of the 3rd S.G. studied in 1952/1954)

When radio-relay system are used for international telephony, is it possible to recommend that the telephone channels should be assembled in the first instance, by methods used in frequency division multi-channel telephony, using terminal equipment of the type recommended by the C.C.I.F. for carrier systems on cable in which telephone channels are assembled into groups of 12 channels (of if necessary, supergroups of 60 channels) ; the output from this channel assembly equipment to be translated into the appropriate part of the radio frequency spectrum using the type of modulation judged the most appropriate (for example, frequency modulation or pulse modulation) ?

Note by the C.C.I.R. — When channels are assembled in Frequency Division Multiplex the C.C.I.R. recommends using C.C.I.F. type equipment *. However, Time Division Multiplex is also used for certain radio-relay systems, and a draft recommendation on the use of such equipment in international connections is contained in Document No. 46 of Study Group IX, 1954 **.

ANNEX 1

(to Question No. 2)

Extract from Doc. No. 69 (revised) of the C.C.I.R. (Geneva, 1954)

Notes of Study Group IX of the C.C.I.R. on Table 1

1. The level shown is referred to a point of zero relative level in the system, in accordance with the practice of the C.C.I.F.

For the cases in which the Table indicates not a single value of the level but a range of values, the C.C.I.R. will ask the C.C.I.F. to indicate a single preferred value ; this value will replace the range of values shown in the Table.

Notes by the C.C.I.F. Secretariat:

* See Annex 1 attached.

** See Annex 2 attached.

2. In the case of 12-circuit systems either of the basic groups A (12-60 kc/s) or B (60-108 kc/s), recommended by the C.C.I.F., may be accommodated in the band 12-108 kc/s.

3. This level corresponds to the output level recommended by the C.C.I.F. for 12 and 24-channel repeaters used with balanced-pair cables (C.C.I.F., Florence, 1951, Vol. III *bis*, page 99).

4. This band accommodates 60 circuit systems either in the band 12-252 kc/s with balanced-pair cables, or 60-300 kc/s with coaxial cables (C.C.I.F., Florence, 1951, Vol. III *bis*, pages 96 and 97).

5. This level corresponds to the output level proposed by the C.C.I.F. for 60 channel repeaters used with balanced-pair cables (C.C.I.F., Study Group 3, 1952/1954, Doc. No. 46, page 98).

Observations by the 3rd and 5th Study Groups of the C.C.I.F. relative to Table 1

Note 1 of this Table invites the C.C.I.F. to indicate for certain characteristics, instead of a range of values, a unique preferred value.

After discussion the 3rd and 5th Study Groups propose the introduction of the following definite values in the table :

For the relative power level for each telephone channel :

(1) at the input to a radio-relay system : — 52 db for the six cases considered ;

(2) at the output from a radio-relay system :

(a) for 24-channel systems in the band 12 to 108 kc/s : +4.5 db ;

(b) for 60-channel systems in the band 12 to 252 kc/s with a nominal impedance of 150 ohms, balanced : +1.75 db ;

(c) in all the other cases : —15 db.

Furthermore, the attention of the C.C.I.R. is drawn to the fact that in the future carrier-current systems transmitting, for example, 120 channels on balanced-pair cables, in the frequency band 12 to 552 kc/s, with a nominal impedance of 150 ohms, balanced, is envisaged. In this case the C.C.I.F. envisages the following values for the relative power level in each telephone channel :

— at the input to a radio-relay system : —52 db ;
— at the output from a radio-relay system : +1.75 db.

TABLE 1

Preferred Values for International Interconnection at Baseband Frequencies

Maximum number of telephone traffic channels	Frequency limits of baseband (kc/s)	Nominal impedance at baseband (ohms)	Relative power level per channel [1] (db)	
			Input	Output
24	12- 108 [2]	150 - bal.	—40 to —52	+4.5 [3]
60	12- 300 [4]	150 - bal. (for 12-252 kc/s)	—40 to —52	+1.75 [5]
		75 - unbal. (for 60-300 kc/s)	—40 to —52	—11 to —23
120	60- 552	75 - unbal.	—40 to —52	—11 to —23
240	60-1052	75 - unbal.	—40 to —52	—11 to —23
600	60-2540	75 - unbal.	—40 to —52	—11 to —23

ANNEX 2

(to Question No. 2)

C.C.I.R. Document 46 (revised)

Sub-Group IX B of Study Group IX

Draft Recommendation

International wide-band radio relay systems operating on frequencies above about 30 Mc/s

Interconnection of multiplex systems providing telephony circuits

The C.C.I.R.,

Considering :

(a) That frequency-division-multiplex in accordance with C.C.I.F. recommendations is used widely for multi-channel telephony on line and radio-relay systems, while time-division multiplex is used only for radio-relay systems of limited channel capacity ;

(b) That interconnections between systems employing frequency-division-multiplex in accordance with C.C.I.F. recommendations can readily be made for groups of 12 and supergroups of 60 channels ; while interconnections between existing time-division-multiplex systems on the one hand and frequency-division-multiplex systems on the other must be made in channels at audio frequencies ;

Recommends :

1. That, where for operational reasons all international connections to a radio-relay system must be made at audio frequencies, either a time-division-multiplex or a frequency-division-multiplex radio-relay system may be employed ;

2. That in such cases interconnection should be made on a 4-wire basis in accordance with the relevant C.C.I.F. rules ;

3. That where there are no operational reasons for an international connection between a radio-relay system and another radio-relay or line system to be made at audio frequency, then the first-named radio relay system should preferably use the same form of multiplexing as the system to which it is to be connected, in order to permit the connection to be made at baseband, intermediate or radio-frequency, as may be appropriate.

4. That in any case of international interconnection not adequately covered by the above, frequency-division-multiplex is in general to be preferred.

Note. — The recommendation contained in § 4 above may need to be reconsidered in the future if mixed T.D.M./F.D.M. systems (e.g. systems in which speech channels are first associated into groups by frequency-division-multiplex and in which these groups are thereafter multiplexed by time division) or more advanced time-division systems (e.g. using pulse-code modulation) become of importance.

Question No. 3.

(5th Study Group in co-operation with the 3rd and 4th S.G. of the C.C.I.F. and with representatives of the C.C.I.R.) (Category A 1) [urgent] (continuation of question B of the 3rd S.G. studied in 1952/1954).

(a) What are the relative advantages and disadvantages of the different systems of modulation which may be employed in radio-relay systems taking into account both technical and economic factors (e.g. frequency modulation or the various different types of pulse modulation)?

(b) What is the effect, for each of these types of modulation, on the over-all quality of telephone transmission?

Note 1. — The C.C.I.R. will provide the C.C.I.F. with general information on the different systems of modulation (within the scope of § 2.4 of study programme IX-28), the 3rd and 5th Study Groups can then study Part *(a)* of this question, and the 4th Study Group, Part *(b)*.

Note 2. — In certain cases instead of using a single radio system with a 300 Mc/s radio carrier, modulated in frequency and bearing the required number of telephone channels, it may be advantageous (in terms of economics and technique) to use several adjacent radio systems each carrying a smaller number of channels.

(c) What are the advantages and disadvantages of the various modulation processes, particularly from the point of view of the extraction of a certain number of other channels from a radio-relay system and from connection to a cable or another radio system, as well as from the point of view of the interconnection of radio-relay and coaxial-cable systems?

Note of the C.C.I.R. — The problem postulated in this question and other related matters are already being considered by the C.C.I.R. in the form of various C.C.I.R. Questions and Study Programmes. In due course, the results of these studies will be incorporated in Recommendations and Reports of the C.C.I.R. The C.C.I.R. will pay particular attention to any special effects that the modulation system may have on the quality of telephone transmission, and will transmit its findings to the C.C.I.F.

Question No. 4.

(5th Study Group in co-operation with the C.C.I.R.) (Category A 2) [urgent] (new question)

The use of multi-channel techniques in telephony, is made possible by the use of multiplex equipment.

At the present time two types of multiplex exist :—

— frequency-division multiplex,
— time-division multiplex.

Recommendations are in existence which define arrangements to be adopted for frequency-division multiplex systems.

However in the future time-division multiplex techniques are likely to be used and it is desirable to lay down recommendations for them. The following new question is therefore posed, in association with Questions IX-92 and IX-93 (reproduced in Section IV of the present list) of the VIIth Plenary Assembly of the C.C.I.R. (London, 1953) :—

(a) What are the technical characteristics of time-division multiplex systems which should be specified in order to be able to achieve international interconnection of two such systems ?

(b) What specifications should be drawn up for such characteristics and what standards should be laid down for international interconnection of such systems ?

(c) What conditions should be imposed on systems for various uses such as telephony, telegraphy, music circuits, television ?

Note. — It would be desirable to indicate for each type of multiplex considered (P.P.M., P.C.M., etc.).

— the pass-band required
— the effect of various distortions and transient disturbances
— limiting noise level
— etc.

Question No. 5.

(5th Study Group in co-operation with the 3rd S.G. of the C.C.I.F. and with representative of the C.C.I.R.) (Category A 2) [urgent] (continuation of question C of the 3rd S.G. studied in 1952/1954).

What methods are to be recommended for the extraction, at a branching station, of a number of channels on a broadband radio system, taking into account the general conditions relating to telephone transmission over these channels ?

Note by the C.C.I.R. — The C.C.I.R. does not anticipate that any difficulty will arise at a branching station in systems employing Frequency-Division Multiplex as Frequency-Division Multiplex methods recommended by the C.C.I.F. will be used. At a branching station in a system using Time-Division Multiplex, channels can be made available at audio frequency, and normal audio-frequency methods of connection can be used.

Question No. 6.

(3rd, 4th and 5th Study Groups in co-operation: question No. 23 of the 3rd S.G.: question No. 6 of the 4th S.G.) (Category A 2) [urgent] (continuation of question E ter *of the 3rd S.G. studied in 1953/1954, corresponds to question No. 112 of the C.C.I.R.)*

What is the variation (as a function of time) of the ratio between signal and noise which may be allowed on an international communication ?

Note 1. — It would be desirable to bring into alignment the specifications concerning total noise for carrier systems on coaxial-cable, symmetrical pairs and radio-relay links (see Question No. 1 below). On the other hand Administrations are asked to forward to the C.C.I.F. Secretariat the results of observations made on each of the systems as regards the variation of noiseas a function of time.

In particular, it would be useful to discover whether the noises conform to a normal or to a log-normal distribution (i.e. one which is normal if the psophometric power is expressed in decibels or nepers).

Note 2. — The C.C.I.F. Laboratory will carry out articulation tests under the following conditions. The Laboratory has already at its disposal recordings of typical noise produced at the end of a radio-relay link in the absence of telephone conversation. Administrations and private operating countries are asked to send as soon as possible to the Laboratory recordings on magnetic tape of the total noise, during the busy hour, on a telephone circuit on which there is no telephone conversation. This circuit should be routed over one of the carrier systems of the following types :

1. A system containing a very large number of telephone channels (e.g. 600 circuits) on coaxial cables.
2. A system of 60 circuits on symmetrical pairs.

The equivalent of the telephone circuit should be adjusted to 0.8 nepers or 7 decibels. These recordings are to be sent to the C.C.I.F. Laboratory together with all the necessary information and will serve as a source of noise in the tests to be carried out.

To allow an adjustment of the mean intensity of the noise (before the tests are made in the Laboratory) the recordings should include (before and after the section of tape to be used for the articulation tests) a recording of a sine wave at 800 c/s having an absolute power level of −40 db at the point where there cording has been carried out. This recording of 800 c/s will allow, if it is necessary, the study, at a later date, of the behaviour of the variations (as a function of time of these noises.

The C.C.I.F. Laboratory will study by means of tests at *constant speech power* the reduction in the articulation produced by this noise for various values of the reference equivalent of the total connection between two subscribers. It will also determine the transmission impairment corresponding to this variable noise and and thereby the impairment corresponding to a variation of the signal-to-noise ratio.

Question No. 7.

(3rd and 5th Study Groups in co-operation with the C.C.I.R. and the C.C.I.T.: question No. 24 of the 3rd S.G.) (Category A 2) [urgent] (new question)

Will it be possible to have a recommendation, concerning total noise, common to all wideband carrier systems (carrier systems on coaxial cable, on symmetrical pair cable or on radio-relay links) ?

Note 1. — There exists at present a C.C.I.F. recommendation concerning the total noise that can normally be admitted for 99% of the time on a carrier system over coaxial pairs in cable. This recommendation was established to enable each Administration, independently of other Administrations, to make plans for the sections crossing its own territory in an international carrier system on coaxial pairs.

The establishment of similar recommendations is the subject of question No. 34 of the 3rd Study Group for systems on symmetrical pairs in cable *.

Finally, in the case of radio-relay links, it is convenient to take note of the proposals of the C.C.I.R., on the matter of the specifications concerning noise which it proposes to establish on the basis of the hypothetical reference circuit, for radio-relay links, defined in Annex 1 which follows.

Note 2. — On the other hand, the note concerning Question No. 6 above asks Administrations to observe the variation, as a function of time, of the total noise existing in various types of systems. The comparison of the results of these observations will enable it to be seen whether the observed noises have sufficiently similar characteristics for it to be possible to retain for this total noise, a common specification for all systems and in this case attention is drawn to the proposal of the Cuban Telephone Company contained in Annex 2 which follows.

ANNEXES 1 AND 2
(to Question No. 7)

(See pages 303 to 309 of the annexes to Question No. 24 of the 3rd S.G.)

Question No. 8.

(5th Study Group of the C.C.I.F., in co-operation with the 3rd and 4th S.G. of the C.C.I.F. and with representatives of the C.C.I.R.) (Category A 2) [urgent] (continuation of Question D of the 3rd S.G. studied in 1952/1954)

In multi-channel telephone systems using pulse-position modulation, crosstalk into a disturbed channel may be different according to whether speech is or is not being transmitted on the interfering channel.

How may conditions be defined which should be applied from the point of view of crosstalk between speech circuits on such systems ?

Note 1. — Distinction should be made between intelligible and unintelligible crosstalk.

Note of the C.C.I.R. — The C.C.I.R. will study this question and hopes to transmit its views to the C.C.I.F. in due course.

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* Question No. 38 of the 3rd Study Group concerns a similar problem for 12 channel systems in open-wire lines, which are not to be studied within the framework of the present question.

Question No. 9.

(5th and 9th Study Groups of the C.C.I.F. in co-operation with Commission IX of the C.C.I.R.; (Category A 2) [urgent] (continuation of Question F of the 3rd S.G. studied in 1952/1954).

(1) What channels can be used for the exchange of service information between the terminal and the intermediate stations of a radio relay link (radio relay with frequency modulation and radio relay with pulse modulation of different types) ?

(2) Should supervisory signals coming from unattended stations be transmitted to an attended station :

1. On the radio relay network itself ?
2. By means of a separate radio relay using the same towers ?
3. Or by means of metallic circuits ?

Note 1. — Annex 1 which follows reproduces the reply of the 3rd and 5th Study Groups to Question F studied in 1952/1954. Annex 2 which follows reproduces the contributions provided in 1953 by various Administrations.

Remark by the C.C.I.R. — In the view of the C.C.I.R., it is not necessary to formulate standards in these matters, which it is felt should be the subject of agreement between the Administrations concerned.

ANNEX 1
(to Question No. 9)

Reply by the 3rd and 5th Study Groups of the C.C.I.F. in October 1953, to Question F of the 3rd Study Group

The 3rd and 5th Study Groups consider that they have not studied any ways of providing service channels on the radio system itself.

From the point of view of the necessity of ensuring so far as possible continuity of international telephone service on the general telecommunication network, the 3rd and 5th Study Groups of the C.C.I.F. consider that the following principles should be taken into consideration :

I. *Channels used for exchanging service information*

It is probable that each radio link will contain an omnibus circuit (i.e. between all relay stations) set up for example by one of the ways which have been shown in the various replies received by the C.C.I.F. on this question (see Appendix). But it is essential that as well as this omnibus circuit there should always be direct telephone connection between the principal attended stations of the radio link so that if the radio link is faulty and if there are no reserve circuits which can be immediately brought into service, these stations can immediately contact the control stations for circuits carried on the radio link : suitable arrangements can then be made without delay in order to make arrangements for alternative routing of telephone circuits.

It is evident that, if it is economically possible, the safest way of achieving direct telephone connection between the control stations would be to use a wire circuit. In any case a degree of protection would be to recommend that the principal attended stations should be connected to the general public telephone network so that in case of need, the control stations of the radio link could have priority service communications between themselves and control stations of international circuits carried on the radio link under consideration.

II. *Channels for the use of supervisory and control signal transmission*

The importance of supervisory and control signals depends to a very large extent on the extent of provision of reserve equipment (see the reply to Question G) if the reserve equipment is ample and the reserve equipment can be automatically switched in and if the reserve equipment is maintained in good order, control and supervisory signals can be transmitted over the radio system itself. In cases where automatically switched reserve equipment is not adequately provided, it is considered desirable to transmit control and supervisory signals over a wire circuit connecting the relay stations one with another or to provide the same facilities by any other process which gives the same degree of security as a cable circuit.

ANNEX 2

(to Question No. 9)

Methods in use or proposed in various countries for provision of an omnibus control circuit on the radio link itself

I. *Method visualised by French Administration*

Supervisory signals should contain both signals which give information on conditions at an unattended station as well as remote control signals transmitted from a control station. The French Administration considers that control and supervisory signals should be routed for example on channels in the frequency bands 0-60 kc/s and 300-312 kc/s having regard of course to the fact that transmission of the speech circuits should not be thereby affected.

II. *Method visualised by Federal German Administration*

For frequency modulated systems it is possible to insert a service channel below the band of frequencies used for the carrier system, since the lower limit of carrier systems is usually about 12 kc/s and frequency modulated receivers or transmitters can be arranged in such a way that frequencies may be transmitted down to a lower limit of 300 c/s. A service channel may be introduced into the terminal equipment by branching filters and may be derived at relay stations by the use of demodulators and corresponding branching filters in order to be reintroduced by the use of a special modulator.

For other relay stations, this channel can be considered as an omnibus circuit, the total frequency band being transmitted without frequency demodulation.

In order to reduce any disturbance to the normal telephone circuits the frequency deviation for the service channel should be extremely small. On this account therefore transmission quality of the service channel for speech may be somewhat limited.

III. *Method used by the Swiss Administration*

In radio-relay systems in use by the Swiss Administration the service channels for communication between terminal and relay stations are built up as follows.

For frequency modulated relay systems the service channel is superposed by amplitude modulation on to the frequency modulated wave. At each relay or terminal station the amplitude modulation is detected so that all stations in the transmission system are in parallel on a service channel. Thus simultaneous conversation between all stations is possible.

For pulse-modulated radio systems the service channel is built up by an additional pulse inserted in the synchronizing pulse circuit. This channel is reduced to audio frequency at each station. Each station may be selected by means of a selective calling scheme. When a fault occurs at a certain station and transmission is interrupted, the succeeding stations automatically transmit a replacement pulse so that continuity of the service channel is maintained and the faulty station recognized by a process of elimination.

Question No. 10.

(5th and 9th Study Groups of the C.C.I.F. in co-operation with Commission IX of the C.C.I.R.) (Category A 2) [urgent] (continuation of Question G of the 3rd S.G. studied in 1952/1954)

What arrangements should be made to provide for the automatic substitution of stand-by radio relay equipment in the case of failure of the normal equipment?

Note 1. — The annex reproduces the reply of the 3rd Study Group to Question G studied in 1952/1954.

Remark by the C.C.I.R. — In the view of the C.C.I.R., it is not necessary to formulate standards in these matters, which it is felt should be the subject of agreement between the Administrations concerned.

ANNEX
(to Question No. 10)

Reply by the 3rd Study Group of the C.C.I.F. to Question G in October, 1953

The importance and nature of reserve equipment which is provided depends directly on the degree of importance which is attributed to the continuity of the international telephone service. Obviously the importance is greater for a radio link upon which is transmitted an international circuit for which there is no alternative routing than in the case of a radio link in operation in regions where there are several alternative routes for international traffic.

A solution which seems to be desirable at any rate from an initial point of view for radio links on important routes for which there is no alternative is :

(i) either to have a reserve channel in continuous operation between terminal stations and on to which may be switched rapidly, either automatically or manually, any given faulty circuit of the radio system.

(ii) or to provide at each relay station reserve equipment which may be rapidly switched in the case of failure of the normally operating equipment at that station.

It is good practice to alternate from time to time, at suitably chosen intervals, the use of " normal " and " reserve " equipment ; it is also desirable to make arrangements such that this switching can be readily achieved.

Question No. 11.

(5th and 9th Study Groups of the C.C.I.F. in co-operation with Commission IX of the C.C.I.R.) (Category A 2) [urgent] (continuation of Question H of the 3rd S.G. studied in 1952/1954)

Source of normal and emergency power supply for attended and unattended stations in a radio relay network forming part of the cable networks of Europe and the Mediterranean Basin.

Note 1. — The annex reproduces the reply by the 3rd Study Group to Question H studied in 1952/1954.

Remark by the C.C.I.R. — In the view of the C.C.I.R., it is not necessary to formulate standards in these matters, which it is felt should be the subject of agreement between the Administrations concerned.

ANNEX

(to Question No. 11)

Reply by the 3rd Study Group of the C.C.I.F. to Question H in October, 1953

Given that international telecommunication channels may provide either telephony (automatic or manual), multi-channel telegraphy, telex, phototelegraphy, etc. and given that none of these services can suffer even short breaks, the C.C.I.F. considers it desirable to provide at each power feeding station for modern systems arrangements for reserve plant which may be brought into service automatically and without interruption of the normal equipment. Under all circumstances, substitution of this reserve plant should not produce disturbances of duration longer than about 150 ms.

The preceding paragraph is an extract from the specification for power supply systems for carrier circuits on cables.

The C.C.I.R. is asked to take account of the above specification when it is considering recommendations for power supply sources for radio relay systems.

Question No. 12.

(5th Study Group in co-operation with the 3rd S.G. of the C.C.I.F. and with representatives of the C.C.I.R.) (Category A 2) [non urgent] (continuation of Question I studied in 1952/1954)

Pulse Code Multiplex telephone systems used on radio-relay links permit a very large signal-to-noise ratio to be obtained for all noise introduced between the coding and decoding of signals. At the same time, the coding principle introduces a noise called " quantisation noise " which exists only with the signal to be transmitted.

Under these conditions, can present C.C.I.F. recommendations for noise on international telephone circuits be applied to this type of modulation :

1. As regards the method of measuring noise or signal-to-noise ratio ?

2. As regards the specification of maximum permissible noise or minimum permissible signal-to-noise ratio ? (If not, the minimum signal-to-noise ratio should be indicated).

Note 1. — Various Administrations which have had experience of multi-channel pulse-code-modulated telephony are asked to make (if possible) tests for example using arrangements and conditions described in the following appendix.

Note 2. — The attention of the C.C.I.T. should be drawn to the desirability of drawing up documentation on the subject of the effect produced by quantisation noise on telegraph transmission, and particularly multi-channel V.F. telegraphy on telephone circuits.

Note by the C.C.I.R. — As far as is known, there is no proposal to use Pulse Code Modulation on international connections ; the C.C.I.R. does not, therefore, propose to comment on this question at present.

ANNEX

(to Question No. 12)

Proposals from the French Telephone Administration on laboratory tests to determine the disturbing effect of quantisation noise on telephone speech

Quantisation noise in code modulation presents as well as the characteristics of only being present in the presence of signals, the two following peculiarities :

(a) The frequency band occupied by this quantisation noise is large and depends directly on the number of coding levels used. It is, however, only necessary to consider that portion of the noise which appears in the speech band after demodulation. It has been noted incidentally that in this frequency band the energy spectrum of the noise is almost constant (white noise).

(b) In order to take advantage of possibilities offered by code modulation, the quantisation steps are not generally constant but depend upon the amplitude of the signal to be coded.

It can be admitted, at least as an approximation, that the value of the quantisation step is proportional to that of the sample to be coded ; or alternatively, the relative value of the quantisation step may be considered as constant.

Taking account of the foregoing considerations, the French Telephone Administration considers that the arrangement described below should be used to determine the maximum permissible level for noise of this type (at a zero level point) without necessarily having in mind any particular system.

The test arrangement is shown schematically in Figure 1.

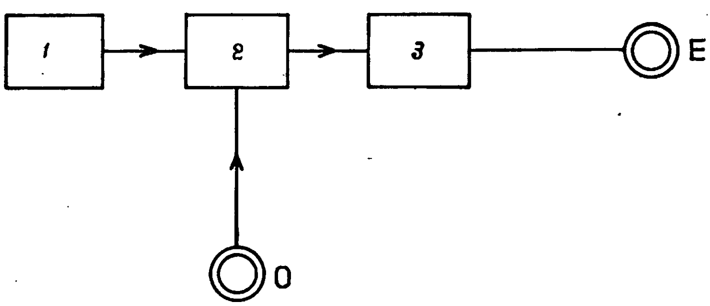


FIGURE 1

It consists essentially of :

— A noise generator (1) delivering white noise over a spectrum of 4 kc/s.
— A modulator (2) of push-pull Class B type, for example.
— A band-pass filter (3) 300-3400 c/s.

The speech of the reference signal is applied to the modulatior (2), at O ; the noise from the noise generator is also applied to the modulator (2) thus modulating the signal coming from O. From the nature of the modulator in use, the noise received at E is negligible when the signal is not applied to O at the modulator. At the output E therefore there is white noise covering the band 300-3400 c/s which only exists in the presence of the signal and the level which is a function of the signal as required by Note *(b)*. In order to evaluate the admissible signal-to-noise ratio it is only necessary to make subjective tests between O and E for various noise levels.

Figure 2 gives as an example the schematic of a possible modulator.

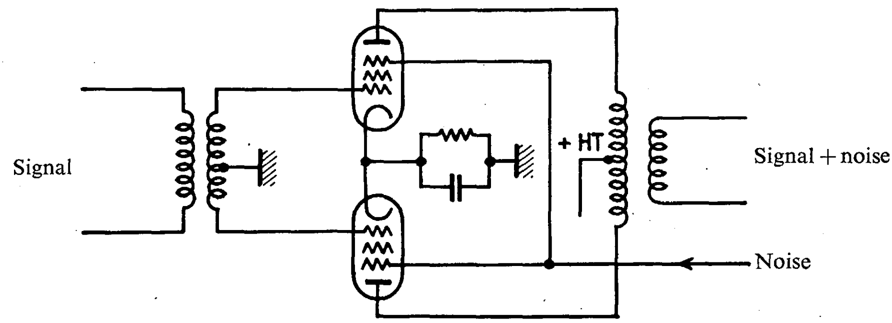


FIGURE 2

In order to determine the relationship between signal-to-noise ratio in such a device, the following procedure should be followed :—

A. Apply to O a sinusoidal 800 c/s signal at a level of 0 nepers (at a point of zero level) and measure at E the level of received signal.

B. Apply to O a sinusoidal signal (for example at 4 kc/s) at a level of 0 db (zero level point). At E this signal is received and its harmonics removed by a filter (3). The signal is them modulated by noise and the detected noise measured at E.

On the assumption that the conversion gain of the modulator is constant over the band 0-4 kc/s it can be assumed that the definition of *signal-to-noise ratio* will be *the relation between the effective value of the signal measured as in A and the valeur of the noise measured as in B.* Replacing therefore the single frequency signal by speech, it is possible to take account of the effect produced by noise for given values of the signal-to-noise ratio which has just been defined.

Question No. 13.

(5th Study Group in co-operation with the 3rd S.G. of the C.C.I.F. and with the C.C.I.R.) (Category A 2) [urgent] (new question)

(a) What are (in the case of international transmissions) the conditions to be fixed for the interconnection between a coaxial system transmitting alternatively telephony and television, and a radio-relay link providing the same alternative transmission ?

(b) What are the scheme or schemes of frequency allocations recommended for the systems envisaged under *(a)* ? The case of coaxial pairs and radio-relay links will be examined at the same time.

(c) What are (in the case of international transmission) the conditions to be fixed for the interconnection between the coaxial system transmitting simultaneously telephony and television, and a radio-relay link providing the same simultaneous transmission ?

(d) What are the frequency allocations recommended for the systems envisaged under *(c)* ? The case of coaxial pairs and radio-relay links will be examined at the same time.

Note. — The 3rd Study Group considers it extremely desirable that this new Question of the 5th Study Group should be dealt with before the meeting of the Study Groups which precede the next Plenary Assembly of the C.C.I.R. (Warsaw, 1956), so that the same frequency allocation for telephony and television on wideband systems on coaxial pairs and radio-relay links may be agreed.

Question No. 14.

(5th Study Group in co-operation with the 3rd S.G. and with the C.C.I.R.) (Category A 2) [urgent] (new question)

What conditions should be fixed, for international transmissions, for the interconnection of a coaxial cable system carrying a television transmission and a radio-relay system carrying the same transmission :—

(a) In the case of interconnection at video frequency ?

(b) In the case where the modulated signal transmitted over the coaxial pair is applied without alteration to the radio-relay system if this is possible ?

III. — QUESTIONS ON RADIO RELAY SYSTEMS WHICH THE C.C.I.R. IS ASKED TO STUDY IN CO-OPERATION WITH THE C.C.I.F.

Question No. 15.

(to be studied by the C.C.I.R., with the co-operation with the 5th S. G. of the C.C.I.F.) (new question).

Having regard to the already considerable diversity of types of equipment which already exist in radio-relay systems ; in order to furnish (for example), the operating Services of Telephone Administrations with the information that they require for the selection of systems for building up the international telecommunication network—to fix as precisely as possible for the C.C.I.R. (as a contribution to its studies for standardisation of radio-relay link systems) the general characteristics of long-distance transmission systems which are useful from the operational newpoint, it is desirable to make a preliminary classification of radio-relay links, on the bases indicated below :

1. *Radio systems using individual voice channels:*

   — Number of channels.
   — Possibility of using : several channels for the formation of a circuit for broadcast programme transmissions, one or more channels for telegraph transmission, etc.

— Upper limit for the range of the system.
— Maximum separation of relay stations under, for example, typical propagation and topographical conditions for radio-relay routes.
— Maximum permissible number of modulation and demodulation stages.
— Possibilities and types of interconnexion achievable at relay stations.

2. *Radio-relay systems capable of transmitting wide bandwidth modulation. (Video channel or carrier frequency channel on the radio system)* *.

— Number of " *canaux hertziens* " on a " *faisceau* " (a " *canal* " is a " *voie video* " after modulation to radio frequency or to intermediate frequency).
— " *Voie video* ", corresponding to each " *canal hertzien* " and the nature of the signals which can be transmitted over this channel.
— Upper limit for the range of the system.
— Maximum spacing of relay stations, under for example, typical propagation and topographical conditions for radio-relay routes.
— Maximum permissible number of modulation and demodulation stages.
— Possibilities and types of interconnexion that can be achieved at the relay stations.

Each Administration should study the necessary terminology and make proposals for choice of standard terms corresponding to the more important characteristics used in radio-relay systems, for example :

" *canal hertzien* " *
" *voie video* " (Term unsuitable in telephony), etc.

IV. — QUESTIONS WHICH THE C.C.I.R. HAS DECIDED TO STUDY AND IN THE STUDY OF WHICH THE C.C.I.F. SHOULD COOPERATE

The 5th Study Group considers that the C.C.I.F. should be associated with the study of the following question :

Question No. 90 (IX) of the C.C.I.R.

International broad-band radio-relay systems operating on frequencies above about 30 Mc/s

Interconnection of multiplexing systems
(London 1953)

The C.C.I.R.,

Considering :

(a) That there is current development of radio systems using time-division multiplex techniques ;

* *Translator's note.* — The purpose of this question is, in part, to establish a correspondence between English and French terminology. The question was originally drafted in French, and hence studies in connection therewith should be undertaken by reference to the original French document and the terminology used in this English translation should be taken a provisional only. In addition, it will be noted that there are no direct English equivalents of many of the French terms proposed. Where such do not exist, the French term has been carried into the English text, for the purpose of this document.

(b) That there is also current study of the technical characteristics of frequency-division multiplex systems ;

(c) That the process of frequency-division multiplex is largely used in cable systems ;

(d) That if the two types of multiplex are used in different networks, difficulties of interconnection will arise in due courses ;

decides that the following questions should be studied :

1. What economic technical, operational and maintenance problems arise if the two types of multiplex are used in radio-relay systems forming part of the international network ?

2. What type or types of multiplex should be recommended for multi-channel radio systems forming part of the international network if interconnection problems are to be minimised ?

3. In the case where interconnection of two systems using different types of modulation is necessary, what are the best arrangements to adopt ?

The 5th Study Group considers it useful that the C.C.I.F. be associated with the study of Question No. 91 (IX) of the C.C.I.R., reproduced below (Question No. 46 of the 3rd Study Group of the C.C.I.F. concerns a similar problem in the case of coaxial pair cables ; furthermore, the interconnection between systems, on coaxial pair cables or on radio-relay links, providing alternate or simultaneous transmission of telephony or television, is the subject of Questions Nos. 13 and 14 of the 5th Study Group).

Question No. 91 (IX) of the C.C.I.R.

International wideband radio-relay systems operating on frequencies above about 30 Mc/s

Transmission of telephony and television on the same system

(London 1953)

The C.C.I.R.,

considering :

(a) That the technical characteristics of wideband multi-channel radio telephone systems are being studied ;

(b) That the technical characteristics required for long-distance transmission of television signals are also being studied ;

(c) That there may be advantages, both technical and economic, if wideband radio-relay systems are planned to permit the transmission of telephony and television, simultaneously or alternatively, on the same system ;

decides that the following questions should be studied :

1. What are the advantages, if any, if wideband radio-relay systems are planned to permit the transmission of telephony and television, simultaneously or alternatively, on the same system ?

2. If there are advantages, what essential technical characteristics of such systems should be studied and what are the values that should be assigned to such characteristics for international circuits ?

The 5th Study Group has noted the wordings of Questions Nos. 92 (IX) and 93 (IX) reproduced below, submitted for study by the C.C.I.R. concerned with, on the one hand, standardization of time-division multiplex systems and, on the other hand, standardization of frequency-division multiplex systems. The 5th Study Group will be interested to note any documentation received by the C.C.I.R. on the subject and may possibly make some comments on the subject of terminal equipment and equipment for branching.

Question No. 92 (IX) of the C.C.I.R.

Standardization of multi-channel radiotelephone systems using time-division multiplex operating at frequencies above 30 Mc/s

(London, 1953)

The C.C.I.R.,

considering :

(a) That a variety of types of multi-channel radio systems using time-division multiplex have been developed ;

(b) That in certain cases it is desirable to be able to interconnect systems of different manufacture, particularly on international circuits ;

(c) That the lack of uniformity with regard to choice of the type and characteristics of modulation (for example, number of channels, pulse rate, synchronising methods, signalling and supervisory arrangements, etc.) in many cases makes direct interconnection impossible ;

(d) That direct interconnection would provide the most economical and, from a technical point of view, the most satisfactory solution ;

decides that the following questions shall be studied :

1. What are the technical characteristics of time-division multiplex systems which should be specified in order to be able to interconnect any two such systems ?

2. What specifications should be drawn up for such characteristics and should be recommended as standards for radio telephone systems using time-division multiplex for use on international circuits ?

Question No. 93 (IX) of the C.C.I.R.

Standardization of multi-channel radiotelephone systems using frequency-division multiplex operating at frequencies above 30 Mc/s

The C.C.I.R.,

considering :

(a) That a variety of types of multi-channel radio systems use frequency-division multiplex ;

(b) That in certain cases it is desirable to be able to interconnect systems of different types particularly on international circuits ;

decides that the following questions shall be studied :

1. What are the radio or intermediate-frequency characteristics of frequency-division multiplex systems which it is essential to specify in order to enable two such systems to be interconnected ?

2. What specifications should be drawn up for such characteristics and should standards be recommended for radio systems carrying frequency-division multiplex for use on international circuits ?

SUMMARY TABLE

of questions, the study of which is to be undertaken by the 5th Study Group in 1955, 1956 and 1957

Question No.	SUMMARY OF SUBJECT	CATEGORY	STUDY GROUP (other than the 5th S.G.) or international organization concerned	OBSERVATIONS
1	Connections between mobile radio-telephone stations and international telephone lines	A 1	8th S.G. C.C.I.R.	Non-urgent (continuation of old Question No. 1)
2	Use of groups of 12 or 60 telephone channels in radio-relay links	A 2	3rd S.G. C.C.I.R.	Urgent (continuation of old Question A of the 3rd S.G.
3	Systems of modulation applicable to radio-relay links	A 1	3rd S.G. 4th S.G. C.C.I.R.	Urgent (continuation of old Question B of the 3rd S.G.)
4	Time-division multiplex systems	A 2	C.C.I.R.	Urgent (new question)
5	Derivation of telephone channels on radio-relay links	A 2	3rd S.G. C.C.I.R.	Urgent (continuation of old Question C of 3rd S.G.)
6	Variation, as a function of time, of the signal-to-noise ratio	A 2	3rd S.G. 4th S.G.	Urgent (Question No. 23 of the 3rd S.G.)
7	Specification of noise common to all systems	A 2	3rd S.G. C.C.I.R. C.C.I.T.	Urgent (Question No. 24 of the 3rd S.G.)
8	Crosstalk in pulse-position modulation	A 2	3rd S.G. 4th S.G. C.C.I.R.	Urgent (continuation of old Question D of the 3rd S.G.)
9	Channels used for the purposes of service and supervision on radio-relay links	A 2	9th S.G. C.C.I.R.	Urgent (Question No. 14 of the 9th S.G.)
10	Standby equipment in radio-relay links	A 2	9th S.G. C.C.I.R.	Urgent (Question No. 15 of the 9th S.G.)
11	Electrical power-supply for radio-relay links	A 2	9th S.G. C.C.I.R.	Urgent (Question No. 16 of the 9th S.G.)
12	Noise in radio-relay links with pulse-code modulation	A 2	3rd S.G. C.C.I.R.	Non-urgent (continuation of old Question No. 1 of 3rd S.G.)
13	The transmission, alternatively, or simultaneously, of telephony and television on coaxial pairs or on radio-relay links	A 2	3rd S.G. C.C.I.R.	Urgent (new question)
14	Interconnection of television transmission systems on coaxial pairs and on radio-relay links	A 2	3rd S.G. C.C.I.R.	Urgent (new question)

Question No.	SUMMARY OF SUBJECT	CATEGORY	STUDY GROUP (other than the 5th S.G.) or international organization concerned	OBSERVATIONS
15	Classification of radio-relay links			To be studied by the C.C.I.R. in co-operation with the 5th S.G.
IX-90	Interconnection of multiplex systems			Questions of the C.C.I.R., with which the 5th S.G. of the C.C.I.F. should be associated
IX-91	Transmission of telephony & television in the same system			
IX-92	Time-division-radio-relay links			
IX-93	Frequency-division radio-relay links			

LIST OF OPERATING AND CHARGING QUESTIONS
the study of which should be undertaken or continued in 1955, 1956 and 1957 by the C.C.I.F. 6th and 7th Study Groups

Questions :

Nos. 1, 2, 3, 4 and supplementary questions A and B should be studied by the *Sub-Committee for Rapid Operating Methods,*

Nos. 4, 5, 6, 7 by the *Committee for the Revision of International Tariffs.*

Question No. 1.

(6th and 8th Study Groups in co-operation with the 3rd S.G. of the C.C.I.F. and the C.C.I.T.: 8th S.G. Question No. 1, C.C.I.T. Question No. 30) (Category A2) [urgent] (new question)

In the case of a fault on an international telephone circuit used for telegraphy, should the C.C.I.F. admit the immediate use of a telephone circuit whether or not this circuit is in use for a telephone call at the moment ?

In the affirmative what steps should be recommended for effecting the passage from one circuit to the other in the case of :

(a) Manual switching ;

(b) Automatic switching.

Note 1. — In the case of international circuits operated on an automatic switching basis, it would be an advantage if several reserve circuits in one direction were designated so that a free reserve circuit could be selected and thus avoid frequent interruptions of a telephone call in progress.

Note 2. — This question should be examined in the first place by the Sub-Committee for Rapid Operating Methods.

Note 3. — See documents " C.C.I.F. — 1952/1954 — 6th and 7th S.G. — Documents Nos. 28, 28 *bis* and 28 *ter* ".

Question No. 2.

(6th Study Group) (Category A2) [urgent] (new question)

The statistics for European international telephone traffic (C.C.I.F. Recommendation No. 60) was devised for the needs of advance preparation operating. It seems that it is not entirely suitable for manual rapid or semi-automatic service.

What are the statistical particulars to be collected for the particular needs of the manual rapid or semi-automatic service, and what modifications should be made to the form currently used ?

Note. — This question should first be examined by the Sub-Committee for Rapid Operating Methods.

Question No. 3.

(6th and 8th Study Groups in co-operation: 8th S.G. Question No. 11) (Category A2) [urgent] (continuation of 6th S.G. Question No. 17 studied in 1952/1954)

The Sub-Committee for Rapid Operating Methods has noted for information in its reply to Question No. 17 of the 6th S.G. two methods for calculating the number of circuits to be provided for semi-automatic operation when there is overflow from a group of circuits used for terminal traffic to a group used for transit traffic. Can either of these two methods or some other method be recommended as both practical and sufficiently accurate ?

Furthermore what method of calculating the number of circuits should be recommended for application to alternative routing (of which the former is only a particular case) when it is desired to guarantee a particular quality of service ?

Note. — This question should be examined in the first place by the Sub-Committee for Rapid Operating methods.

ANNEX 1

(to Question No. 3)

Method of calculation used by the Swedish Administration for determining the optimum number of circuits to be envisaged when alternative routes are used .

Introduction

The third part of 6th Study Group Question No. 19, studied in 1952/1954, raises the question of what factors it is necessary to take into consideration for a complete economic study of the value of using alternative routes in the various circumstances in which the employment of such routes is to be envisaged.

It is quite evident that the economic advantage that must be estimated in this connexion for a particular case consists in the *maximum* economic advantage that it is possible to obtain. The first thing to be done for this study is to discover a rule or a method—and to get it agreed—for determining, for all values of traffic and for every specified quality of service, the particular optimum arrangement for alternative routing ; the optimum arrangement is that which gives the minimum net cost (circuits and exchange equipment) expressed for example in the form of annual charges incorporating interest, amortisation of the invested capital, power costs, maintenance charges, etc. A comparison with the net cost of a corresponding arrangement without alternative routing will then give directly the value of the economic advantage offered by the first arrangement. Optimum arrangements can be determined from points of view other than the economic one, so as the establish whether or not such arrangements are advantageous in other respects.

A method of determining the optimum arrangement for alternative routing has been adopted provisionally by the Swedish Administration for the purpose of establishing circuit and exchange equipment programmes for the national long-distance interconnection plan in the automatic service.

There follows a brief description of this method and its bases.

Rigorously exact calculations for finding an optimum arrangement

The exchange equipment for long distance traffic in the automatic service has been planned so that the number of outlets from the switches should be sufficient always to afford full availability access to the circuits in all long-distance routes. On every full availability route without the facility of alternative routing, the number n of circuits necessary to carry a volume of A erlangs of traffic, for a given quality of service (or loss probability) B, is given by the classic Erlang formula :

$$B = E_{1,n}\,(A) = \frac{\dfrac{A^n}{n!}}{1 + A + \ \ldots\ + \dfrac{A^n}{n!}}$$

This formula defines n as a function of B and A, that is to say : $n=f(B, A)$. Numerical tables for this formula are available.

Consider as a typical example, three telephone exchanges P, Q and C, the volume of traffic being respectively :

from P to C = A_1 erlangs
from C to Q = A_2 erlangs
from P to Q = A_3 erlangs (see Figure 1)

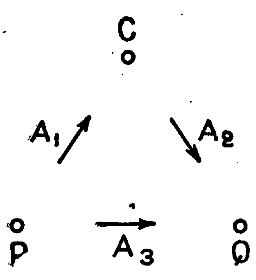


FIGURE 1

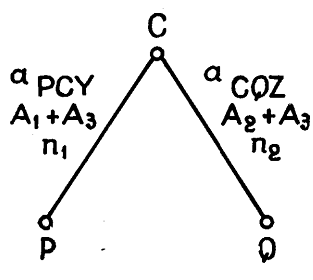


FIGURE 2

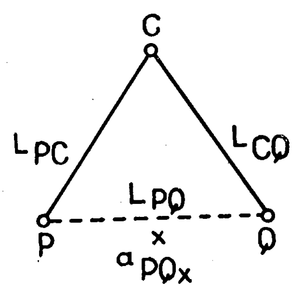


FIGURE 3

Suppose first of all that C is a transit exchange and that the traffics A_1, A_2 and A_3 are carried on two groups of circuits with full availability :

the first with n_1 circuits between P and C
the second with n_2 circuits between C and Q

There is thus an arrangement conforming with Figure 2, in which :

$$n_1=f\,(B, A_1+A_3)$$
$$n_2=f\,(B, A_2+A_3)$$

If direct circuits can be provided between P and Q at a sufficiently low net cost, the arrangement represented by Figure 2 can be replaced by an economically more advantageous arrangement with alternative routing, and comprising a high usage route with x direct circuits between P and Q: this arrangement is depicted in Figure 3. It is supposed that the equipment of exchange P is arranged so that calls to Q outgoing from P are switched in the first place to the x high-usage circuits and are routed to Q via C only when no free direct circuit between P and Q is available.

The fact of providing x direct circuits signifies that at least a part of the traffic A_3 is carried by this high-usage route ; the routes P-C and C-Q do not have to carry this part of traffic A_3 and, in consequence, should only comprise a lesser number of circuits than the n_1 and n_2 necessary in the case of Figure 2.

When there is an arrangement with alternative routing in which the value of x and the corresponding numbers of circuits in the routes P-C and C-Q are such that the total net cost of the equipment (circuits and exchanges) is lower than the corresponding costs in the case of Figure 2, the arrangement with alternative routing presents an economic advantage. Normally, there is a series of values of x for which there is such an economic advantage. In the typical example now considered, a rule or a method is sought which will enable the particular value of x to be fixed (and the numbers of circuits to be deducted from the routes P-C and C-Q) which gives the minimum total net cost for a given quality of service B.

This rule or method must depend upon the net cost to be taken into consideration. The following notations are introduced to represent these net costs :

L_{PC} = the net cost of a circuit (line) for the route P-C
L_{CQ} = the net cost of a circuit (line) for the route C-Q
L_{PQ} = the net cost of a circuit (line) for the route P-Q

Each of these quantities L_{PC}, etc. also includes the cost of the exchange equipment directly or indirectly associated with the circuits.

In addition, the rule described is completed by the adoption of a particular hypothesis ; this is that the circuits in each route are tested in numerical order (as if explored at the outgoing end by a homing switch) in such a way that in each route the first circuit is tested first, the second is tested immediately after, and so on. By means of the Erlang formula defining lost traffic, the trafic carried by each individual circuit can be determined in the different cases which follow :

1. On the high-usage route P-Q to which the traffic A_3 is offered, the xth circuit carries a traffic a_{PQx} equal to

$$a_{PQx} = A_3 \; [E_{1,x-1} \; (A_3) - E_{1,x} \; (A_3)] \text{ erlangs}$$

2. On the groups of n_1 circuits between P and C to which the traffic A_1+A_3 is offered, the yth circuit carries a traffic a_{PCy} equal to

$$a_{PCy} = (A_1+A_3)\,[E_{1,y-1}\,(A_1+A_3) - E_{1,y}\,(A_1+A_3)]$$

3. On the group of n_2 circuits between C and Q to which the traffic A_2+A_3 is offered, the zth circuit carries a traffic a_{CQz} equal to

$$a_{CQz} = (A_2+A_3)\,[E_{1,z-1}\,(A_2+A_3) - E_{1,z}\,(A_2+A_3)]$$

If the quantity

$$\frac{L_{PQ}}{a_{PQx}}$$

is now considered with these notations this quantity evidently represents the net cost per unit of traffic (erlang) required for the carriage of the traffic a_{PQx} over the xth circuit of the high-usage route P-Q.

Consider a succession of values of x, comprising all the values for which there exist alternative routing arrangements economically more advantageous than the one represented by Figure 2. Suppose this set of values to be :

$$1, 2, 3, \ldots p.$$

For the first of these values, $x = 1$, the traffic a_{PQ1} carried by the first circuit on the high-usage route P-Q is carried on the circuit for a lower cost than if this traffic were routed by the intermediary of C.

If h (C, 0) represents the cost per erlang involved in carrying the traffic between P and Q by the intermediary of C, the foregoing inequality can be written

$$\frac{L_{PQ}}{a_{PQ1}} < h\,(C, 0)$$

If now, in taking account of this economic advantage, the arrangement represented by Figure 2 is modified and if a first direct circuit is provided between P and Q, this circuit will carry the traffic a_{PQ1} and the volumes of traffic carried by the routes P-C and C-Q will be reduced by this same value. In making the corrèsponding reduction in the numbers of circuits in the routes P-C and C-Q, let it be supposed that this reduction is just sufficient to maintain on these routes the prescribed quality of service B. For simplicity of reasoning, suppose that this reduction can operate in a continuous manner. Let h (C, 1) represent the total cost per erlang for carrying the traffic by there two routes in tandem with the new reduced number of circuits.

If it is established that

$$\frac{L_{PQ}}{a_{PQ2}} < h\,(C, 1)$$

it is still economically advantageous to provide a second circuit between P and Q and to make a corresponding reduction in the numbers of circuits in the routes P-C and C-Q. Let h (C, 2) represent the total cost per erlang for carrying the reduced traffic now remaining on these routes.

Operating stage by stage a value of x is finally reached for which :

$$\left.\begin{aligned} \frac{L_{PQ}}{a_{PQx}} &< h\,(C, x-1) \\ \frac{L_{PQ}}{a_{PQ\,(x+1)}} &\geq h\,(C, x) \end{aligned}\right\} \qquad (1)$$

These equations indicate that it is economically advantageous to provide direct circuits between P and Q up to a maximum number of x such circuits if it is desired to draw the maximum economic advantage.

In the optimum arrangement with x direct circuits, the route P-C is offered $A_1 + A_3E_{1,x}$ (A_3) erlangs of traffic and the route C-Q, $A_2 + A_3E_{1,x}$ (A_3) erlangs. Neither of those two volumes of traffic comprises a chance distribution of calls and, consequently, do not constitute pure chance traffic. For this reason the Erlang formula cannot be used to determine the numbers of circuits in the routes P-C and C-Q ; that is, the number which will suffice for the total traffic between P and Q always with the prescribed quality of service B and, at the same time, carry the traffic A_1 between P and C, and A_2 between C and Q without reducing the quality of service below the prescribed value. Moreover, no formula or exact method is known for making this calculation ; in other words, the function h (C, x) is still unknown.

Provisional empirical method adopted by the Swedish Administration

Until this difficulty has been resolved, the Swedish Administration has provisionally adopted an empirical method by means of which a sensibly optimum arrangement can be determined for alternative routing. In the example so far considered, this method consists in fixing values for x, y and z, which satisfy the relationships :

$$\frac{L_{PQ}}{a_{PQx}} < \frac{L_{PC}}{a_{PCy}} + \frac{L_{CQ}}{a_{CQz}} \tag{2}$$

$$\frac{L_{PQ}}{a_{PQ\,(x+1)}} \geq \frac{L_{PC}}{a_{PC\,(y+1)}} + \frac{L_{CQ}}{a_{CQ\,(z+1)}} \tag{3}$$

y and x being determined by the equations

$$A_1+A_3-(A_1+A_3)\,E_{1,y}\,(A_1+A_3) = A_3 - A_3\,E_{1,x}\,(A_3) \tag{4}$$

$$A_2+A_3-(A_2+A_3)\,E_{1,z}\,(A_2+A_3) = A_3 - A_3\,E_{1,x}\,(A_3) \tag{5}$$

If, in conformity with Figure 4, in this more or less optimum arrangement of alternative routing, the numbers of circuits are designated by N_1, N_2, N_3 with :

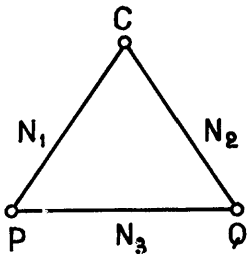


FIGURE 4

N_1 = number of circuits in the route P-C
N_2 = number of circuits in the route C-Q
N_3 = number of circuits in the route P-Q

these numbers are then values of x, y and z obtained from relationships (2) to (5) by means of the equations :

$$\left.\begin{aligned} N_1 &= n_1 - y \\ N_2 &= n_2 - z \\ N_3 &= x \end{aligned}\right\} \tag{6}$$

It follows that the method or empirical rule described, which is expressed by means of the relationships (2) to (6), results from the combination of two very simple conditions realised at the same time. One of these conditions is obtained directly by means of the equations (4) to (6) and consists in showing that, at least as a first approximation, the $x = N_3$ direct circuits between P and Q together carry the same volume of traffic, in an arrangement conforming with Figure 2, as the $y = n_1 - N_1$ circuits tested in the first place on the route P-C ; and as the $z = n_2 - N_2$ circuits tested in the first place on the route C-Q. The second condition is expressed by relationships (2) and (3) and consists in showing that the cost per erlang entailed by the arrangement of Figure 4 for carrying the traffic a_{PQx} on the last, or xth, direct circuit between P and Q, is at least approximately in an arrangement conforming with Figure 2, the same as : the sum of the cost per erlang for carrying the traffic a_{PCy} on the yth of n_1 circuits between P and C, and for carrying the traffic a_{CQz} on the zth of n_2 circuits between C and Q.

The method described always gives higher values of N_1 and N_2 than would be obtained by means of the Erlang formula for the same volumes of offered traffic. A result in this direction is desirable since the traffic offered to the groups N_1 and N_2 divides more irregularly than pure chance traffic for which the Erlang formula is applicable. As long as the function h (C, x) has not been determined for a sufficiently large interval, it will not be known more accurately whether the values N_1 and N_2 are too large or too small than would be necessary to maintain exactly the prescribed quality of service. Nevertheless it is to be hoped that the empirical results obtained in actual traffic conditions will enable it to be verified whether this provisional method is too liberal or too restrictive and will permit suitable adjustments to be made. Traffic analysis machines which have been developed by certain Administrations for making investigations should enable a conclusion to be reached about the function h (C, x) and it is very desirable that this task be completed without delay. Once the function h (C, x) is known, the provisional rule will be replaced by the accurate method given by formula (1).

If the circuits are used for bothway traffic between the exchanges, the rule given by (1) and the provisional rule given by the relationships (2) to (6) applies to the one and the other without change ; these rules apply to every arrangement made with groups of circuits each of which carries bothway traffic. It is easily seen that this derives from the fact that the characteristics of groups of circuits for carrying traffic are independent of the direction in which the calls are established and, on the contrary, depend only on the duration and distribution of the calls ; that is to say the volume of traffic.

However, each of the traffics A_1, A_2 and A_3 which have been considered in the example envisaged, must then be replaced by the sum of the traffics in the two directions between the exchanges concerned, and conformity must be established between the rules applied at the two extremities of each group of circuits in order to decide upon the order of testing the circuits.

Results obtained with this provisional method

Figure 5 enables account to be taken of the results of the provisional rule described above in a particular case of which the details are given in that figure.

The curve in Figure 5 represents the increase on diminution of the total net cost required for an arrangement with alternative routing conforming with Figure 3, compared with the total cost of an arrangement conforming with Figure 2 (this latter arrangement is designated by III in this Annex). In order to obtain this curve, the costs is calculated for arrangements conforming with Figure 3, in the case of :

$$x=1,\ 2,\ 3\ \dots\ n_1$$

as well as the corresponding values for y and z, determined according to equations (4) and (5).

Clearly the arrangement III corresponds with $x = 0$.

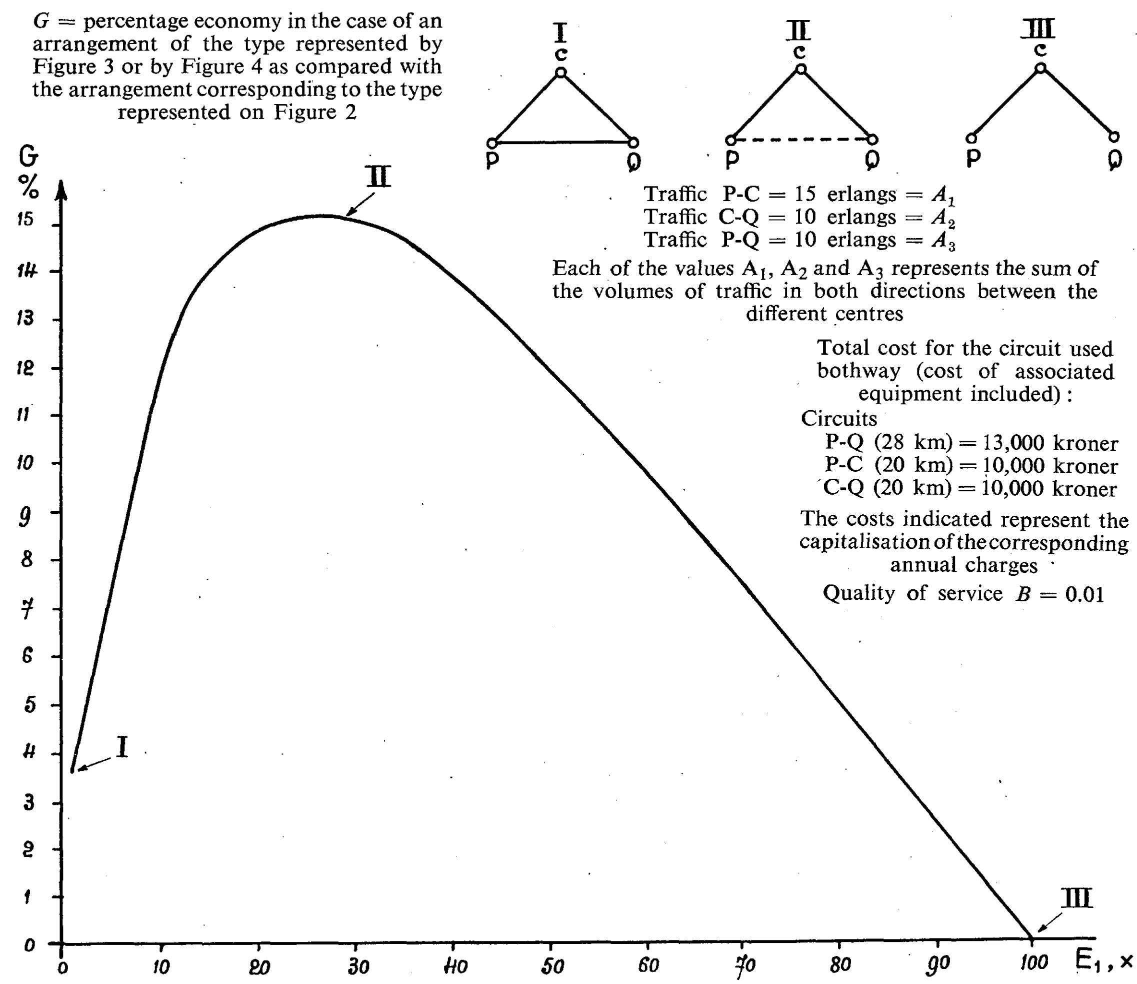


FIGURE 5

The arrangement designated by I and comprising n_1 circuits between P and Q corresponds to the case where no part of the traffic A_3 between P and Q is routed via C: in this arrangement I, each of the three routes P-Q, P-C and C-Q possesses a number of circuits determined by means of the Erlang formula.

The largest gain, 15%, is obtained for the arrangement II as can be determined by means of relationships (2) and (3) : it corresponds to the arrangement of Figure 4, with the following values : $N_1=28$, $N_2=22$ and $N_3=9$. The value of 15% for the gain represents a considerable gain although the example chosen is not particularly favourable for alternative routing. This example also demonstrates the fact that it is desirable to express the economic advantage of an optimum alternative routing in terms of the gain over a total net cost, rather than express it in terms of a reduction in the number of circuits.

Extension of the provisional method to more complicated arrangements

Naturally, the greater the number of exchanges considered, the more difficult is it to determine the optimum economic arrangement of alternative routing. The same method of reasoning as that which resulted in the condition (1) applies also in the more complicated cases and leads readily to the mathematical expressions given below for the conditions determining the optimum arrangement : these relationships are always expressed by means of functions such as h (C, x) which are not yet determined in an explicit form which can be used in numerical calculations. In a certain number of complicated cases, the Swedish Administration has provisionally adopted corresponding approximations.

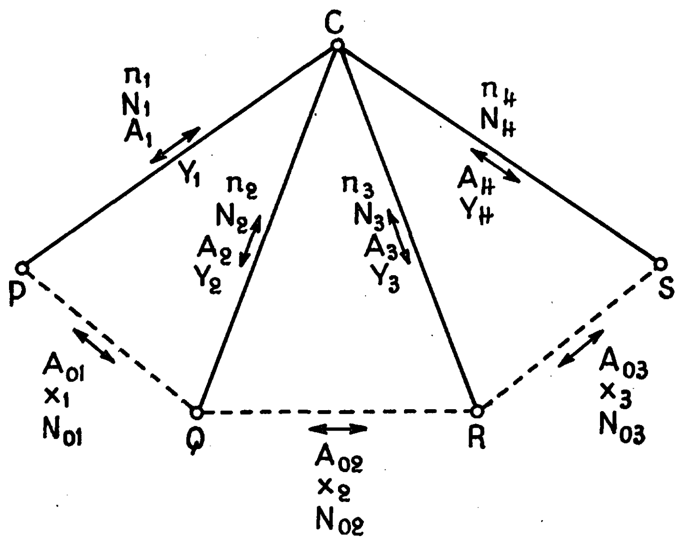


FIGURE 6

A typical example of these complicated cases can be represented by the case in Figure 6 ; in this figure a transit centre C is shown which possesses routes with direct circuits to four other centres P, Q, R and S. Alternative routing has been envisaged with an overflow of traffic from a high-usage direct route over itineraries passing in transit through C—and only through C—for :

the traffic A_{01} occurring between P and Q
the traffic A_{02} occurring between Q and R
the traffic A_{03} occurring between R and S

The values of traffic offered are then as follows :

Traffic	offered between	
	on the one hand	on the other hand
A_1	P	C R S
A_2	Q	C S
A_3	R	C P
A_4	S	C P Q

All the circuits in Figure 6 are supposed to be bothway circuits.

The provisional appropriate method adopted for determining the optimum arrangement of alternative routing in the case of Figure 6, consists in fixing the values associated with the numbers of circuits corresponding to the relationships (7) to (17) below. As will easily be seen, these relations constitute a simple extrapolation of the relationships (2) to (6). In place of the notations previously indicated n_1, n_2, x, y, z, N_1, N_2 and N_3 there are in the case of Figure 6

$n_1 = f(B, A_1+A_{01})$
$n_2 = f(B, A_2+A_{01}+A_{02})$
$n_3 = f(B, A_3+A_{02}+A_{03})$
$n_4 = f(B, A_4+A_{03})$
x_1 = variable number of circuits on the route P-Q
x_2 = ,, ,, ,, ,, ,, Q-R
x_3 = ,, ,, ,, ,, ,, R-S
y_1 = ,, ,, ,, ,, ,, P-C
y_2 — ,, ,, ,, ,, ,, Q-C
y_3 = ,, ,, ,, ,, ,, R-C
y_4 = ,, ,, ,, ,, ,, S-C
N_1 = optimum number of circuits on the route P-C
N_2 = ,, ,, ,, ,, ,, Q-C
N_3 = ,, ,, ,, ,, ,, R-C
N_4 = ,, ,, ,, ,, ,, S-C
N_{01} = ,, ,, ,, ,, ,, P-Q
N_{02} = ,, ,, ,, ,, ,, Q-R
N_{03} = ,, ,, ,, ,, ,, R-S

The significance of the other new notations such as L_{RS}, a_{RSx_3}, etc... according to the notations previously indicated, will be readily understood.

The relations in Figure 5 which correspond to relationships (2) and (3), are

$$\frac{L_{PQ}}{a_{PQx_1}} < \frac{L_{PC}}{a_{PCy_1}} + \frac{L_{CQ}}{a_{CQy_2}} \tag{7}$$

$$\frac{L_{PQ}}{a_{PQ(x_1+1)}} \geqq \frac{L_{PC}}{a_{PC(y_1+1)}} + \frac{L_{CQ}}{a_{CQ(y_2+1)}} \tag{8}$$

$$\frac{L_{QR}}{a_{QRx_2}} < \frac{L_{QC}}{a_{QCy_2}} + \frac{L_{CR}}{a_{CRy_3}} \tag{9}$$

$$\frac{L_{QR}}{a_{QR(x_2+1)}} \geqq \frac{L_{QC}}{a_{QC(y_2+1)}} + \frac{L_{CR}}{a_{CR(y_3+1)}} \tag{10}$$

$$\frac{L_{RS}}{a_{RSx_3}} < \frac{L_{RC}}{a_{RCy_3}} + \frac{L_{CS}}{a_{CSy_4}} \tag{11}$$

$$\frac{L_{RS}}{a_{RS(x_3+1)}} \geqq \frac{L_{RC}}{a_{RC(y_3+1)}} + \frac{L_{CS}}{a_{CS(y_4+1)}} \tag{12}$$

The associated relationships corresponding to relationships (4) and (5) which serve to determine x_1, x_2, x_3, y_1, y_2, y_3, and y_4 in order to have an optimum arrangement of alternative routing are :

$$A_1+A_{01}-(A_1+A_{01})\ E_{1,y_1}\ (A_1+A_{01}) = A_{01}-A_{01}\ E_{1,x_1}\ (A_{01}) \tag{13}$$

$$A_2+A_{01}+A_{02}-(A_2+A_{01}+A_{02})\ E_{1,y_2}\ (A_2+A_{01}+A_{02}) = A_{01}-A_{01}\ E_{1,x_1}(A_{01})+A_{02}-A_{02}\ E_{1,x_2}(A_{02}) \tag{14}$$

$$A_3+A_{02}+A_{03}-(A_3+A_{02}+A_{03})\ E_{1,y_3}\ (A_3+A_{02}+A_{03}) = A_{02}-A_{02}\ E_{1,x_2}(A_{02})+A_{03}-A_{03}\ E_{1,x_3}(A_{03}) \tag{15}$$

$$A_4+A_{03}-(A_4+A_{03})\ E_{1,y_4}\ (A_4+A_{03}) = A_{03}-A_{03}\ E_{1,x_3}\ (A_{03}) \tag{16}$$

The number of circuits on the different routes, which represent the optimum arrangement of alternative routing in the case of Figure 6 are deduced from equations (7) to (16), thanks to the relationships :

$$\begin{array}{ll} N_1 = n_1-y_1 & N_{01} = x_1 \\ N_2 = n_2-y_2 & N_{02} = x_2 \\ N_3 = n_3-y_3 & N_{03} = x_3 \\ N_4 = n_4-y_4 & \end{array} \tag{17}$$

Modified forms of the provisional rule described above have been adopted and used in the case where alternative routing has been envisaged via more than one transit centre. Since, however, it seems doubtful that the European network of international circuits will have such double transits, the corresponding modifications to the provisional rule have not been described in this annex.

Practical application of the provisional network and an example of its use

One of the reasons for adopting the above described provisional method rests on the fact that in spite of some expressions rather more complex than have been used to explain this method, it has been established that it was very convenient to use in practical cases. The associated optimum values for x, y and z, etc. can readily be determined from graphs specially prepared for the purpose and using a method of successive approximation.

A specimen graph of this type is at Figure 7. In the upper and lower parts the graph gives :

— as ordinates the values of traffic offered A and,

— as abscissae the values n (number of the circuit) ; n designates the particular circuit tested in the nth position for the offered traffic A, when the circuits are searched over as a group and tested one after the other in numerical order.

The curves in the upper part of the graph give the occupation of the nth circuit when the traffic A is offered to the whole group of circuits. For example, when $A=16$ erlangs, the occupation of the first circuit in 0.94 and that of the fourth circuit 0.92 ; that is to say that the first circuit carries a traffic of 0.94 erlangs and the fourth circuit a trafic of 0.92 erlangs.

The curves in the lower part of the graph give the value of the traffic $AE_{1,n}$ (A) which is offered to the (nth+1) circuit ; that is to say the traffic which could not be carried by the first n circuits, when the traffic A is offered to the whole of the circuits.

As an example it can be seen how optimum arrangements for alternative routing can be determined by means of this graph in the particular case which is the subject of Figure 5.

Firstly the values n_1 and n_2 are determined from the Erlang formula and this gives :

$$n_1 = f\ (0.01,\ 15+10) = 36$$
$$n_2 = f\ (0.01,\ 10+10) = 30$$

As a first approximation, let it be supposed that the occupation a_{PQx} of the xth circuit on the route P-Q is such that it results in the same net cost per erlang carried over the xth circuit, as for the traffic carried through C on the first of the n_1 circuits of the route P-C, as well as on the first of the n_2 circuits between C and Q. From the upper part of the graph is read

$$\begin{array}{ll} a_{PC1} = 0.96 & \text{for } A = 25 \text{ erlangs} \\ a_{CQ1} = 0.95 & \text{for } A = 20 \text{ erlangs} \end{array}$$

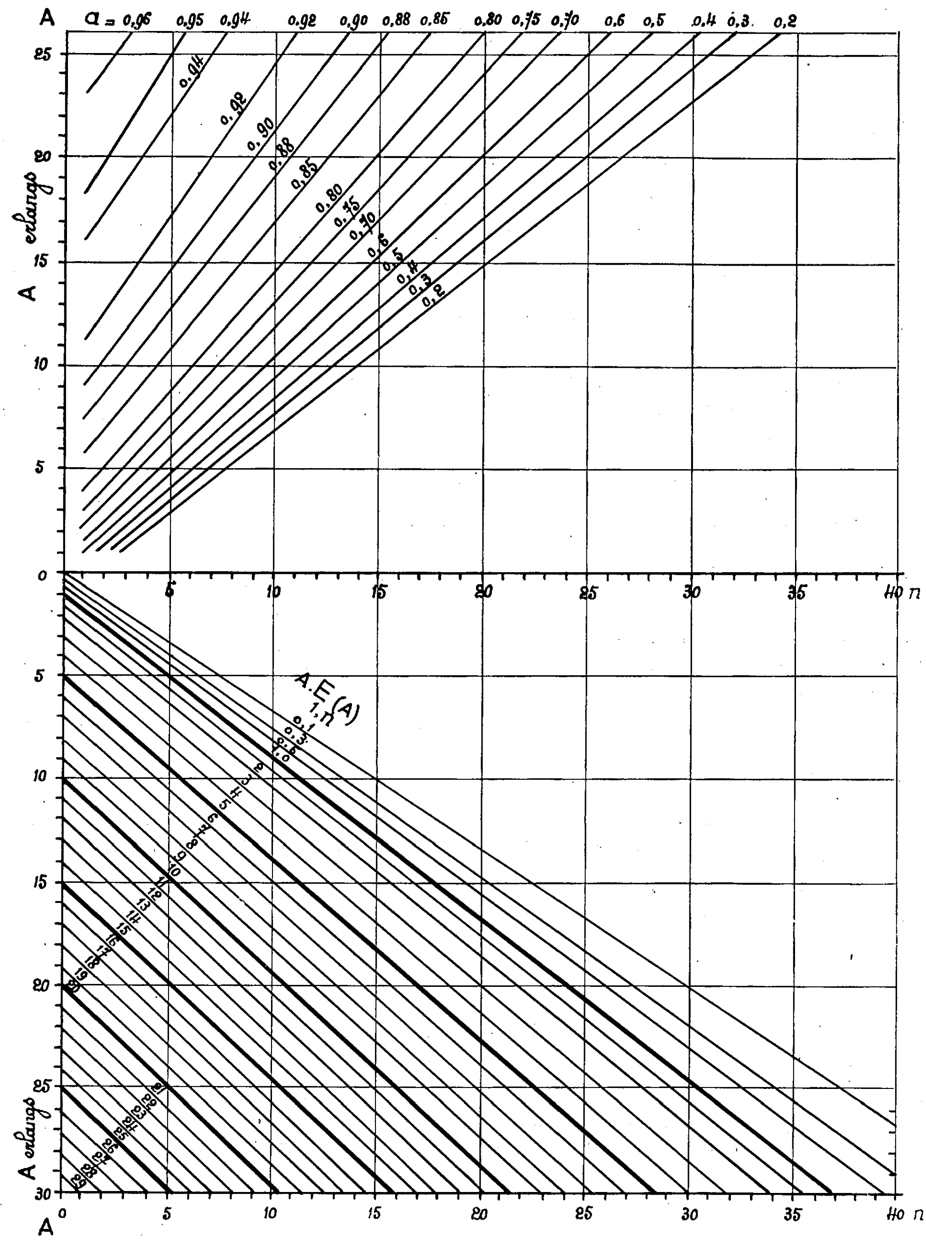

A
a = 0,96 0,95 0,94 0,92 0,90 0,88 0,85 0,80 0,75 0,70 0,6 0,5 0,4 0,3 0,2
A erlangs
A.E(A) 1,n
n
A erlangs
n'

FIGURE 7

Then, in conformity with the hypothesis, (see legend of Figure 5) there is obtained :

$$\frac{13\,000}{a_{PQx}} = \frac{10\,000}{0.96} + \frac{10\,000}{0.95}$$

from which is deduced

$$a_{PQx} = 0.62$$

For this occupation of 0.62 with the traffic offered of $A_3 = 10$ erlangs the graph shows for the value x : $x = 9.4$.

Trying the value $x = 10$ and determining the corresponding values of y and z according to the formulae (4) and (5), this gives

$$25 - 25E_{1,y}\,(25) = 10 - 10E_{1,10}\,(10)$$
$$20 - 20E_{1,z}\,(20) = 10 - 10E_{1,10}\,(10)$$

On the lower part of the graph, we read : $10E_{1,10}\,(10) = 2.2$ erlangs, and hence we have :

$$25E_{1,y}\ (25) = 17.2$$
$$20E_{1,z}\ (20) = 17.2$$

Reading the corresponding values from the lower part of the graph: $y=8$, $z=8$.

For the associated values : $x=10$, $y=8$, $z=8$, the corresponding values shown on on the graph are :

$$a_{PQ10} = 0.58 \qquad a_{PC8} = 0.934 \qquad a_{CQ8} = 0.908$$

A comparison of cost according to the relationships (2) and (3) gives

$$\frac{13\,000}{0.58} \ (?) \ \frac{10\,000}{0.934} + \frac{10\,000}{0.908} \qquad \text{or :} \qquad 224 > 217$$

It follows that the x is a little too high.

Trying then the value $x=9$, it is also found that according to (4) and (5) the values $y=8$ and $z=8$. The corresponding occupations are

$$a_{PQ9} = 0.65 \qquad a_{PC8} = 0.934 \qquad a_{CQ8} = 0.908$$

A cost comparison according to (2) gives $200 < 217$

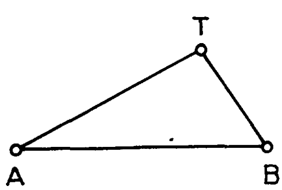
Consequently $x=9$, $y=8$, $z=8$ represents the optimum alternative routing arrangement in this case. The corresponding numbers of circuits on the three routes are :

$$N_1 = 36-8 = 28 \qquad N_2 = 30-8 = 22 \qquad N_3 = 9$$

ANNEX 2

(to Question No. 3)

Method proposed by the French Administration for determining the number of circuits in the direct route when alternative routing is employed



1. It is supposed that at the international terminal exchange A, the traffic to another international terminal exchange B is offered in the first place to a group of direct circuits AB, which are supposed to form a full availability group.

If all the direct circuits are occupied, the traffic is " overflowed " to an international transit exchange T : the circuits AT, which carry the traffic from A to T and also if necessary the traffic (normal or overflow) to other exchanges accessible via T, are also supposed to have full availability access.

2. Designating by :

C the "annual charge" (interest on invested capital, financial amortisation, manufacturing amortisation, maintenance) corresponding to one circuit in the direct route AB.

U the "annual charge" corresponding to *one unit of intensity of traffic* (1 erlang) carried via T. This annual charge can be considered as accurately determined and almost invariable, *if it be admitted* that in every care, the number of circuits to be added to the groups AT and AB to carry the overflow traffic *remains small* compared with the number of circuits necessary for the other traffics carried ; and in particular for the traffics AT and TB and in consequence the "efficiency" (number of erlangs per circuit) rests more or less the same, whatever the hypothesis made about the proportion of the traffic AB which overflows ; and if a similar hypothesis is made about the "transit equipment" at the exchange T.

3. Then suppose that there are n direct circuits between A and B, and that the traffic offered is y erlangs. It is proposed to ascertain whether or not it is economic to provide an additional direct circuit.

With n direct circuits, the traffic carried by the direct route will be :

$$Y\,[1-\mathrm{P}\,(Y,\ n)]$$

P (Y, n) being the loss probability when a traffic Y is offered to n circuits forming a full availability group.

If $(n + 1)$ were provided, the traffic carried by the direct route would be :

$$Y\,[1-\mathrm{P}\,(Y,\ n+1)]$$

It follows that the provision of an $(n + 1)$th direct circuit has the effect of enabling the direct route to carry a supplementary traffic equal to :

$$q = Y\,[\mathrm{P}\,(Y, n) - \mathrm{P}\,(Y, n+1)]$$

The corresponding annual charge will be C.

But, if this traffic is carried via T, the corresponding annual charge is :

$$q \times U$$

The provision of an $(n + 1)$th direct circuit is economic if :

$$C < q\,U$$

$$\frac{C}{U} < q$$

4. In order to facilitate the study, a series of curves will be used by way of an example, each prepared for n direct circuits, and giving the overflow traffic y, as a function of a traffic offered Y. If the hypotheses of the Erlang theory for a system of lost calls are admitted as valid, these curves are curves of the equation :

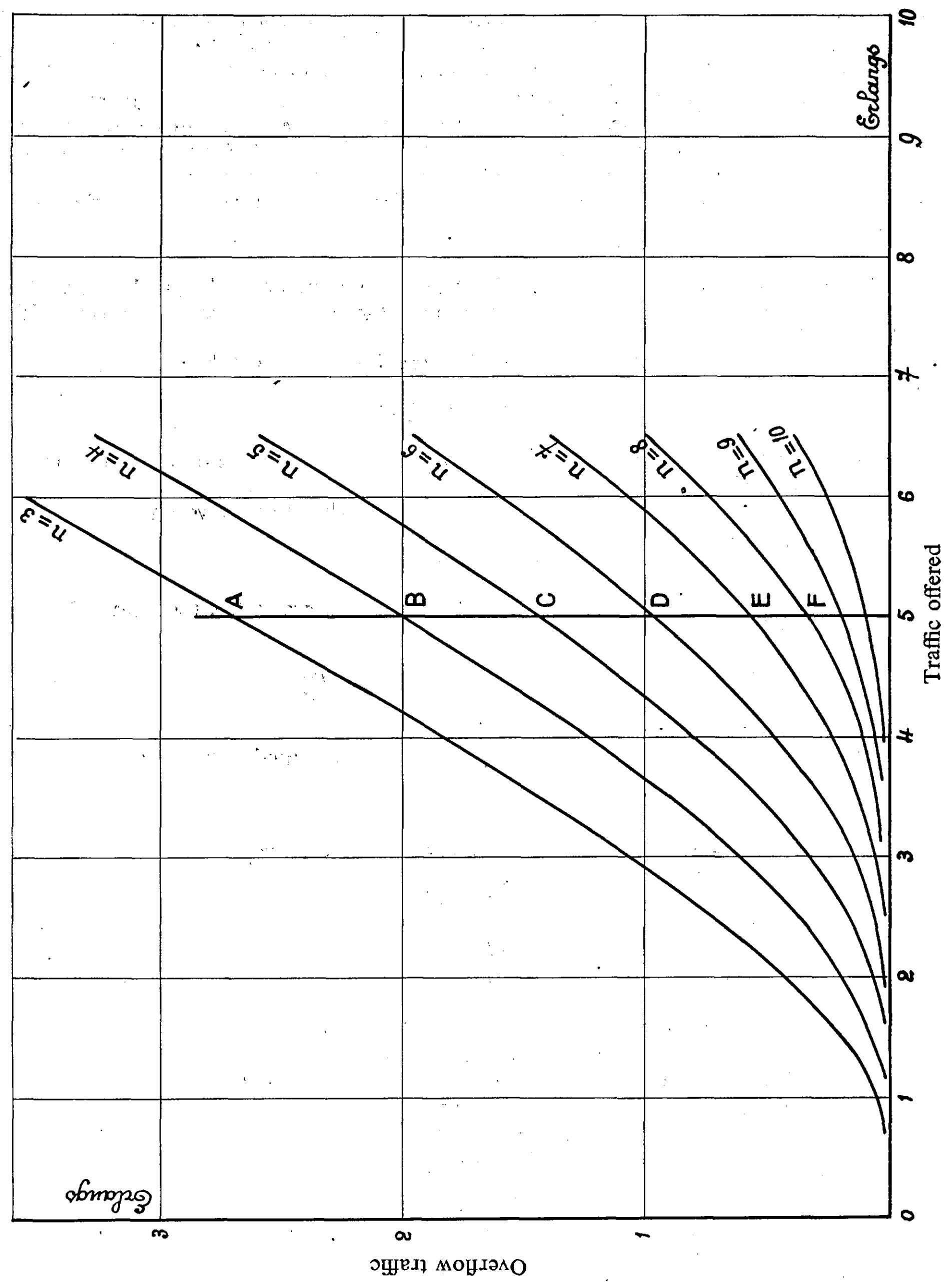
$$y = Y \times E\,(n,\ Y)$$

$E\,(n, y)$ being the well-known Erlang function.

A series of such curves for values of n from 3 to 10 circuits and of Y from 0 to 6 erlangs is reproduced as an example.

If the ordinate corresponding to the value of traffic offered Y is traced, it cuts the different curves at the points A, B, C, etc.

The interval AB represents the traffic which "passes from the alternative route to the direct route" if the number of direct circuits is increased from three to four ; the interval BC the traffic which passes from the alternative route to the direct route if the number of direct circuits is increased from four to five, etc. These intervals are evidently decreasing.



Erlangs
Traffic offered
Overflow traffic
Erlangs
n=3
n=4
n=5
n=6
n=7
n=8
n=9
n=10
A
B
C
D
E
F
0
1
2
3
4
5
6
7
8
9
10
1
2
3

The two successive intervals the values of which " span " the highest given $\frac{C}{U}$ value are found by " trial and error " methods.

If for example :

$$BC > \frac{C}{U} \qquad \text{and} \qquad CD < \frac{C}{U}$$

the provision of a fifth direct circuit is economic, but a sixth is not. The optimum number of direct circuits is five.

Remarks about the calculation of annual charges

1. That part of the net cost of a call falling to switching equipment at exchanges A and B can be considered as the same whether this call is established by the direct or the alternative route. Account need not be taken of the cost of this equipment in calculating the annual charges.

2. The notion " annual charge corresponding to one unit of traffic intensity " carried between A and B via T will be more readily understood from a concrete example.

For the purpose of this example let it be admitted that the circuits are calculated accordingly to recommendations 63 of Vol. VI of the *Green Book* and for a loss probability of 0.03 (see table on page 138 of Vol. VI).

Suppose that the traffic to be routed from A to T and from T to B, if there is no overflow, to be 23 and 17.6 erlangs respectively, which would necessitate 30 and 24 circuits ; and the traffic from A to B to be 5 erlangs.

The number of circuits AT could vary from 30 if the overflow is nil, to 36 if all the traffic AB is routed via T. The " load per-circuit " will vary from $\frac{23}{30} = 0.767$ erlangs to $\frac{28}{36} = 0.778$ erlangs ; this variation is very small. Let C' be the annual charge corresponding to one circuit ; then the annual charge corresponding to one erlang will vary from $\frac{C'}{0.767} = 1.304\ C'$ to $\frac{C'}{0.778} = 1.286\ C'$: the difference is very small and an average value of $1.295\ C'$ can be taken.

Similarly the number of circuits TB could vary from 24 to 30 ; the load per circuit, from $\frac{17.6}{24} = 0.733\ C$ erlangs to $\frac{22.6}{30} = 0.753$ erlangs ; if C'' is the annual charge corresponding to one circuit, the charge in respect of one erlang will vary from $\frac{C''}{0.733} = 1.364\ C''$ to $\frac{C''}{0.753} = 1.325\ C''$; the average is $1.345\ C''$.

The corresponding annual charge for carrying one erlang from A to B via T will be :

$$U = 1.295\ C' + 1.345\ C'' + C'''$$

C''' being the charge in respect of switching one erlang at the transit exchange.

General remarks

1. It is evident that the foregoing calculation is of theoretical value only, if the constitution of the circuits is such, for example, that they are provided in groups of twelve.

The problem is then to ascertain whether it is economic to provide twelve direct circuits (for example six in each direction) or to provide none at all.

2. The calculation can be singularly complicated and even became inextricable if the circuits follow several different itineraries.

Question No. 4.

(7th Study Group in co-operation with the 8th S.G.) (Category A2) [urgent] (continuation of former question No. 19 of th 6th S.G. studied in 1952-1954)

In the case of semi-automatic operation, what ought to be the shares which accrue respectively to an international terminal exchange (outgoing international terminal exchange and incoming international terminal exchange) and to an international transit exchange ?

Note. — For the study of this question, the C.C.I.F. Secretariat will ask Administrations to reply to the following questionnaire, it being understood that the replies will remain confidential and will be examined by the " Committee for the revision of international tariffs ", which will report to the 7th Study Group on the subject.

Note 2. — The results of the study of this question should be transmitted to the Sub-Committee for Rapid Operating methods and to the 8th Study Group.

Questionnaire for the study of the net cost of calls put through semi-automatically

Preliminary note

(a) The present questionnaire concerns only international semi-automatic operation ; all charges found to relate to the national service are excluded. It includes, on the contrary, the whole of the equipment used for international semi-automatic circuits in any one country.

(b) The numerical information relating to net costs or telephone charges, sent in response to this questionnaire, should be expressed both in national currency and in gold francs.

For determining the value in gold francs, account should be taken of the official rate of conversion in force at the date on which the expenses taken into consideration were incurred, unless the expenses have been revalued so as to make applicable the single rate of conversion in force on the date of that revaluation.

(c) In calculating staff costs, account will be taken not only of actual salaries, but also of the cost of any special privileges enjoyed by the staff (retirement pensions, holidays, sick absence, free medical treatment, recreational facilities, social insurance, family allowances, etc.).

A. *Investment*

1. In taking account of the expenditure incurred by your Administration (including miscellaneous charges), what are the manufacturing and installation costs :

(1) Of automatic, including signalling, equipment for handling:

(a) outgoing and incoming calls ?

(b) transit calls ?

(2) Operating positions ?

2. Taking account of the expenditure incurred by your Administration (including miscellaneous charges), what are the costs of construction and fitting out of the buildings used:

(1) For telephone apparatus for calls :

(a) outgoing and incoming ?

(b) transit ?

(2) For operators' positions ?

B. *Maintenance*

1. What are your annual maintenance charges (including miscellaneous expenses) relating to :

(1) Automatic equipment for calls :

(a) outgoing and incoming ?

(b) transit ?

(2) Operating positions ?

In determining maintenance charges account should be taken of labour costs, renewals of equipment and electric power costs.

2. What are the annual maintenance charges (including miscellaneous expenses) relating to buildings (labour, heating, lighting, etc.) used :

(1) For equipment for calls :

(a) outgoing and incoming ?

(b) transit ?

(2) For operating positions ?

C. *Operating costs*

What are your annual costs for operators (including miscellaneous expenses) for the whole of the traffic over semi-automatic circuits :

(a) outgoing call ?

(b) incoming call (codes 11 and 12) ?

(c) transit call (codes 11 and 12) ?

D. *Miscellaneous*

Useful life — Residual value

(1) In order to calculate an annuity for depreciation, what length of life do you assume :

(a) for automatic equipment ?

(b) for buildings ?

(2) If you take account of a residual value in calculating repayment of capital, what is the ratio (as a percentage) between the residual value and the initial value for each of the two elements under consideration ?

E. *Statistical Information*

(a) Number of circuits taken into consideration in the preceding § A :

— useable for outgoing traffic (or outgoing transit) ;
— useable for incoming traffic (or incoming transit).

(b) Number of operating positions taken into consideration for the same paragraph.

F. *Traffic*

1. What is the traffic effectively carried over the whole of the circuits considered :

(a) outgoing traffic exclusively ?

(b) incoming traffic exclusively ?

(c) transit traffic ?

(This traffic will be expressed in chargeable minutes for a period of one year.)

2. What percentage of the traffic is handled by operators (codes 11 and 12).

— in reference to incoming traffic ?
— in reference to transit traffic ?

3. What is the ratio of chargeable time in the busy hour to the chargeable time for the day ?

Degree of utilisation of the equipment considered in the present study

What, for the whole installation, is the ratio between the amount of the investment (§ A) and the amount of the investment which would only be necessary in order to carry the traffic considered in § F with the loss probability recommended by the C.C.I.F. ?

G. *Conclusions*

What is the amount in gold francs which, in your opinion, would cover the establishment of an international semi-automatic call of 3 minutes :

— in an outgoing exchange ?
— in an incoming exchange ?
— in a transit exchange ?

Question No. 5.

(7th Study Group) (Category A 2) [urgent] (continuation of Question No. 20 of the 6th and 7th S.G. studied in 1952/1954)

Study of the net cost of telephone calls, carried over carrier-current systems and over broad-band radio links.

Note 1. — The study in reference to co-axial cable systems has already been completed (see Document C.C.I.F. — 1952/1954 — 6th and 7th S.G. — Document No. 23).

Note 2. — The following questionnaire will be used for the study to be made of broad-band radio links. The (confidential) replies to this questionnaire will be examined by the Committee for the revision of international telephone tariffs.

The Administrations which do not yet have broad-band radio links in operation are invited to reply on the basis of studies made or approved contracts.

Important Observations

1. The numerical particulars relating to net costs or to telephone charges communicated in response to the present questionnaire should be expressed at the same time in national currency and in gold francs. Because of the fluctuations in the prices of primary materials during recent years, precise dates should be quoted corresponding to the numerical particulars relating to the net costs furnished by the various Administrations.

For determination of the value in gold francs, account will be taken of the official rate of conversion in force at the date on which the expenses taken into consideration occurred, unless the expenses have been revalued so as to make applicable the single rate of conversion in force on the date of that revaluation.

2. In calculating staff costs, account will be taken not only of salaries properly so called, but also of any special privileges enjoyed by the staff (retirement pensions, holidays, sick absence, free medical treatment, recreational facilities, social insurance, family allowances, etc.)

Questionnaire preparatory to a study of the net costs of international telephone calls over broad-band radio links

A. *Investment and depreciation relating to installations*

1. In assessing the expenditure to which your Administration is committed (including miscellaneous expenses) what have been the costs of provision (value of the plant and installation costs) of *each station* (terminal or relay), equipped for the establishment of broad-band radio links, in service in your territory (interior trunk service or international service) ?

With a view to assembling a literature capable of being used by all the countries concerned it is requested that this question be answered by indicating, for each of the two categories of stations mentioned above, the expenditure to be entered for each of the items ennumerated below :

(a) land, access (road, tunnel, mountain lift, etc...) ;
(b) buildings (including, if appropriate, water supply and staff quarters) ;
(c) power (distribution lines, generating sets, transformer substations, etc...) including stand-by plant ;
(d) aerials, pylons, feeders, anti-freezing arrangements, etc. ;
(e) junction cable between the terminal station and the interurban telephone network ;
(f) radio equipment, including equipment normally in reserve, intended for the transmission of the telephone channels in the radio link itself ;
(g) telephone equipment, including equipment normally in reserve, for the separation of the 12-channel telephone groups and their extension to the general telephone network (excluding demodulation equipment for obtaining individual circuits) ;
(h) other costs.

2. For the calculation of an depreciation annuity (see Question No. 8 below), what is the average useful life that you assume for each of the elements *(a)* to *(h)* ennumerated in the above question ?

If you take account of the residual value of any of the elements ennumerated above, what is the ratio (as a percentage) between this residual value and the initial value of each of the elements considered ?

B. *Maintenance*

3. What are the annual maintenance charges for each station, equipped for the establishment of broad-band radio links, in service in your territory (interior trunk service or international service) ?

Show separately :

(a) the staff costs,
(b) the costs relative to telecommunication plant (including power supply installations),
(c) transport costs (reads, mountain lift, vehicles including depreciation on vehicles, etc.),
(d) miscellaneous supplies (power comsumption, maintenance of buildings).

C. *Statistical information about completed installations*

4. What is the total length, in kilometres, of the broad-band radio links in service in your country (totalled length without taking account of the capacity of each radio link) ?

5. Indicate for each station in service in your country :

— the number of radio links in service in the various directions (counting the go and return channels in the same route as a single radio link),

— for each radio link, the number of 12-channel groups effectively equipped (relayed or terminated in this station) and the total capacity (maximum number of 12-channel groups which could be established), in completing the following table :

Number of radio links	Number of equipped 12-channel groups		Total capacity of the radio links
	relayed (relay stations)	terminated (terminal stations)	

6. What is the number of kilometres of telephone circuit in service in the broad-band radio links indicated in the reply to Question No. 4 ?

This number will be the sum of the products obtained (for each section between two neighbouring stations) by multiplying the number of circuits by the crowflight distance between the two neighbouring stations.

D. *Miscellaneous information*

7. What rate of interest do you pay on borrowed capital ?

8. What method do you use to calculate the annual depreciation of an installation or building ?

(a) Do you simply divide the costs of provision by the number of years of useful life assumed for this installation or building ?

(b) Do you take account of the law of compound interest and, if so, what rate of interest do you use in the calculation ?

(c) Do you take account of the residual value of the recovered plant ?

E. *Conclusions*

9. Taking account of the information assembled in responses to Questions Nos. **1** to 8 above, on what basis do you envisage the remuneration of the Administrations having equipped broad-band radio links (excluding telephone type carrier current terminal equipment) *in the case of metric waves or in the case of decimetric or centimetric waves* ?

(a) Is it necessary to preserve the habitual method of charging for the " line " portion of metallic or centimetric circuits (per 100 kilometres of circuit) ?

(b) Or rather must account be taken of the actual annual charge for each station used ?

(c) Or would it be better to introduce a uniform remuneration per station whatever the type of station ?

(d) Or again is it necessary to envisage a rental for each station, these being classified in a limited number of categories according to the annual charges for each station ? (see, merely as an example, the following remark).

If you favour this latter method, how would you classify the stations situated on your territory and mentioned in the reply to Question No. **1** above ?

10. Following the method advocated by your Administration in reply to Question No. **9** above, and taking account of the charges for :

— interest on capital engaged
— depreciation
— maintenance

(including miscellaneous expenses)

What is the sum which, in your opinion, would cover the charges borne by your Administration for each unit of ordinary private international conversation (3 minutes) ?

Remark on Question No. 9. — If it appears suitable, particularly for certain metric wave broad-band radio links, to reply in the affirmative to point *(d)* of Question No. **9** above, the classification of the stations in three categories could be envisaged :

1. Relays situated at points easily accessible by road and habitable. These relays would be the least onerous to operate.

2. Relays situated at isolated points accessible by road but not suitable for normal residence and consequently necessitating periodical relief of the staff.

For these two classes, there would be no particular difficulty in supplying power, either by the electrical distribution network, or by electric generating sets easily refuelled.

3. Relays situated at very isolated points inaccessible to normal vehicles and not suitable for residence necessitating, for example, a mountain lift and possibly presenting difficulty with the production of electric power. These relays involve the most onerous operating conditions.

In such a case, it would be suitable to indicate the annual net cost, in gold francs, to be taken into consideration for each of the types of station defined above and according to their capacity and their equipment. This information could be given in the form of the following table :

	12 channels	24 channels	36 channels	48 channels
Stations of the 1st category :				
Stations of the 2nd category :				
Stations of the 3rd category :				

Question No. 6.

(7th Study Group) (Category A 2) [urgent] (new question)

Is it necessary to revise Recommendation No. 49 of the C.C.I.F. as regards the tariff applicable to broadcast transmissions using a normal-type circuit ? If so, what do you propose ?

Note. — It would be useful for these proposals to include information concerning :

(a) The capital invested in circuits for broadcast transmissions of normal type ;

(b) The annual charges for these circuits, taking account of operating costs, and maintenance and general costs.

Question No. 7.

(7th Study Group in co-operation with the C.C.I.F. 3rd and 5th S.G.) (Category A 2) [urgent] (continuation of Question No. 12 of the 6th and 7th S.G's studied in 1952/1954)

In accepting that television will develop rapidly during the next few years and that Administrations will have to place circuits at the disposal of Broadcasting Organizations for this new service, is it not desirable to fix the charges for these television transmissions by considering at the same time ;

(a) the case of a television circuit on a coaxial system ?

(b) the case of a television circuit on broad-band radio relay links ?

Note 1. — With a view to providing the necessary technical information to the 7th S.G., in order to fix the charges to be applied to occasional television transmission or the renting of circuits for television transmissions, the C.C.I.F. 3rd and 5th S.Gs. should first reply to the following points which are the subject of Question No. 22 of the 3rd S.G.

A. — *Coaxial systems.*

(a) What, at least approximately, is the ratio between the net cost of a telephone conversation exchanged from end to end on a telephone circuit in a coaxial system for the one part, and the net cost of a television transmission in one direction only over a coaxial system *without modification of the cable and the repeaters,* for the other part ?

(b) In view of the fact that for good-quality television transmissions, it is necessary to have terminal equipment different from that for telephony and, moreover, to modify the repeaters in order to realise a supplementary phase compensation, what supplement is envisaged to the abovementioned ratio in order to take account of these modifications ?

B. — *Broad-band radio relay system.*

(c) What, at least approximately, is the ratio between the net cost of a telephone conversation exchanged from end to end over a carrier current telephone system on a broad-band relay system for the one part, and the net cost of a television transmission, in one direction only, over a broad-band radio-relay system without modification of the relay stations, for the other part ?

(d) In view of the fact that for good-quality television transmissions, it is necessary to have terminal equipment different from that for telephony and, moreover, to modify the relay stations in broad-band radio relay systems, what supplement should be envisaged to the above-mentioned ratio in order to take account of these modifications ?

Note 2. — The questions set will be studied for the three television standards envisaged in Europe (405, 625 and 819 lines) on the basis of the replies of the C.C.I.R. to its study programme No. 32.

Note 3. — When the abovementioned information requested of the C.C.I.F. 3rd and 5th S.Gs becomes available, the Committee for the Revision of International Tariffs will draw up a detailed questionnaire in order to study the net cost of television transmissions.

Question No. 8.

(6th Study Group in co-operation with the 9th S.G.) (Category A 2) [urgent] (new question)

(a) Is it desirable that all the circuits for television transmissions, that is to say :

— circuits necessary for the transmission of live pictures (television),
— circuits for the transmission of sound accompanying the pictures,
— conversational circuits,

be asked for by the television organizations from the already existing centralized service of the different countries, in the same way as that provided for broadcast transmissions in C.C.I.F. Recommendation No. 49 ?
or is it judged necessary to establish special services for this purpose ?

(b) In the affirmative, what particular conditions should be foreseen as regards these transmissions ?

Question No. 9.

(6th Study Group) (Category A 2) [urgent] (new question)

Should it be recommended that the international terminal exchange advises the caller of the reasons for which the called subscriber refuses a call *without préavis*, if the called subscriber has consented to the reason being given ?

Question No. 10.

(6th and 8th Study Groups in co-operation: Question No. 13 of the 8th S.G.) (Category A 2) [non urgent] (continuation of Question No. 10 studied in 1952/1954)

What are the essential conditions which should be fulfilled by apparatus used at the subscriber's premises to reply to, or record, messages in his absence ?

Should there be a recommendation, in particular, not to admit the periodical emission of a tone in order to declare the presence, in the course of conversation, of a speech recording device ⊘, in view of the inconvenience that can be caused by the introduction of new tones in the telephone service ?

Note. — There follows, as an example, certain conditions which might be imposed :

1. The apparatus should reply to a ring, either automatic or manual, within a period of 10 to 15 seconds. This period would avoid waste of line time and allow the call to be answer in the ordinary way if desired. It is desirable that this delay period should be measured by means independent of the duration or periodicity of the ringing current.

2. Standard metering conditions should be given by the apparatus when it answers the call.

3. Normal supervisory conditions during the call and a clearing signal at the end of it, should be given.

4. Automatic clearing arrangements should operate within a brief period (for example 20 seconds) after the calling subscriber has cleared or at the end of dictation.

5. The correct functioning of the apparatus should not depend upon (nor be adversely affected by) the emission or reception of signalling frequencies (signalling frequencies used in the telephone network or generated specially in the apparatus).

6. The telephone instrument should work normally if the speech recording apparatus or its power supply develops a fault.

Question No. 11.

(6th and 7th Study Groups) (Category A 2) [urgent] (new question)

What charge ought to apply for an international call terminating on an apparatus ⊘ which substitutes the called subscriber and gives the verbal indication recommended by the C.C.I.F. (Recommendation No. 12 *bis* in the following cases :

(a) ordinary, urgent or lightning calls ?

(b) *preavis* call ?

(c) when the call booking is cancelled ?

(d) when the call is refused ?

Note. — C.C.I.F. Recommendation No. 37 may need to be adapted to the different circumstances envisaged above.

Question No. 12.

(6th and 7th Study Groups) (Category A 2) [non-urgent] (continuation of Question No. 6 studied in 1952/1954)

Where the number of circuits is sufficient to carry the traffic without delay, could a reduction be agreed in the charge applicable (during the heavy traffic period) to subscription calls (weekly or monthly) if the duration of the subscription call is at least one hour ?

If so, what reduction could be agreed ?

Question No. 13.

(6th and 7th Study Groups) (Category A 1) [urgent] (new question)

Ought payment of the *preavis* charge to be required in the case where a *preavis* call booking cannot be satisfied because the agreement for the called line has been cancelled (ceased line) ?

Question No. 14.

(7th Study Group) (Category A 2) [urgent] (new question)

In the case of an occasional fixed time call on a " collect " basis, ought both the fixed time and the collect fees to be charged ?

Question No. 15.

(6th and 7th Study Groups) (Category A 2) [urgent] (continuation of Question No. 15 studied in 1952/1954)

In Recommendation No. 21, " Leasing of international communication channels for private service ", it is clearly stated : " The leased line may not, in any circumstances, be ceded to third parties ".

Ought this principle, which naturally applies to all privates services, to be strictly applied to public services other than telecommunications ; for example, meteorological, civil aviation, railways, electric power ? Could the use of an international telephone circuit by one or more third parties be allowed in special circumstances ? If so, what precautions should be taken to avoid abuse, what should be the basis of charging and, if necessary, reckoning the duration of use ?

Note. — The 6th and 7th Study Groups had a long discussion about this question in 1952/1954. The following Annex summarises the points of view expressed.

ANNEX

(to Question No. 15)

Summary of the principal points of view expressed during the 6th and 7th Study Group meetings in Geneva in March, 1953

1. Modification of the general rule expressed in C.C.I.F. Recommendation No. 1 : " The rented line may in no way be ceded to third parties ", was opposed by a certain number of Administrations on principle, and in particular for the following reasons :

Although it is relatively easy, in telegraphy, to record messages when abuses are feared in order to be able to furnish later proof that the abuses have been committed, this seems much more difficult in telephony. When, in particular, a public service renter is concerned, it would be rather unpleasant for a Telecommunication Administration to exercise such means of control ; besides, if a dispute arose between two public services (for telecommunications and another public service), it would be difficult to arbitrate. (The difficulties already met on the subject of the use of the Civil Aviation private telegraph network for carrying Class B telegraph traffic, is an instance).

Moreover the extension of the international private networks for various public services would entail the risk of an appreciable reduction in the size of the general telecommunication network. As it is not practically possible to remedy abuses, it is to be feared that such abuses will grow.

It is well known that, in airports, there are numerous private aviation companies which could benefit simultaneously from a leased international circuit ; there exist also numerous connexions between airports and meteorological services. Likewise the Railway Administrations have rather limited communication with road transport companies, which are themselves in limited communication with tourist services. If, therefore, the number of private networks for the various public services increases, the danger of them carrying traffic which should normally go over the Telephone Administration circuits, also increases.

On this subject, it is recalled that the first article of the agreement between the United Nations and the International Telecommunication Union provided for United Nations recognition of the International Telecommunication Union as the specialized agency responsible for taking all appropriate measures to attain the objects defined in the International Telecommunications Convention ; and that Article 3 of the said Convention specifies that the objectives of the Union are, in particular, the rational use of telecommunication of all kinds, the development of technical means for increasing the efficiency of the telecommunications services and their widest possible availability to the public.

It should also be remembered that telephone operating experience has always shown the value of avoiding undue division of the circuits interconnecting two towns. In the event of private international networks for various public services being set up and expanded, the points of activity of the different services not necessarily coinciding, there would probably be a better overall telephone service if the circuits between the same two points, previously shared among the various private networks, were grouped into a single route.

2. Another point of views was expressed as follows :

— If there could be a system of metering (call duration meters) affording sufficient guarantees, there need no longer be concern about the use made of the circuit and third-party use of leased circuits could be accepted from the time that the rental agreement provided for a minimum remuneration from the leased circuit.

3. A third point of view was also expressed according to which the application of an adequately penalising tariff, sufficiently increased for " multiple " leases, would allow third party use of leased international telephone circuits to be authorised ; this would avoid the need to supervise the use of the circuit as well as having to instal meters.

Experience acquired in the telegraph service shows, unfortunately, that most of the public services consider themselves as single users of a leased circuit and refuse to admit the principle of a multiple lease, although several branches of the same public service may use the leased circuit.

Question No. 16.

(6th and 7th Study Groups) (Category A2) [urgent] (new question)

The tariff for a permanently-leased circuit, envisaged in C.C.I.F. Recommendation No. 21, is based on 6000 minutes of ordinary conversation per month during the heavy traffic period in the route considered.

Should not the growing generalisation of the manual rapid service lead to a revision of this basis of charging for a leased international telephone circuit ?

Question No. 17.

(7th Study Group) (Category A2) [urgent] (continuation of Question No. 7 studied in 1952/1954)

In the case of a circuit being rented for broadcast transmissions for a long period, for example one month, should the tariff to be applied be determined within the framework of C.C.I.F. Recommendations Nos. 21 and 49 ?

Note. — The following Annex recapitulates the various stages in the study of this question in 1952/1954.

ANNEX

(to Question No. 17)

This question was studied in 1952/1954 when the following replies were made :

(a) in document " C.C.I.F. — 1952/1954 — 6th and 7th S.G. — Document No. 7 *a* " by the Administrations of Switzerland, Austria, the Netherlands, Norway, Sweden, Denmark and by the American Telephone and Telegraph Company,

(b) in document " C.C.I.F. — 1952/1954 — 6th and 7th S.G. — Document No. 7 *b* " by the Administrations of France, Belgium and Great Britain,

(c) in document " C.C.I.F. — 1952/1954 — 6th and 7th S.G. — Document No. 7 *c* " by the Administrations of Turkey and the German Federal Republic and by the National Telephone Company of Spain.

A draft recommendations was prepared during the 6th and 7th Study Group meetings in Geneva in March, 1953.

This draft recommendation was re-examined by the 7th S.G. in October 1954, during its meeting preceding the XVIIth Plenary Assembly ; after a wide discussion it was apparent that the draft recommendation would not meet with the approval of a considerable number of the members of the 7th S.G., especially Part II " Charging " which is reproduced below and constitutes an essential element in the reply to this question :

" II. *Charging* (text rejected by the 7th S.G. in October 1954)

1. The number of chargeable minutes in the tariff for telephone calls during the period of heavy traffic in a period of one month is $6000 \times 1.25 = 7500$ in the case of an old-type broadcast transmission circuit. In the case of a normal-type broadcast transmission circuit, this number should be fixed at $6000 \times 3 = 18{,}000$ if the same rule were observed, but, accepting that this rental corresponds in fact to the simultaneous leasing of three telephone circuits, the number is reduced to 13,500.

" 2. In the event of an interruption which is the fault of the telephone service, the Administration or private operating Agency of origin will reimburse the renter at his request. If the duration of the interruption is less than six consecutive hours and if the interruption does not occur during the period between 8 h. 00 and 24 h. 00, no reduction is due. Otherwise, the reimbursement is calculated on the basis of a reduction of 1/30th of the monthly rental, for each day during which there was an interruption giving a right to refundment."

Question No. 18.

(7th Study Group in co-operation with the 3rd S.G. and the C.C.I.T.) (Category A2) [urgent] (new question)

In order to meet the particular needs of certain users having heavy telephone, telegraph or phototelegraph traffic, is it to be recommended that it should be agreed to lease telephone circuits permitting, at the will of the user, a telephone conversation, a phototelegraph transmission or the use of more than one telegraph channel ?

What should be the conditions of leasing such a circuit which could be only of good quality it being understood that the transmissions are always successive ?

Question No. 19.

(6th and 7th Study Groups) (Category A1) [urgent] (new question)

In order to respond to the particular needs of certain users interested only in either the reception or the emission of messages, photographs or broadcast programmes, is it to be recommended that Administrations or private Operating Companies should provide, in parallel with existing broadcast (or telephone) circuits, a lease of receivers or transmitters (possibly connected by telephone circuits to the domicile of those interested) in order to effect either reception only, or simply transmission ?

In the affirmative, what general regulations (conditions of admission and charging) ought to be observed in the interest of the general international telephone service ?

Note 1. — On this subject see the International Telegraph Regulations (Paris, 1949, revision)—Chapter XXIV entitled " Radiocommunications to multiple destinations ".

Note 2. — It is desirable that no precedent should be created in this matter in the international sphere before the C.C.I.F. has issued a recommendation on the subject.

Question No. 20.

(6th and 7th Study Groups) (Category A1) [urgent] (new question)

With Recommendation No. 4 as on example, is it now possible to establish the bases of an international telephone regulation of worldwide scope concerning the operation of intercontinental telephone circuits (radio-electric links or metallic circuits) ?

It C.C.I.F. Recommendation No. 4 is insufficient, what modifications and additions should be made with a view to harmonising in the best possible way the operation of intercontinental telephone circuits with the operation of the international circuits in the European system ?

Question No. 21.

(6th and 7th Study Groups) (Category A2) [urgent] (new question)

Because of difficulties arising from currency regulations many countries have already made arrangements for the rental charges for international telephone circuits not to be included in the international accounts, but for them to be collected in national currency from the subscriber concerned in each country.

Would it not be expedient to modify C.C.I.F. Recommendation No. 21 so that each terminal Administration would have the possibility of collecting the share of the rental charges accruing to its country directly from the users of the leased circuit who reside in its country ?

What arrangements should be made to enable transit Administrations to receive their share ?

Question No. 22.

(6th and 7th Study Groups) (Category A2) [urgent] (new question)

During the period of progressive utilisation of a group of 12 channels which, subsequently, will serve entirely for transit across certain countries, how ought the transit country or countries to be remunerated before the 12 channels are all utilised for transit purposes ?

Note. — Because of the great progress made in the constitution of the network of telephone cables with high-speed transmission (symmetrical pair and coaxial cables), it happens that entire groups of 12 telephone channels transit one or several countries. The result is that the transit country or countries cannot use any of the 12 channels of the system in question. But it happens that, while such a system is being put into service, a certain number of the 12 channels are spare.

As long as this situation continues, the transit country or countries are not remunerated for the whole of the 12 channels.

Question No. 23.

(7th Study Group) (Category A2) [urgent] (new question)

What system of international accounting could be recommended to replace the one used at present?

Note 1. — In studying this question, account should be taken of the following principal considerations :

(1) The system proposed should enable the checking and account preparation arrangements to be simplified in order that telephone operation as a whole can benefit from the financial advantages which can be procured from modern methods of establishing calls.

(2) One possibility would appear to be a fundamental transformation from the system based on the actual unit charge to a system based upon some kind of bulk payment, which could be revised periodically.

(3) The case of a major temporary increase in the volume of traffic should also be envisaged.

Note 2. — In the event of the proposed study not resulting in a new method of accounting eliminating the difficulties outlined, and in order to enable international accounts to be established under semi-automatic operation and, in the future, fully automatic working, it will be necessary to consider what charging rules should apply. It will be desirable to specify what rules there should be in event of the automatic alternative routing of traffic over normal routes other than first choice ones not traversing the same countries ; distinghishing for semi-automatic service the two following cases :

(a) The outgoing international terminal exchange is equipped with a device indicating to the outgoing operator over which of the normal routes (1st choice or... nth choice) a particular telephone call has been connected ;

(b) The outgoing international terminal exchange is not so equipped.

Question A (Supplementary).

(6th Study Group in co-operation with the 8th S.G.) (Category A 2) [urgent]

(a) What loss probability is to be recommended for the calculation of the number of switches required at an international switching centre in automatic or semi-automatic operation in the case of :

— an outgoing international terminal exchange ?
— an incoming international terminal exchange ?
— an international transit exchange ?

(b) How should the number of operating positions be determined, in order to reduce to a reasonable value (to be fixed), the time necessary to obtain :

— an incoming operator (code 11) ?
— a suspended-call operator (code 12) ?
— an assistance operator ?

Note 1. — The proposed study leads to the fixing of a limiting value for the total loss probability of a chain of switches. It appears to be necessary to specify to what this expression is directed and, for example, to indicate that :

— in an outgoing exchange, the chain comprises all the links which afford access from the operator's position to the international circuit,
— in a transit exchange, the chain going from the incoming international circuit to the outgoing international circuit.

Note 2. — In addition, it would be desirable to indicate for equipment such as registers :

— a loss probability,
— or if necessary, a delay probability,
— or even that the delay probability should not exceed x seconds.

Note 3. — It will be necessary to indicate the kinds of probability formulae to be used.

Note 4. — The following Annex recalls the reasons which led to a study of this question by the Sub-Committee for Rapid Operating Methods and the points already examined in associated fields.

ANNEX

(to supplementary Question A)

1. For a number of years the Sub-Committee for Rapid Operating Methods has been anxious to arrive at a complete solution of the problem of how to calculate the number of circuits in international automatic or semi-automatic operation.

The method of calculating the amount of equipment required at international transit exchanges has come to be associated with this question. Indeed it would be illogical to recommend the adoption of less probability values for calculating the number of circuits which are necessary, and not to furnish standards for the switching equipments which ensure the connexion between two international circuits in a transit exchange.

Moreover, it seems clear that this standardisation should be extended to the links in incoming terminal exchanges ; the question of the number of outgoing equipments can be considered to be more or less a national question.

2. The urgency of undertaking a study of this question of the method of calculating the number of connecting links in international exchanges, springs also from considerations associated with the problem of the net cost of calls established over semi-automatic circuits ; a problem the solution of which affects, in some measure, the establishment of a routing plan for semi-automatic traffic in Europe.

Every economic study must in reality be based on precise information in the matter of assessing the quantity of switching equipment ; and it is highly desirable to secure standardisation on this subject, in order that the studies conducted in this field by the various Administrations may lead to results which are in every way comparable.

3. It is not without interest to note that the question of the method of calculating the amount of switching equipment in international exchanges is not new.

Question No. 15 of the 8th Study Group, studied in 1947/1949, relative to the essential conditions to be fulfilled in the arrangement of automatic exchanges, included the method of calculating the number of switches (Joint Report of the 8th S.G. and the Sub-Committee for Rapid Operating Methods, Paris, July, 1949, page 63).

In the propositions for modifications and additions to Volume V, established by the C.C.I.F. Secretariat in 1949, for submission to the Sub-Committee for Rapid Operating Methods before the Plenary Assembly of Paris, 1949, it was indicated on page 39 :

" It appears premature, in 1949, to clarify various essential clauses relating to trunk exchanges for international semi-automatic operation ; these should be determined only in the light of experience gained on the field trials network with semi-automatic international telephone operation..."

See also Volume VI, page 50 of the *Yellow Book.*

Question No. 15, relating to the arrangement of automatic trunk exchanges, is in the province of the 8th Study Group, but it is quite evident that that part of this question which dealt with the method of calculating the amount of switching equipment in international exchanges, is of operating interest and should first be dealt with by the Sub-Committee for Rapid Operating Methods.

There is no reason to defer any longer the framing of this question at least in reference to international exchanges and it is proposed that it should figure in the programme for the meeting of the Sub-Committee for Rapid Operating Methods at Geneva, in March/April 1956. This question could be integrated with that of establishing standards for determining the number of Code 11 operators at incoming international exchanges.

On the subject of determining the number of operators, it should be noted that, during its meeting in Stockholm in 1948, the Sub-Committee for Rapid Operating Methods proposed a question dealing with the maximum value to be recommended for the average time to answer by operators at incoming exchanges in the European international telephone service. In reply to this question which constituted question No. 25 of the 6th S.G. in 1950/1951 (see Volume I *bis* of the *Yellow Book*, Paris, 1949, page 418), the C.C.I.F. recommended at Florence, in 1951, in Recommendation No. 40 *bis* (see Volume I *ter* of the *Yellow Book*, page 189) that the time to answer should not exceed *an average* of 5 seconds and in any case, during the busy hour, should not exceed (for 80% of calls) a duration of 10 seconds.

Question B (Supplementary).

(6th Study Group in co-operation with the 8th S.G.) (Category A2) [urgent]

(a) What arrangements are to be recommended at outgoing international terminal exchanges, in the case of semi-automatic operation, when these is prolonged congestion on the normal route or routes ; and in such circumstances how can the use of auxiliary routes be facilitated ?

(b) What arrangements are to be recommended at outgoing international terminal exchanges, in the case of semi-automatic operation, in the event of major breakdowns of the normal and auxiliary routes ; and in such circumstances how can the use of emergency routes be facilitated ?

Note 1. — The XVIIth Plenary Assembly (in taking account of the possibilities offered by semi-automatic operation) concluded that, in the semi-automatic service, there could be several normal routes. For example, there could be a first choice normal route, a second choice normal route, a last choice normal route ; all normal routes other than the first choice one could be called " overflow " routes.

These definitions figure in Column 22 " Normal route " in Recommendation No. 1—operating (Geneva 1954).

Note 2. — The Annex which follows recalls the reasons which have led to an examination of these questions by the Sub-Committee for Rapid Operating methods, and the studies which have already been undertaken in this connexion.

ANNEX

(to supplementary Question B)

Question No. 16 studied by the Sub-Committee for Rapid Operating Methods in 1947-1949, referred primarily to the arrangement of international terminal exchanges to permit (in the case of a rapid service) the quick passage, when necessary, from rapid to advance preparation operating or vice-versa. (Report of the meeting at Stockholm, June 1948).

In the proposals for modifications and additions to the draft of Volume VI of the C.C.I.F. *Yellow Book*, established by the Secretariat in 1949, intended for submission to the Sub-Committee for Rapid Operating Methods before the Plenary Assembly of Paris, 1949, it was indicated on page 40 :

" It seems premature in 1949 to specify the measures to be taken in detail and the results of the international semi-automatic telephone operating trials should be awaited before formulating final recommendations."

Volume VI of the *Yellow Book* repeats this text on page 51.

It seems desirable to resume the examination of this question without further delay, and to study at the same time the measures to be taken (in the semi-automatic service) for putting auxiliary or, if necessary, emergency routes into service in case of congestion or major faults affecting the normal route or routes.

It is proposed that these questions appear in the programme for the meeting of the Sub-Committee for Rapid Operating Methodes in Geneva, in March/April, 1956.

Associated with this question is the problem which was the subject of the supplementary Question G of the 6th Committee of Reporters (Stockholm, 1948); that is the problem of the possible institution of permanent committees charged with the rapid establishment of emergency circuits in order to overcome line faults or fortuitous and unforeen congestion or temporary and exceptional needs in certain European international telephone relations.

At that time the Sub-Committee for Rapid Operating Methods considered that such an institution would be premature, but it would be desirable for the study of this question to be continued in the light of the new requirements which may be considered necessary to ensure the regulation of the traffic.

RECAPITULATORY TABLE

of the operating and charging questions the study of which should be undertaken or continued in 1955, 1956 and 1957

Question No.	SUBJECT	CATEGORY	STUDY GROUP (other than the 6th and 7th S.Gs.) or other interested international organisations	REMARKS
1	Immediate changeover to an emergency circuit in replacement of a faulty telegraph circuit	A 2	8th S.G. 3rd S.G. C.C.I.T.	Urgent (new question)
2	Statistics for semi-automatic operation	A 2		Urgent (new question)
3	Number of circuits to be envisaged in the case of overflow to alternative routes	A 2	8th S.G.	Urgent (continuation of Question No. 17 of the 6th S.G. studied in 1952/1954)
4	Revenue sharing in semi-automatic operation	A 2	8th S.G.	Urgent (continuation of former Question No. 19 studied in 1952/1954)
5	Study of the net cost of calls : *(a)* exchanged over coaxial systems *(b)* exchanged over broadband radio links	A 2		Urgent (continuation of Question No. 20 studied in 1952/1954)
6	Tariff for broadcast transmissions over a normal type circuit	A 2		Urgent (new question)
7	Charging for television transmissions	A 2	3rd S.G. 5th S.G.	Urgent (continuation of Question No. 12 studied in 1952/1954)
8	Provisions of circuits for television transmissions	A 2	9th S.G.	Urgent (new question)
9	Refusal of a *préavis* call by the called person	A 2		Urgent (new question)
10	Arrangements for ⌀ apparatus	A 2	8th S.G.	Non-urgent (continuation of Question No. 10 studied in 1952/1954)
11	Charge for an international call terminating on apparatus ⌀	A 2		Urgent (new question)
12	Charges for subscription calls of long duration	A 2		Non-urgent (continuation of Question No. 6 studied in 1952/1954)
13	*Préavis* charge when the called subscriber has terminated his agreement (ceased line)	A 2		Urgent (new question)

Question No.	SUBJECT	CATEGORY	STUDY GROUP (other than the 6th and 7th S.Gs.) or other interested international organisations	REMARKS
14	Charge for an occasional fixed-time call on a " collect " basis	A 2		Urgent (new question)
15	Use of a leased circuit by third parties	A 2		Urgent (continuation of Question No. 15 studied in 1952/1954)
16	Revision of the rental for a leased circuit	A 2		Urgent (new question)
17	Leasing of circuits for broadcast transmissions	A 2		Urgent (continuation of Question No. 7 studied in 1952/1954)
18	Leasing of a circuit employed at the will of the user for telephony or a number of telegraph channels	A 2	3rd S.G. C.C.I.T.	Urgent (new question)
19	Lease of radiotelephone transmitters or receivers	A 1		Urgent (new question)
20	Regulations for the operation of intercontinental telephone circuits	A 1		Urgent (new question)
21	Payment for the leasing for of an international circuit	A 2		Urgent (new question)
22	Remuneration for a primary group in transit	A 2		Urgent (new question)
23	Replacement of the present system of international accounts	A 2		Urgent (new question)
Supp. A	Loss probability in international automatic exchanges	A 2	8th S.G.	Urgent (new question)
Supp. B	Auxiliary and emergency routes in semi-automatic operation	A 2	8th S.G.	Urgent (new question)

Note. — Questions Nos. 1, 2, 3, 4 and supplementary Questions A and B shall be examined by the Sub-Committee for Rapid Operating Methods.

Questions Nos. 4, 5, 6 and 7 shall be examined by the Committee for the Revision of International Telephone Tariffs.

LIST OF SIGNALLING AND SWITCHING QUESTIONS

the study of which must be undertaken or continued by the 8th Study Group during 1955, 1956 and 1957 (it being understood that the study of switching questions should be confined to specifying only the essential points relating to the interconnection of the automatic systems of different countries without entering into the details of the automatic installations themselves)

Question No. 1.

(6th and 8th Study Groups in co-operation with the 9th S.G. of the C.C.I.F. and with the C.C.I.T.; Question No. 1 of the 6th S.G., Question No. 30 of the C.C.I.T.) (Category A2) [urgent] (new question)

In the case of a fault on an international telephone circuit used for telegraphy, should the C.C.I.F. admit the immediate use of a telephone circuit whether or not this circuit is in use for a telephone call at the moment ?

In the affirmative, what steps should be recommended for effecting the passage from one circuit to the other in the case of :

(a) Manual switching ;

(b) Automatic switching.

Note 1. — In the case of international circuits operated on an automatic switching basis, it would be an advantage if several reserve circuits in one direction were designated so that a free reserve circuit could be selected and thus avoid frequent interruptions of a telephone call in progress.

Note 2. — This question should be examined in the first place by the " Sub-Commission for Rapid Operating Methods ".

Question No. 2.

(3rd and 8th Study Groups in co-operation: question No. 26 of the 3rd S.G.) (Category A1) [urgent] (new question)

Being given :

— the experience acquired with the use of carrier-current telephone systems, and in the field of the design and the construction of voice-frequency signal receivers,

— the advantages which could be obtained, as regards the simplicity and cost of such receivers, and as regards their reliability of operation, if higher limiting values could be used for the power and energy of signals sent over international circuits,

would it not be both desirable and possible to revise the recommendations which appear on pages 21 and 22 of the *Yellow Book*, Volume VI, as regards these limiting values, and if so, what new limits should be recommended ?

Note. — The values might be revised for the following reasons :

1. The 3rd S.G. might consider it possible to modify :—

   (a) The upper limit of -3 N or -26 decibels for the absolute level of power of a continuous sinusoidal wave and for the average power of signals composed of a succession of trains of sinusoidal waves.

   (b) The median value of 0.5 mV allowed for the psophometric e.m.f. produced on a signalling channel by signal pulses on an adjacent channel, and the average value of 62 decibels for the difference of the attenuation between the non-pass band and the pass band of a channel filter of a carrier telephone system, which would allow a new level to be fixed for the power level of a signalling pulse of short duration, according to its frequency.

2. The maximum energy which can be transmitted by the signals during the busy hour depends on the probability of the simultaneous emission of signals on several circuits in the same carrier-current systems : this probability could be made the subject of a new study, the signalling systems being now defined.

3. The 3rd S.G. Working Party, during the course of its meeting at Geneva in January-February 1955, stated that account should be taken in the statistical study, not only of electrical signals, but also of audible tones transmitted over international circuits. On this subject the Working Party noted that the permissible limits for the absolute level of power of a tone at the point at which it is applied to the international connections has not been fixed.

Question No. 3.

(Category A1) [urgent] (new question)

Is it desirable to revise the present recommendation in the *Yellow Book*, Volume VI, page 48, § *(i)* in order to clarify the clauses concerning the attenuation of disturbing currents coming from the near end of the circuit, taking into account the relative level where the receiver is connected ?

If so, in what way should these clauses be established, and is it possible to reduce the value of 60 decibels (7 nepers) at present recommended ?

Question No. 4.

(Category A1) [urgent] (continuation of Question No. 5 studied in 1952/1954)

Considering that

— a clause relating to the maximum psophometric electromotive force which the guard circuit of a signal receiver should take into account, is specified in Volume VI of the *Yellow Book*, in § VI 2.7 (page 48) ;

— but that line noise may comprise not only a continuous noise of uniform energy spectrum of the type assumed in that clause, but also induced noises, at a low frequency and high level, and noises of a transitory nature ;

— in particular, that a clause of this type could not provide protection against infrequent peaks of noise of short duration, but of large amplitude, such as those which can result from surges arising from switching operations, or from microphonic effects due to the movement of adjacent switches on the switching apparatus racks ;

What information exists on the nature, duration, distribution in time, and amplitude, of noises of the transitory nature referred to above ?

Should the occasion arise, what changes would it be advisable to introduce into the specification for the signalling systems, particularly for the signal receivers, to take account of the points enumerated above ?

Question No. 5.

(8th and 9th Study Groups in co-operation; Question No. 4 of the 9th S.G.) (Category A2) [urgent] (new question)

If the statistics, which are to be presented to the 9th S.G. on the subject of the frequency of occurrence and duration of " hits " which are within the band of frequencies liable to cause the operation of the signal receiver, indicate that there is a real danger of false operation of the signalling equipment from this cause :

— and if it is not possible to obtain the assurance that this situation can be rectified,

— what arrangements should be recommended to guard against the false operation of the signalling equipment due to this cause ?

Question No. 6.

(Category A1) [urgent] (continuation of the study of Question No. 6 in 1952/1954)

Taking into consideration all the available evidence concerning the duration and frequency of occurrence, of momentary interruptions of the transmission path of international telephone circuits, what could be their effect on signalling in semi-automatic telephone operation ?

Would the duration and frequency of occurrence of such interruptions be such as to affect adversely, to an appreciable extent, the performance of the signalling equipments, and, if so, what steps can be recommended to safeguard the transmission of signals ?

Note 1. — It seems essential that, in order that the 8th S.G. can consider this matter, it should receive copies of the statistics which will be sent to the Secretariat of the C.C.I.F. in reply to Question No. 3 of the 9th S.G. on the subject of the frequency of occurrence of momentary interruptions of the transmission path. These statistics should be sent directly to the 8th S.G., without waiting until the 9th S.G., has made an analysis of the information received. The information received up to October 1954 is shown as appendices to Question No. 3 of the 9th S.G. (pages 518-522 of Volume I of the *Green Book*).

In accordance with directives of the C.C.I.T., the statistics concerned with momentary interruptions of the transmission path are shown in several categories, according to their duration by dividing the transmission breaks into 3 groups :—

of a duration less than 5 milliseconds
of a duration between 5 and 20 milliseconds
of a duration greater than 20 milliseconds

Note 2. — In telephone signalling, the consequences of the loss of a signal are as follows :

— these consequences are less important than in the case of a telegraphic transmission, because in no circumstances can the loss of a signal result in the breakdown of an established telephone connection,

— the loss of a seizure signal, a proceed-to-send signal, a forward-clear signal, or a release-guard signal is nevertheless a considerable nuisance, because there are corresponding alarms, and the circuits concerned are put out of service until they have been tested by the technical staff,

— the loss of other signals has less serious consequences, the principal effect being to require the operator to set up the call again,

— it could happen that a break in the transmission path caused the misinterpretation of a signal, which might result in incorrect switching of the call, or lead to a false supervisory indication on the circuit concerned.

Note 3. — The 8th S.G. considered, in 1953, that a break in transmission up to 5 milliseconds maximum during the transmission of a signal, would probably not result in the loss or misinterpretation of a signal.

As the signalling time represents only a relatively small proportion of the total time during which breaks in transmission can occur, it is possible that circuit interruptions lasting between 5 and 20 or 25 milliseconds would not have any disastrous effects, but in 1953 there was no precise information available on this matter.

Question No. 7.

(Category B) [non urgent] (continuation of Question No. 7 studied in 1952/1954)

In view of the transmission difficulties which may arise from relay contacts, break jacks and switch wipers connected in the speech path through an international exchange when required to carry only speech or low-voltage signals, what measures are available to improve their reliability ?

In this study special attention will be given to determining the influence which the way contacts are constructed can have on the noise introduced into circuits.

Note 1. — The reliability of contacts in the speech path can be improved by means of various different methods as follows :

(a) Use of precious metals such as platinum, palladium, gold, silver, or alloys of these metals. If for one reason or another it is not desired to wet the contacts, or if enough contact pressure cannot be provided, it is preferable to use the metals or alloys mentioned above, with the exception of pure silver.

(b) Use of high contact pressure.

(c) Double contacts.

(d) Lubrication (with suitable oils) of certain non-precious metal contacts in the case of sliding contacts (e.g. wipers).

(e) D.C. " wetting " of contacts, care being taken to avoid the introduction of noise due to transients when the contacts are made or broken.

(f) Air filtration or other protective measures to avoid dust.

(g) The maintenance of suitable humidity.

(h) The use of protective covers.

(i) Protection against fumes, vapours, and gases.

(j) Avoidance of the use near contacts of materials likely to be detrimental to the contacts.

Note 2. — For the application of voice-frequency signals to a circuit it is advisable not to use contact wetting, so as to avoid the surges which could result from the making and breaking of the contacts. To obtain adequate contact reliability, use should be made either of dry precious-metal contacts with adequate contact pressure, or of static modulators with rectifier elements.

Note 3. — Appendices 1 and 2, attached, indicate the influence of the method of making contacts on the noise introduced into circuits.

ANNEX 1

(to Question No. 7)

Contribution by the British Telephone Administration to the study of Question No. 7

1. *Resistance of contacts and its measurement*

A contact has a certain resistance (R) to an electric current. According to Holm this is composed of the resistance produced by the concentration of the lines of current at the point of contact and the surface resistance which is added in the case of a thin badly conducting surface layer between the conductors forming the contact. If " a " is the radius of the contacting surface and ρ the specific resistance of the material of which the contact is made, the resistance produced by the concentration of the lines of current at the point of contact is $\frac{\rho}{2a}$. The surface resistance is characterised by the expression $\frac{\sigma}{\pi a^2}$ in which σ represents the surface resistance per surface unit of the contact surface. The total resistance between contacts is therefore, according to Holm :

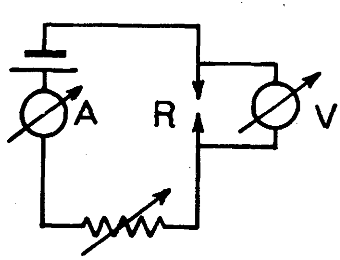
$$R = \frac{\rho}{2a} + \frac{\sigma}{\pi a^2}$$

The radius of the contacting surface can, according to Burstyn, be determined for contact materials by the formula

$$a = \frac{\sqrt[3]{Pr}}{10}$$

In which r is the radius of the spherical contact and P the pressure exercised on the contact. The result is that the resistance between contacts depends on the contact material, the pressure and the state of the contact surface.

The resistances between contacts have been measured with the following circuit arrangement, using a low voltage source, on a large number of contacts which are found in telephone transmission channels.



$$R = \frac{V}{A}$$

Because of the high resistance connected in series with the contact, the current intensity does not vary during the tests. On the other hand the voltage, as examined by the oscillograph, varies constantly between two limiting values. The D.C. voltmeter used for these measurements could not follow these variations but indicated the mean value.

2. *Results of the measurements of contact resistance.*

The Federal German Republic has undertaken investigations on the subject of contact resistance and its influence on noise introduced on the line. The results of these investigations show how the psophometric voltage caused by vibration as a function of the resistance between the contacts, state of maintenance, and wetting current, can vary. A large number of measured values of contact resistance has been obtained. These values can be represented under the form of Gaussian distribution curves for the different contacts as shown in Fig. 1 which follows. The abscissae of these curves gives the value of resistance and the ordinates the distribution probability of a resistance of that value.

Curves have been produced for the contacts of 7 different types of switches and relays :—

(1) Preselector Fg W1 33
(2) Two Motion Selector Fg W1 36
(3) Motor Selector Fg W1 129
(4) Break Jack contacts
(5) Relay Fg 70 rigidly mounted
(6) Relay Fg 70 elastically mounted
(7) Wiper contacts

A distinction has been made where the contact is subject to maintenance (continuous curves) and the case where the contact remains without maintenance (curves in dotted lines).

3. *Noise due to contacts*

Contact noise has been measured by means of a psophometer. The disturbing noise was measured in accordance with the characteristic curves of the filter of the C.C.I.F. psophometer (Filter A).

The measured voltages are " no load " voltages, because the load resistances are very large relative to the resistances between contacts.

The graph shown in Figure 2 (abscissae and ordinates with logarithmic scales) represents the variation of the observed psophometric voltages as a function of contact resistance for wetting currents of 1 mA and 50 mA. This graphical representation is constituted by a straight line for each of the values of wetting current. Within the limits encountered for the resistance between contacts the lines representing the noise have been thickened. The values indicated correspond to the maximum noise voltages present at the contacts ; only a fraction of these voltages reach a subscriber : the value of this fraction is determined by the potentiometer effect which the line resistance and the terminal resistance produce. It may be accepted that the curve representing the mean value of the measured psophometric voltages corresponds approximately to the formula.

$$E_G = K \cdot R^{\alpha} \cdot I^{\beta}$$

in which :—

E_G = the psophometric voltage in mV
R = the resistance between the contacts in ohms
I = wetting current in mA
K = service characteristic constant which is conditioned by vibrations.

FIGURE 1. — *Variation of the psophometric e.m.f. as a function of contact resistance*

1. Preselector Fg W1 33
2. Two motions selector Fg W1 36
3. Motor selector Fg W1 129
4. Sliding knife contacts
5. Relays Fg 70 rigidly mounted
6. Relays Fg 70
7. Breakjack contacts

Wetting current
a=1 mA, b=50 mA

Contact noise, with maintenance

Contact noise, without maintenance

R [mΩ] Resistance between contacts

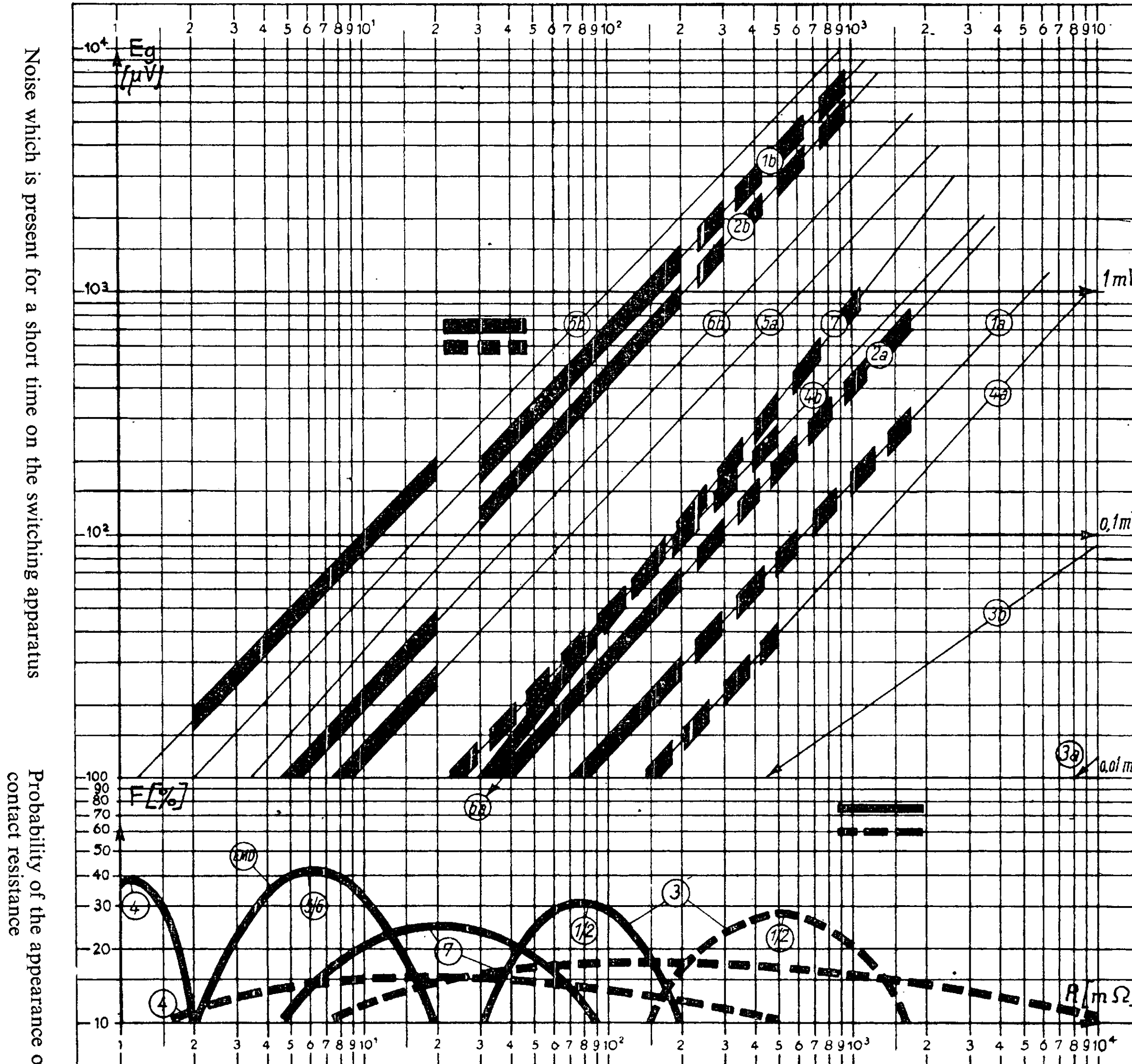


FIGURE 2. — *Probability distribution of contacts resistance of a given value for the apparatus mentioned on this page.*

According to tests made by Siemens & Halske A.G. the following values are adopted for K, α, and β :

Object	K	α	β	Vibrations caused by	Remarks
Preselector	0.15	1.2	1.0	Neighbouring selector operating	Pressure between contacts normal
2 Motion Selector	0.3	1.4	0.9	Neighbouring selector operating	Pressure between contacts normal
EMD Selector (Motor uniselector with precious metals)	0.002	0.7	0.5	Neighbouring selector operating	Pressure between contacts normal
Sliding knife contact	0.08	1.2	0.5	Neighbouring selector operating	Pressure between contacts normal
Relays, flat type FG 70 rigidly mounted	1.7	1.1	0.5	Neighbouring relay pulsing 10 i.p.s.	
Relays, flat type FG 70 mounted with buffers	0.4	1.2	0.5	Neighbouring relay pulsing 10 i.p.s.	Pressure between contacts normal
Breakjacks	0.9	1.3		Movement of neighbouring cords and plugs	

ANNEX 2

(to Question No. 7)

Contribution by the British Telephone Administration to the study of Question No. 7

Before considering the subject referred to in Question No. 7 as applied to the different varieties of contacts, some comments on the general properties of metals in contact are necessary.

The resistance of a contact between two metallic surfaces is very largely affected by the properties of any surface film existing. It is essential for a low resistance contact that the surface film should be broken through and metal contact be obtained. This break through of the surface film may be accomplished by puncturing electrically, or by crushing or scraping by mechanical pressure.

The presence of resistance in a contact will affect the circuit by causing attenuation. Further, if the resistance varies with current, distortion can occur, while if it varies spontaneously or is due to vibration, noise will occur. The magnitude of the distortion or noise will be in proportion to the variation of the resistance. To mitigate these effects, the contact resistance should be of the lowest possible value.

The use of wetting current driven by a voltage sufficient to break down the contact to the low resistance form is a sure means of obtaining a sound contact. If the use of a wetting current is to be avoided, however, the low voltage conditions postulated in the question will demand either the absence of the film or its elimination at the point of contact by mechanical pressure. In the latter case, the hardness and thickness of the film affect the pressure required to eliminate it. Base metals such as nickel silver, brass or phospher bronze form resistive films requiring considerable contact pressure to break through them, while platinum and rhodium are free of films and are suitable for light contact pressures. Between these extremes are contact materials such as palladium and silver which, while providing contacts of low ohmic resistance, nevertheless require an appreciable contact pressure to obtain a satisfactory action. With base metal contacts, the resistance of the contact will be high in comparison with the noble metals even when the initial films has been broken down.

Relay Contacts in Low Voltage A.C. Circuits.

In the experience of the British Administration relay contacts have been found to fail in low voltage speech or signalling circuits, notwithstanding the existence of normal contact pressure, due to the presence of dirt or chemically formed films on the contact surfaces. The risk of failure is such that with silver contacts which tarnish easily a commercial grade of service is not achieved. Platinum contacts being virtually impervious to corrosion have shown an improvement in the ratio 10 : 1 as compared with silver in unwetted circuits ; the residue of faults being presumably due to the presence of dust which is not broken down electrically by the voltage. A tolerable grade of service has been given by the original British national (600/750 c/s) 2 V.F. signalling system relay sets using unwetted platinum contacts working with 1 volt A.C.

To improve the reliability, the only worthwhile measure which is readily available is to apply a wetting potential of about 20 volts to each contact. This is sufficient to break down most films and to ensure a similar standard of reliability to that given by relay contacts in normal switching circuits. Where wetting can be applied at about 20 volts or above, it is not necessary to specify platinum contacts in normal environments, as silver will be equally satisfactory.

There is a possibility that some increase in contact pressure would increase the reliability, but there is insufficient information from which to drawn firm conclusions. Any action which might be taken on these lines would require the design of special spring-sets and would impose additional limitations in the application of relays to circuits.

Very reliable contact performances with stable resistance at low voltage have been claimed for relays using gold plated contacts enclosed in hyrogen. The number of contact actions available per relay appears to be limited to two or three with relays of normal proportions.

Break Jacks and Plug and Jack Contacts.

The present British design of break jack includes single silver contacts for the normal through connexion, while brass plugs bearing on nickel silver contact springs are used for the interception or patching connexions. The contact pressure is high, of the order of 400 grams. This pressure is adequate for satisfactory action with silver contacts ; for the base metal contacts, however, the wiping action of the plug in making with the jack while assisting in giving satisfactory contact under this pressure, is not able to provide such a low contact resistance as desired and wetting is therefore usually provided.

Other plug and jack type contacts are used by the British Administrations for the line fuses and for connexion to selectors and relay sets. These are, with some exceptions, of base metal, but have a wiping action on connexion ; they are subject to the same comments as those given in the above paragraph.

It is the view of the British Administration that for use with low voltage A.C. signals, base metal contacts, due to their high resistance, should be replaced by noble metal contacts to obtain the most noise-free and reliable of connexions. With the high contact pressures available, present knowledge indicates that silver contact surfaces should be satisfactory. Experience with silver plated contacts mounted in bakelite insulators has shown, however, that low insulation faults can arise due to silver creepage under conditions of high humidity. It is considered, therefore, that reliability can most effectively be achieve by the use of bi-metal contacts where the silver is rolled into the base metal on the area of contact only and is not allowed to touch the insulating material ; experiments are now in hand on these lines.

Switch Wiper Contacts.

Most present designs of switch wiper contacts are subject to the difficulties in relation to contact resistance outlined in the first paragraph, particularly where base metals are used for the wiper and contact. In the British Post Office all speech contacts are wetted either by signalling or microphone currents, or, where these do not exist, by special wetting circuits.

With unwetted contacts however, noble metal contact surfaces on either or both wiper and bank contacts would appear to be essential, unless it is possible to achieve greater contact pressures than are normally available. Tests of such noble metal surfaces are being carried out by the British Post Office.

Microphony.

Whilst it will be appreciated that where a good contact is secured noise due to microphony is unlikely, there is always some risk of a poor contact, particularly if the contact is subject to vibration. To avoid microphony it is, therefore, desirable that the operation of switches etc. should not cause equipment vibration. In particular it is the British Administration view that the resilient mounting and wiring or ratchet driven switches is essential.

Wetting currents and their application.

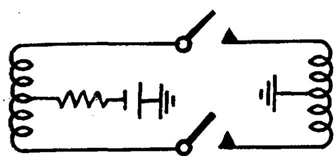
With present designs of switches and relays the most satisfactory means of obtaining a good contact action under low voltage conditions is by the use of an auxiliary wetting current circuit. The application of such wetting current arrangements should ensure :—

1. That an open circuit voltage of about 20 volts exists across every contact which it is intended to wet.

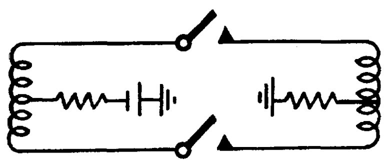
2. That the wetting current passed through a contact should be of sufficient magnitude to ensure that, even with the expected alternating current present, (e.g. due to speech) the current does not drop to zero. (In practice a wetting current of just over one milliampere is usually used).

It is also necessary in cases where two or more contacts are made at the same time, to ensure that the making of one contact does not so reduce the voltage available across another contact that it is unlikely to break it down. Typical illustrations of this are :—

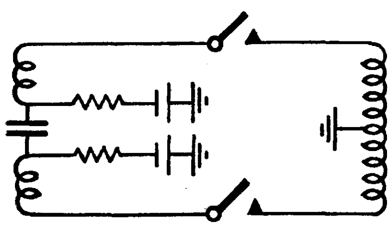
Not



Not



But



Note. — In the experience of the British Administration it will be found convenient to decide on a standard system of contact-wetting for the 4-wire speech path at an early stage in exchange circuit design. It is also advisable to have transformer windings divided so that a condenser can be inserted and independent wetting arranged in appropriate cases, for instance as indicated above.

Guarding the transmission of V.F. signals from interference by noise.

When a V.F. signal is to be transmitted it is usual to disconnect the preceding part of the connection so that noise from that source is prevented from interfering with V.F. signalling. It will, however, be desirable to allow time between this disconnection and the transmission of the V.F. signal tone so that any noise surges present will have time to die away. This has been covered in C.C.I.F. — C.E.A. — Document No. 12 as follows, page 52 :—

" IV.6. *Delay in transmission of signals.* — To prevent interference with the reception of signals at the distant end of an international circuit an interval of at least 30 m.s should elapse between the isolation of the international line following the reception of a direct-current signal at the outgoing end and the transmission forward of the corresponding voice-frequency signal. A voice frequency signal should be similarly protected against interference from surges caused by direct current signals at the outgoing end by maintaining the isolation of the international line for a minimum period of 20 m.s. after the termination of the voice-frequency signal. Such intervals will usually occur as a result of relay operation ".

Application of V.F. Signal Tones.

V.F. signals are of short duration and it is essential that this duration should not be materially altered, for example, by a delay in the breakdown of the tone-feed contacts. The wetting of such contacts is not usually convenient since the wetting current causes a D.C. surge whenever the contact is made or broken, and this surge constitutes an unwelcome noise which accompanies the V.F. signal and may interfere with its reception (particularly if the V.F. signal is of low level). Unwetted platinum contacts have been used for such applications in the past but the British Administration now prefers to use static relays (rectifier modulator) for the application of the V.F. signals in all new equipment. The use of static relays has of course long been standard practice for multi-channel V.F. telegraph purposes and the extremely satisfactory performance given by these items is well known.

It is considered that in the interests of reliability it would be of advantage if the application of all low-level V.F. signals were controlled by static relays, and any contacts which may be incidental to the application of the signals, for instance, those splitting the line and connecting the static relay to it, were properly wetted.

Question No. 8.

(8th Study Group in co-operation with the 3rd S.G. : Question No. 4 of the 3rd S.G.) (Category A1) [non-urgent] (continuation of Question No. 12 studied in 1952/1954)

Is it necessary to take special precautions, in particular at an international terminal centre, such that, when a call in the semi-automatic service has been set up, but the called subscriber has not answered, there will be no risk of singing on the international circuit, and if so, what conditions should be laid down ?

Note. — See the two appendices which follows :

ANNEX 1

(to Question No. 8)

Provisional solution adopted on the field trial network for international semi-automatic telephone operation

(Extract from the " General specification for the field trial networks for International semi-automatic operation ", Document " C.C.I.F. — C.E.A. — Document No. 12 " 1st part, § 15)

Steps should be taken to reduce the risk of singing during the period between the moment when the speech path is established at the outgoing international terminal exchange and the moment when the called subscriber answers. This result can be obtained in principle by one of the following methods :

(a) The insertion of an attenuator in each path on the 4-wire side of the connection.

(b) The insertion of an attenuator in the 2-wire side of the connection.

(c) The provision of a terminating impedance on the 2-wire side of the connection.

It is recommended that, whatever method is adopted, it should always be effected at the incoming end of the international circuit but that each Administration wil be free to adopt the most convenient arrangement.

Taking into consideration the experience acquired with manual circuits, it is considered that initially and for circuits set up to an equivalent of 0.8 nepers (7 db) between the two wire ends it will be sufficient if arrangements are made to increase the stability of the circuits by 0.4 nepers (3.5 db).

ANNEX 2

(to Question No. 8)

Arrangements made in 1953/1954 in the international field trial centres for international semi-automatic telephone operation

The information communicated by the Telephone Administrations of Belgium, France, Italy, Netherlands, Great Britain and Northern Ireland, Sweden and Switzerland are arranged in the following order :—

1. Note by the Dutch Administration describing the arrangements made at Amsterdam.

2. Diagrams showing the arrangements made at :

   (a) Brussels

   (b) London

   (c) Milan

   (d) Zurich

   (e) Stockholm

3. Note and diagrams by the French Administration describing the arrangements made in Paris.

1. Arrangements made by the Dutch Administration at Amsterdam

For the international circuits the prescribed equivalent is 7 db measured between the two wire ends of the two terminations. In Holland the extension of an international circuit to the national network is effected on a 4-wire basis and the termination in question is not then situated in the international circuit but in the National network.

On the two-wire side of this termination there will always be an attenuation of 3.5 db inserted between the termination and the desired subscriber. This attenuation will be inserted automatically if it is not present in the form of a loaded cable.

If an international circuit is extended to the national network the attenuation distribution is such that the internationally recommended equivalent is deemed to be realised by the 3.5 db attenuation always present in the national network. (In other words the international circuit is assumed to terminate on the subscriber's side of the 3.5 db attenuation situated in the national network).

However, so long as the national network attenuation of 3.5 db has not been introduced in the extension of the international circuit to the national subscriber a supplementary attenuation of 3.5 db is inserted in each of the paths of the four-wire connection in international terminal exchanges in Holland so as to guarantee the internationally recommended value for the stability of the call.

In the national network of the Dutch Administration all the outgoing national circuits leaving the international terminal exchange (which then plays the role of an incoming international exchange) have been equipped as carrier-current circuits with a 4 or 6 kc/s spacing.

The simple propagation time of such circuits is approximately 1.5 ms and 1 ms respectively. These circuits are operated with an equivalent of 0 db measured between the two wire ends of the two terminations.

The constitution of the national network is such that up to two 4-wire circuits can be inserted following the international circuit. On leaving the terminal centre, it will never be possible to insert two carrier-current circuits in succession, of which the spacing is 4 kc/s but only to have two carrier-current circuits of 6 kc/s spacing or one circuit of a 4 kc/s spacing and the other of a 6 kc/s spacing.

The echo propagation time within the 4-wire national network is at the most 5 ms ($2\times1.5+2\times1$ ms).

In addition non-amplified loaded circuits (2-wire) are used in the National network having an attenuation of 3 to 4 db and a propagation time of about 2 ms or 0.5 ms according to the type of circuit (two types are used).

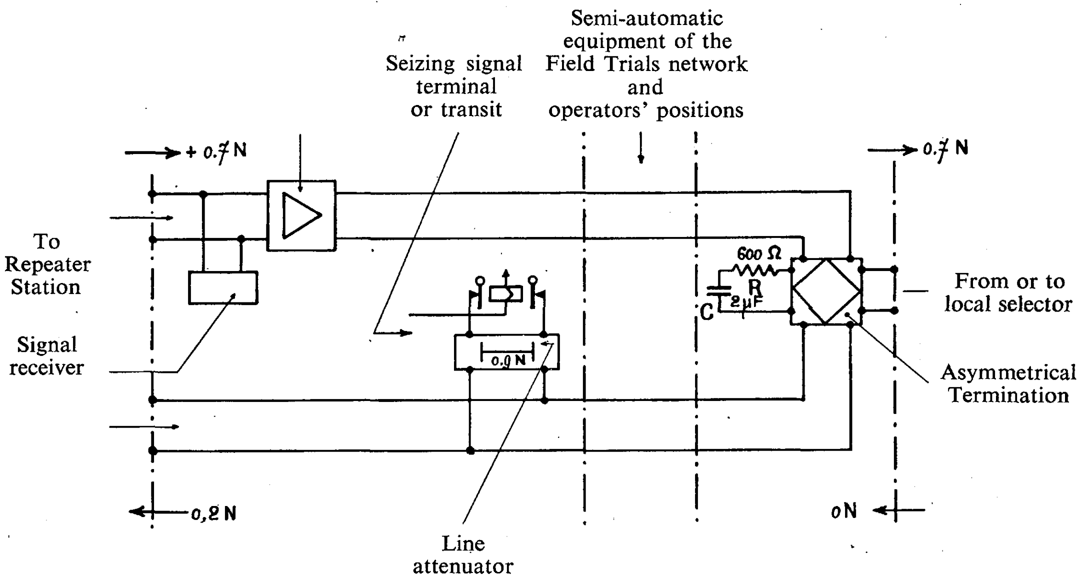
Between these 2-wire circuits having a propagation time of 2 ms and the terminal centre, not more than one 4-wire circuit can be found whilst between those having a propagation time of 0.5 ms and the said centre may be found not more than two 4-wire circuits. However, following a two-wire circuit having a propagation time of 2 ms can be found one 2 W circuit having a propagation time of 0.5 ms.

In consequence in the Dutch National network a maximum echo propagation time of 8 ms can be expected :

2×1.5 ms (4-wire circuits/4kc/s) $+2\times2$ ms $+2\times0.5$ (2-wire loaded circuits).

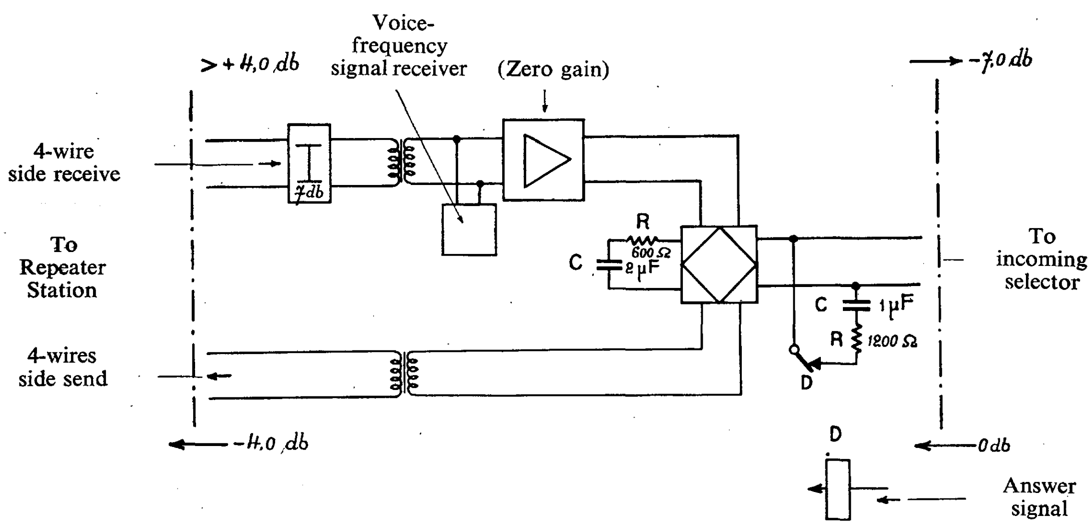
By application of the measures mentioned under *(b)* and *(c)* of the appendix (Question No. 12) there is provided in the Dutch National network an echo attenuation of at least 12 db. This is the case before, during and after the conversation.

2. **Diagrams showing the arrangements made at (a) Brussels, (b) London, (c) Milan, (d) Zurich, (e) Stockholm**



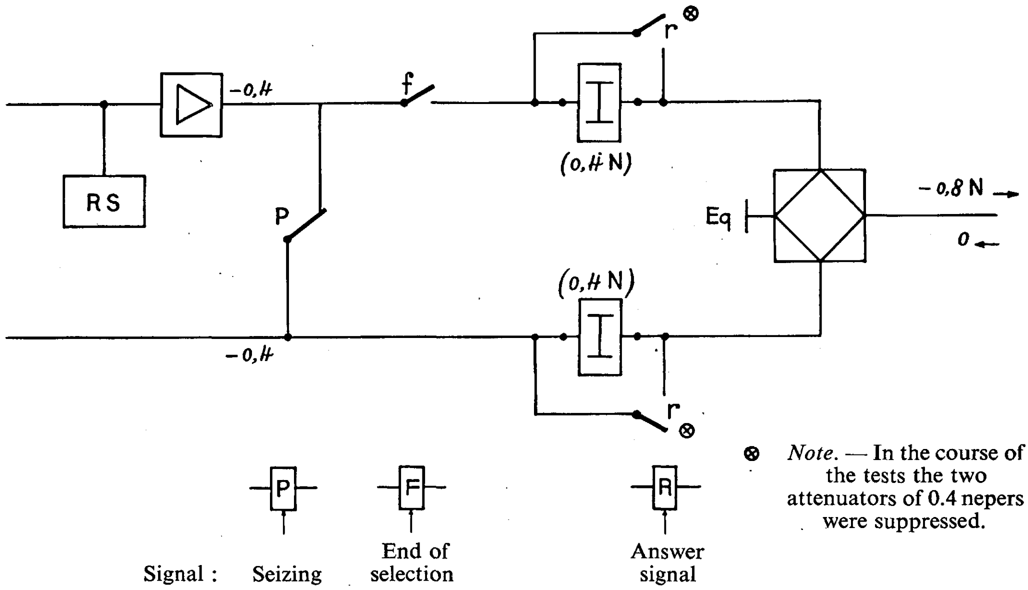
Note 1. — Identical terminating arrangements on incoming and outgoing circuits.
Note 2. — Levels indicated = absolute power levels.

(a) *Terminating conditions at Brussels*



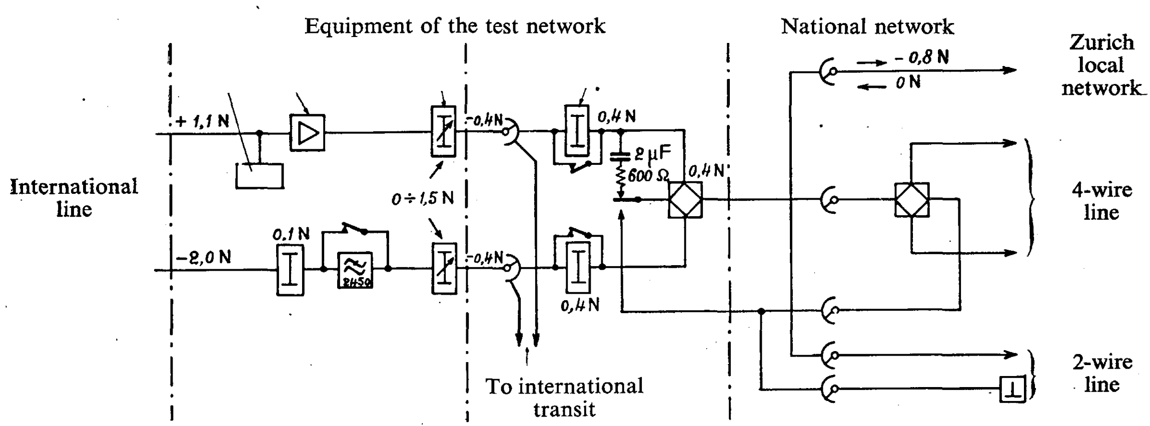
Note 1. — Terminating arrangements identical on incoming and outgoing circuits.
Note 2. — Level indicated = absolute power levels.

(b) *Terminating conditions at London*



⊗ *Note.* — In the course of the tests the two attenuators of 0.4 nepers were suppressed.

(c) *Terminating conditions at Milan*



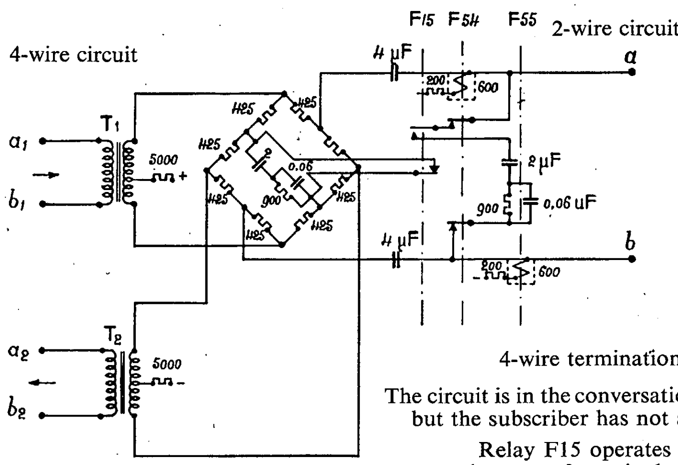
Note 1. — The blocking amplifier is used only for the 2-frequency system.

Note 2. — The filter is inserted if the national circuit is 2-wire.

Note 3. — The value of the attenuation is determined as a function of the national circuit used.

Note 4. — The 0.4 neper attenuation is suppressed when the called party answers.

(d) *Terminating conditions at Zurich*



4-wire termination

The circuit is in the conversation positions but the subscriber has not answered

Relay F15 operates in the case of terminal calls

(e) *Terminating conditions at Stockholm*

When a connection in course of being established passes into the conversations position, the incoming equipment at the Stockholm centre is arranged to insert a terminating impedance reproducing the impedance conditions of a subscriber's circuit on the 2-wire side of the termination (solution C of § 15 of document " C.C.I.F. — C.E.A. — Document No. 12 "). This terminating impedance is disconnected when the called party answers.

When the international semi-automatic service is extended to other parts of Sweden by national transit on arrival at Stockholm, identical arrangements will be made in the Swedish National Exchange equipment at the incoming end of the international connection.

3. Note by the French Administration on the protection against the risks of singing on international circuits

The Field Trials Specification for international semi-automatic telephone operators (Document C.E.A. No. 12) gave three possible methods (§ 15, page 7 of the French text) for the protection against the risks of singing during the period which elapses between the moment when the circuit passes into the conversation conditions at the outgoing exchange and the moment the called subscriber answers. These three methods are :—

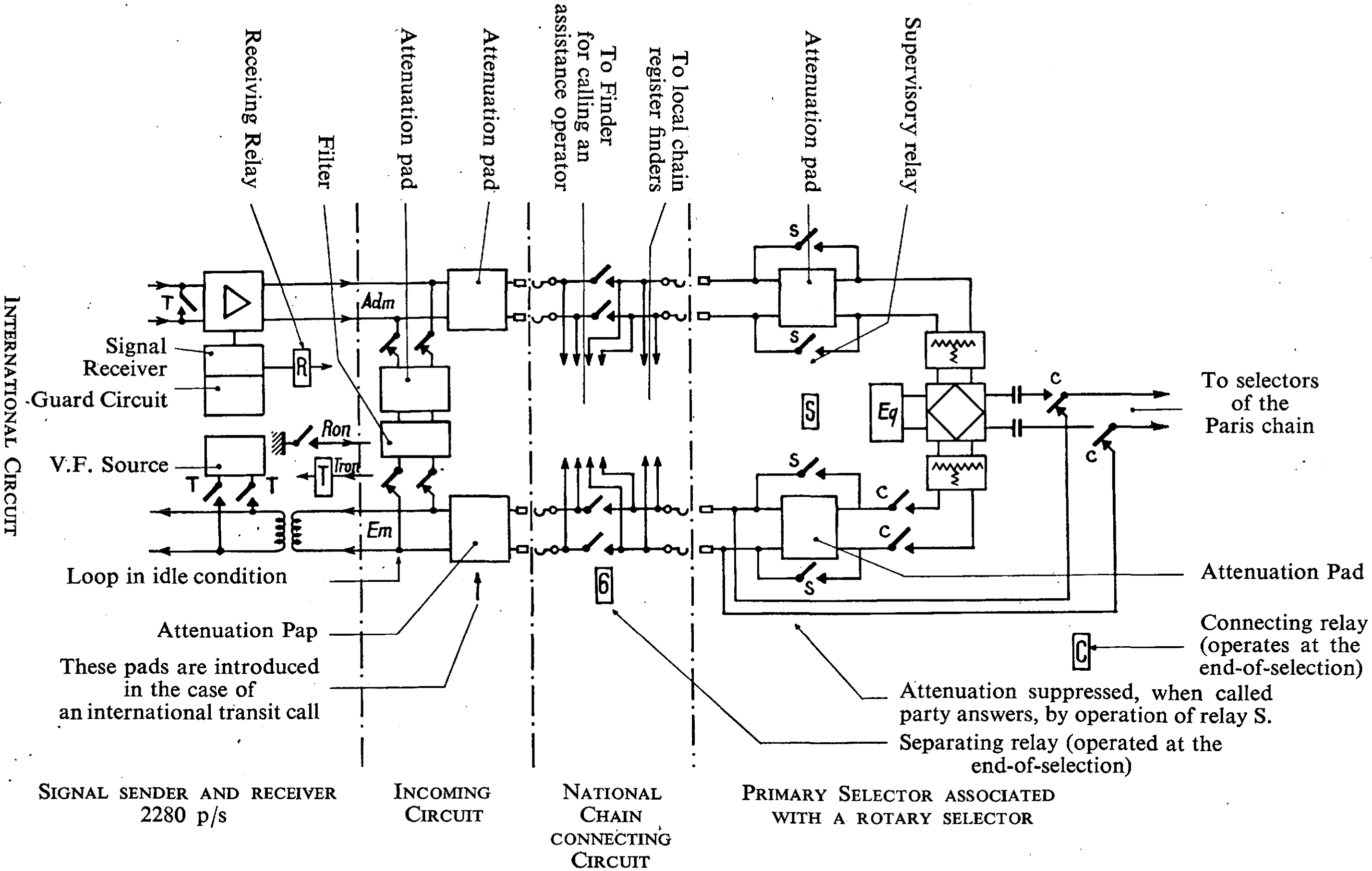
(a) Insertion of an attenuator in each of the paths of the 4-wire part of the connection.

(b) Insertion of an attenuator in the 2-wire path of the connection.

(c) The insertion of a terminating impedance in parallel with the two-wire part of the connection.

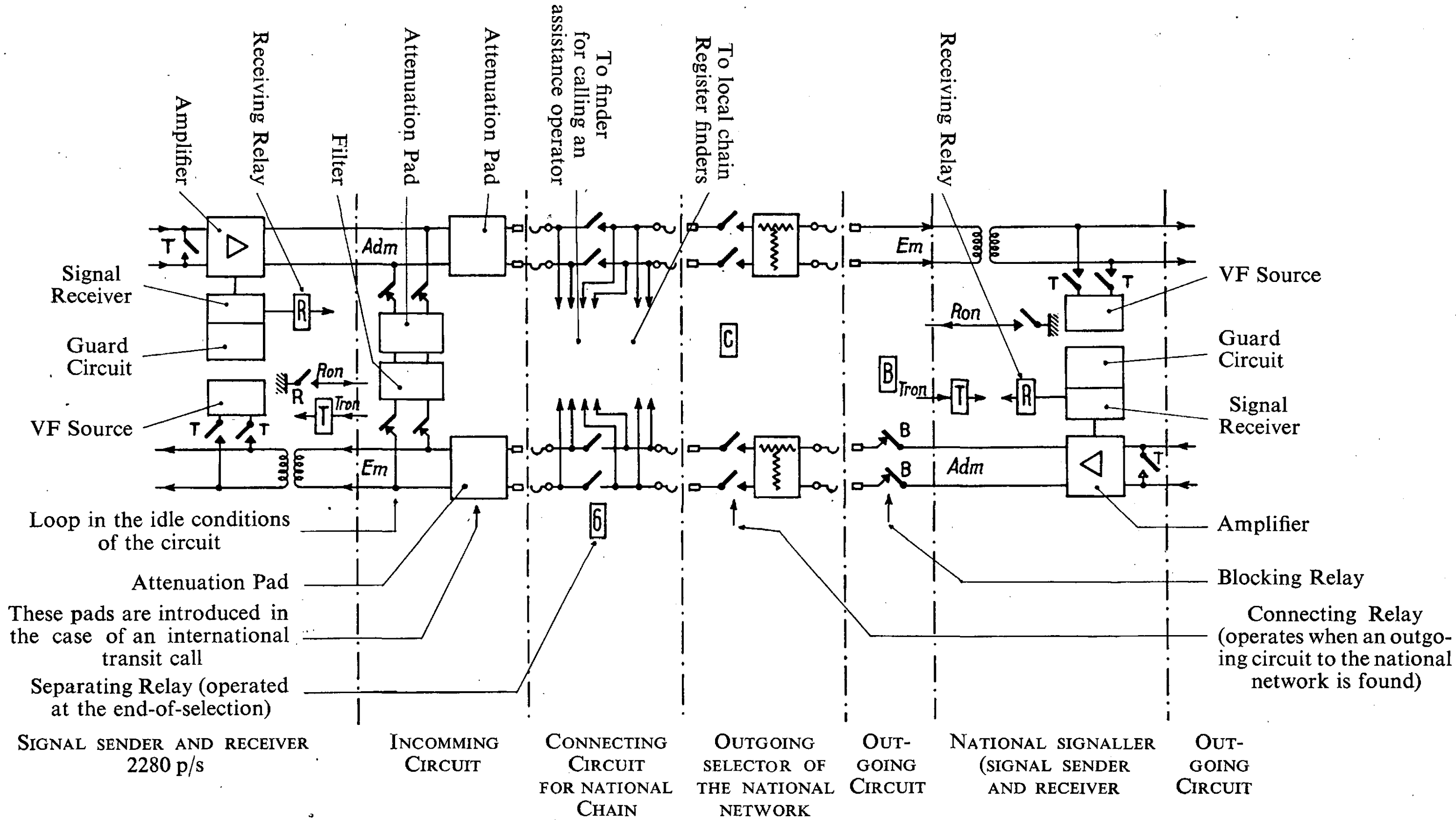
At the Paris Centre the French Administration adopted method *(a)* for each of the two systems in accordance with the detailed arrangements shown in the attached figures.

Call entering the International Centre, Paris, with the 1-Frequency System



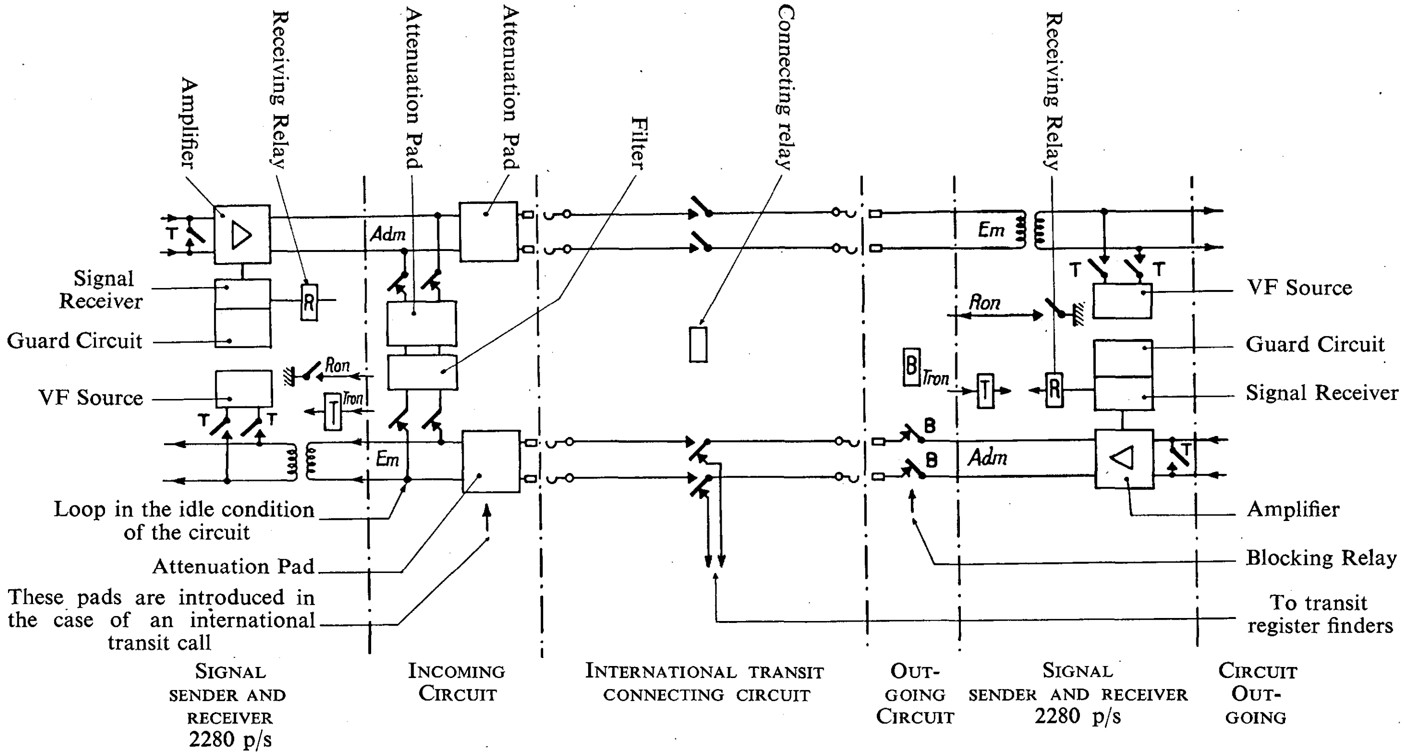
Case of an incoming call

Call entering the International Centre, Paris, with the 1-Frequency System



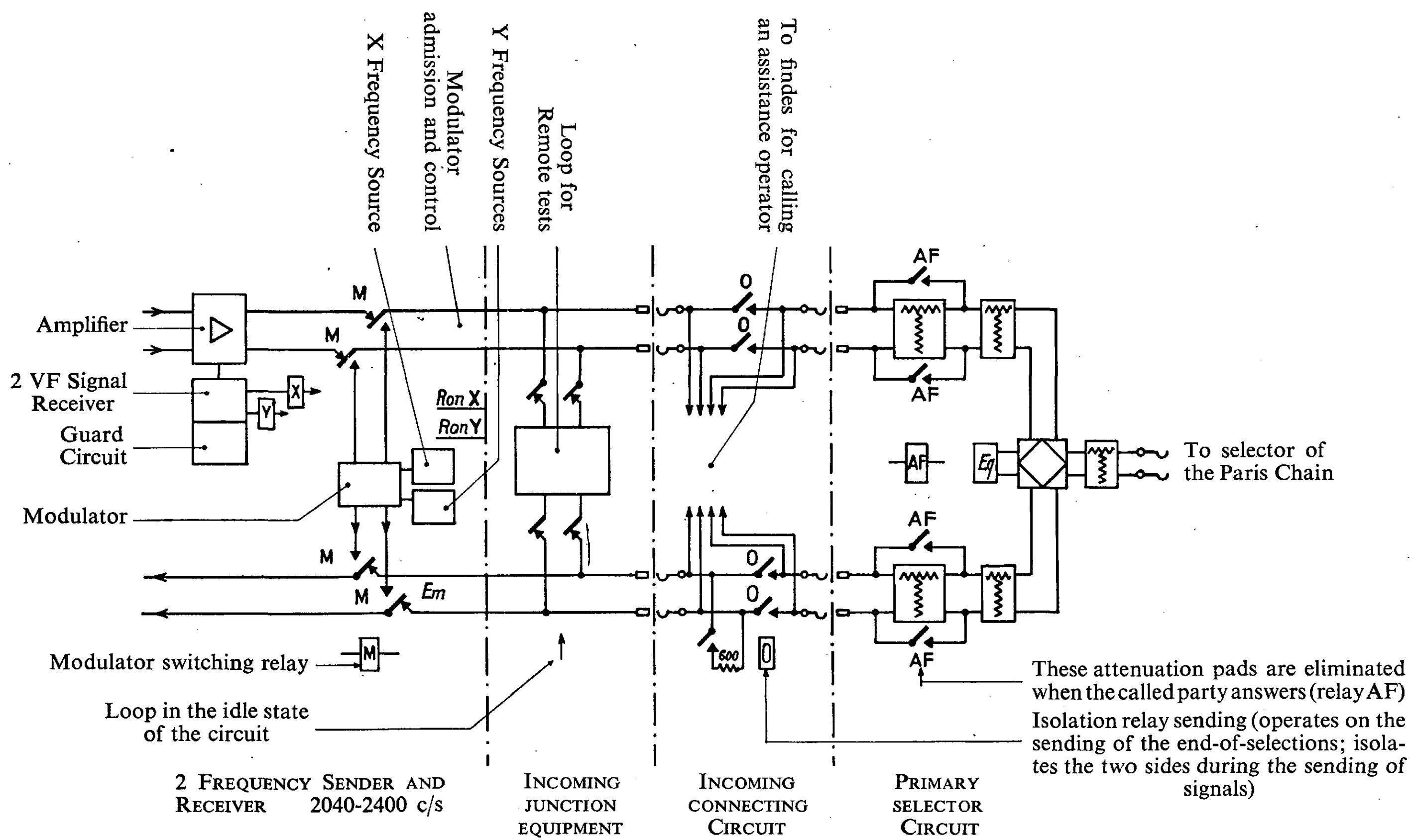
Case of national transit

Call entering the International Centre, Paris, with the 1-Frequency System



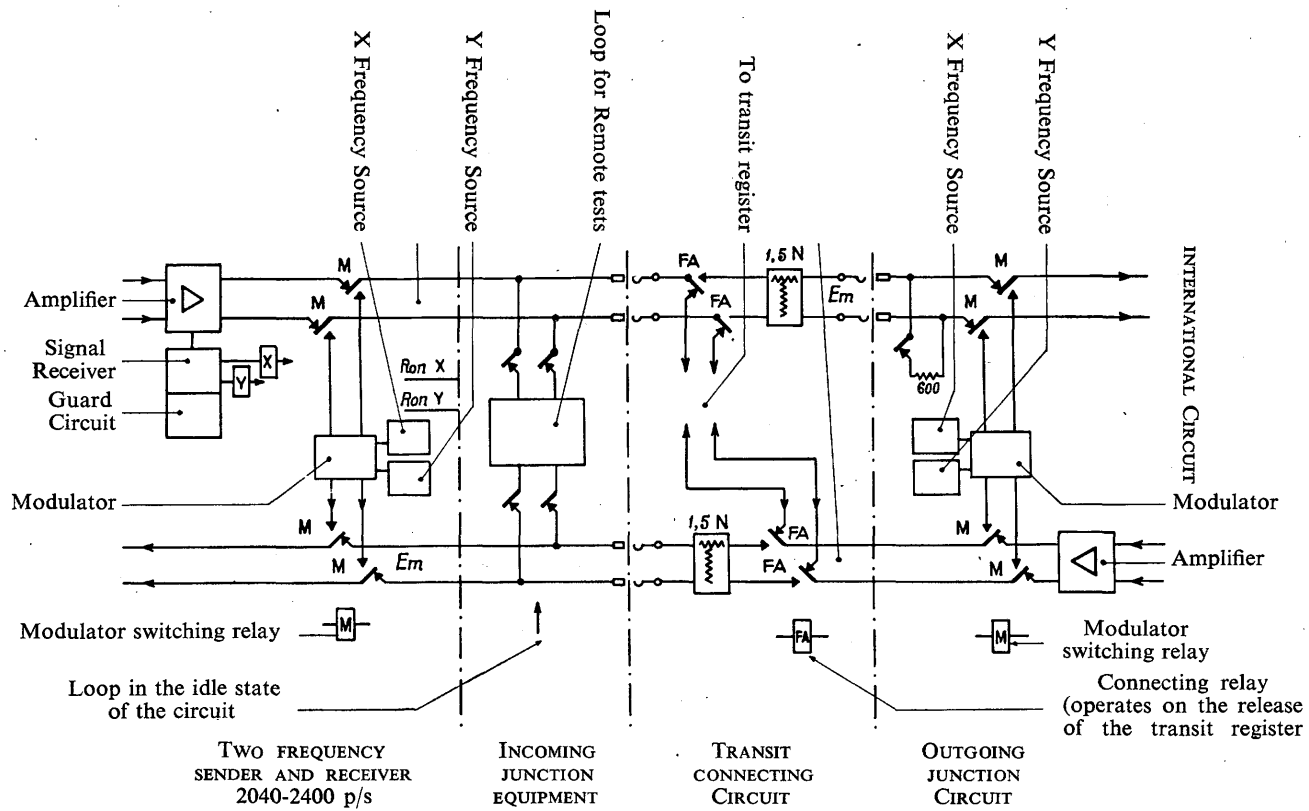
Case of international transit

Call entering the International Centre, Paris, with the 2-Frequency System



Case of an incoming call

Call entering the International Centre, Paris, with the 2-Frequency System



Case of a transit call

Question No. 9.

(8th Study Group in co-operation with the Symbols Commission of the C.C.I.F., the C.C.I.T. and the International Electro-Technical Commission (C.E.I.) (Category B) [urgent] (continuation of Question No. 9 studied in 1952/1954)

1. Is it desirable to standardize time diagrams or sequence charts showing, in switching circuits, the succession of operations of relays?

2. If so, what method is to be recommended?

Note 1. — This question refers only to a time diagram or sequence chart, intended to show the operating sequences of relays and other elements used in a switching equipment, and to replace a written description of the operation of the equipment. The question of standardizing the methods used in the preparation of circuit diagrams is outside the scope of the question.

Note 2. — Certain manufacturers, Administrations and Private Operating Companies use some form of time diagram at present. It would be of interest if some information could be sent to the Secretariat of the C.C.I.F. with respect to the methods used in the preparation of these " time diagrams ".

Subsequently, on the basis of the information thus communicated to the Secretariat of the C.C.I.F., the 8th S.G. will consider whether some degree of standardisation of the methods of preparing such diagrams can be contemplated.

It should be noted that the use of such diagrams may be of value also for telegraphy and in other fields of electro-technology, therefore this question should be studied by the C.C.I.F. in co-operation with the C.C.I.T. and the International Electro-Technical Commission.

Question No. 10.

(8th and 9th Study Groups in co-operation with the 6th S.G.) (Question No. 10 of the 9th S.G.) (Category A1) [urgent] (continuation of Question No. 10 studied in 1952/1954)

Given the possibility that a large number of international circuits may in the future be operated on a semi-automatic basis, what measures should be recommended for facilitating the " general maintenance " of such circuits, including the verification of the correct operation of the signalling equipment.

Note 1. — The term " general maintenance " should be understood to include the setting-up of the international circuits, their routine maintenance, rapid tests of the circuits and the localization of faults.

The measures to be adopted for the general maintenance of international telephone circuits form the subject of the " Maintenance Instructions " appearing in the 5th part of Volume III of the *Yellow Book* of the C.C.I.F.

These arrangements were set up on the basis of a manual service, in which operators can make periodic tests of signalling and speech directly from the multiple. When access to international circuits is obtained indirectly via automatic switching equipment, this method will no longer be possible and a different method will be required. Further, since with voice frequency signalling systems for automatic operation, the signalling is carried out over the same transmission path as is used for voice currents, faults will in general reveal themselves in the form of signalling failures.

The internal organisation of the general maintenance services in certian Administrations may be such that a clear distinction exists between responsibility for the maintenance of automatic signalling equipment and that for line maintenance, so that a procedure considerably different from that now employed (for routine tests and for the clearance of faults) is desirable.

Note 2. — The maintenance instructions which will be drawn up after the XVIIth Plenary Assembly of the C.C.I.F. by a working party to be set up by the Sub-Commission for Rapid Operating Methods (a working party composed of individuals responsible for the maintenance of international switching equipment, individuals responsible for the maintenance of transmission equipment and perhaps one or two representatives from the operating services) will serve as a basis for the final text of the " Instructions for maintenance of semi-automatic circuits ".

Question No. 11.

(6th and 8th Study Groups in co-operation: Question No. 3 of the 6th S.G.) (Category A2) [urgent] (new question)

The Sub-Committee for Rapid Operating Methods has indicated, for information, in its reply to Question No. 17 of the 6th S.G., two methods for calculating the number of circuits to be provided for semi-automatic operation when there is overflow from a group of circuits used for terminal traffic and a group of circuits used for transit traffic. Can either of these two methods or some other method be recommended which is sufficiently accurate and easy to apply ?

Furthermore, what method of calculating the number of circuits should be recommended for application to alternative routing (of which the above case is moreover only a particular case) when it is desired to guarantee a particular quality of service ?

What probability of loss should be adopted in this latter case ?

Note 1. — This question should be examined in the first place by the Sub-Commission for Rapid Operating Methods.

Note 2. — A description of the two methods mentioned in the text to this question is given in the Annex of the 6th S.G.'s list of questions.

Question No. 12.

(Category A 2) [urgent] (new question)

It can be expected that the change-over to a semi-automatic international telephone service will not be the last stage of development in the European telephone network. As has been proved by national experience, a change to a completely automatic service will one day be desirable. The sooner such a development is planned on a common basis and the greater the scale of such planning, the greater will be the advantages for the European Telephone tariff.

The determination with a minimum of delay of standardised methods for the technical realisation of a fully automatic service should not only assist technical development but could enable well-considered solutions to be evolved, as simple as possible, and could influence national developments for a fully automatic trunk service.

It is advisable to examine in detail not only questions regarding the general technique, but also questions relative to the calculation of charges. It is therefore useful to discuss the following question :—

Considering a fully automatic service,

(a) To obtain a technique as simple and as uniform as possible for the recording of the charges to be made to subscribers for international calls (in particular where it is envisaged that the charges will be recorded on the subscribers' meters, or by an analogous method), is it desirable from a technical point of view to abandon the present method of charging used in international manual operation and, if so, what changes should be proposed ?

(b) What technical facilities could reasonably be introduced into the automatic equipment to permit a distribution of charges between the countries concerned ?

Note. — In the study of this question the information which will be received concerning the methods which could be envisaged for furnishing the accounting services with the necessary information on the distribution of charges, should be taken into consideration (Question No. 23 of the 6th S.G.).

Question No. 13.

(6th and 8th Study Groups in co-operation: Question No. 10 of 6th S.G.) (Category A2) [non-urgent] (continuation of Question No. 10 of the 6th S.G. studied in 1952/1954)

What are the essential condition which should be fulfilled by apparatus used at the subscriber's premises to reply to, or record, messages in his absence ?

In particular, should it be recommended that the sending of a tone signal indicating the presence during conversation of a speech-recording apparatus shall not be admitted in view of the disadvantages which would be caused by the introduction of new tones in the telephone service ?

Note. — There follows, as an example, certain conditions which might be imposed :

1. The apparatus should reply to a ring, either automatic or manual, within a period of 10 to 15 seconds. The fixing of this period would avoid waste of line time and allow the call to be answered in the ordinary way if desired. It is desirable that this delay period should be measured by means independent of the duration of periodicity of the ringing current.

2. Normal metering conditions should be given by the apparatus when it answers a call.

3. Normal supervisory conditions during the call and a clearing signal at the end of it, should be given.

4. Automatic clearing arrangements should operate within a brief period (for example 20 seconds) after the calling subscriber has cleared or at the end of dictation.

5. The correct functioning of the apparatus should not depend upon, nor be adversely affected by, the emission or reception of signalling frequencies (signalling frequencies used in the telephone network or generated specially in the apparatus).

6. The telephone instrument should work normally if the speech recording apparatus or its power supply develops a fault.

SUMMARY

of the signalling and switching questions, the study of which should be undertaken or continued by the 8th Study Group during 1955, 1956 and 1957

Question No.	SUBJECT	CATEGORY	STUDY GROUP (other than the 8rd S.G. or other interested international organisations	REMARKS
1	Immediate switching of a telegraph circuit to a reserve circuit	A 2	6th and 9th S.Gs.	Urgent (new question)
2	Revision of the recommendations relating to the maximum admissible signal energy	A 1	3rd S.G.	Urgent
3	Blocking Amplifier of the Signal Receiver	A 1		Urgent (new question)
4	Noise conditions to be considered in the Signal Receiver Specification	A 1		Urgent (continuation of Question No. 5 studied in 1952/1954)
5	" Hits " (pulses within the band of frequencies liable to cause operation of the signal receiver and not affecting the guard circuit)	A 2	9th S.G.	Urgent (new question)

Question No.	SUBJECT	CATEGORY	STUDY GROUP (other than the 8th S.G.) or other interested international organisations	REMARKS
6	Influence of interruptions of the transmission on signalling	A 1		Urgent (continuation of Question No. 6 studied in 1952/1954)
7	Construction of contacts	B		Non-urgent (continuation of Question No. 7 studied in 1952/1954)
8	Terminating conditions in an international automatic centre	A 1	3rd S.G.	Non-urgent (continuation of Question No. 12 studied in 1952/1954)
9	Time Diagram of relay operations	B	Symbols C.C.I.T., C.E.I.	Urgent (continuation of Question No. 9 studied in 1952/1954)
10	Maintenance — Semi-automatic operation	A 1	9th S.G. 6th S.G.	Urgent (continuation of Question No. 10 studied in 1952/1954)
11	Number of circuits to be planned for in the case of overflow	A 2	6th S.G.	Urgent (new question)
12	Arrangements for recording international charges for subscribers	A 2		Urgent (new question)
13	Arrangements for message recording apparatus	A 2	6th S.G.	Non-urgent (continuation of Question No. 10 studied in 1952/1954 by the 6th S.G.)

LIST OF MAINTENANCE QUESTIONS
which should be studied in 1955, 1956 and 1957 by the 9th Study Group of the C.C.I.F.

Question No. 1.

(9th Study Group in co-operation with the 3rd S.G.) (Category A2) [non urgent] (continuation of Question 4 of the 3rd S.G. studied in 1952/1954)

What has been the effect in practice of applying the recommendation issued by the XVIth Plenary Assembly of the C.C.I.F., entitled " Measures to be taken to improve transmission stability on international circuits in the European region "?

Note. — Annex 1 which follows gives a summary of the results of observations made in Europe on international circuits and which led the XVIth Plenary Assembly to make the above mentioned recommendation. Annex 2 which follows gives a summary of the conclusions reached by the United States of America from similar observations they have made.

ANNEX 1

(to Question No. 1)

Comparison of the state of the European network in 1953/1954 with that of the network in 1949/1950 from the point of view of the variations of equivalent with time

1. *General.*

The analysis of the present state of the network is based on the analysis carried out by the British Administration of the results of the series of measurements taken in 1953/1954. This analysis by the British Administration is contained in document " C.C.I.F. — 1952/1954 — 3rd S.G. — Document No. 52 ".

2. *Period of tests.*

The period of the tests was from 1st of December, 1953 to the 30th of May, 1954. Daily readings were taken of the overall equivalent at 800 c/s and 2000 c/s on each of the selected circuits in both directions of transmission. Approximately 280 measurements were taken on each circuit. During the whole of the test period the circuits were subject to the normal maintenance tests at their standard periodic intervals and no special adjustments were made to the circuits as a result of the readings taken during the test.

3. *Circuits tested.*

The total number of circuits tested was 64. A list of these circuits is given in document " C.C.I.F. — 1952/1954 — 3rd S. G. — Document 52 ".

4. *Analysis of the results.*

In keeping with decisions taken at the meeting of the 3rd Study Group in Geneva in October, 1953, measurements were classified in groups corresponding to intervals of 0.1 nepers, each centred on a multiple of 0.1 nepers (so that the value of 0.8 nepers—nominal value of the equivalent—as in the middle of one of these intervals). The mean value of the equivalent and the standard deviation were calculated by taking into account only the measurements included between the limits of 0.8 — 0.55 nepers, and 0.8 + 0.54 nepers, i.e. in 11 of the groups. The results corresponding to values of equivalent less than 0.8 — 0.5 nepers and greater than 0.8 + 0.54 nepers were included in two other groups which were not taken into account for the above calculations because it was felt that they arose exclusively from intermittent faults.

The results of this series of measurements are shown in Tables 2 and 3 hereafter.

5. *Comparison between the state of the European network in 1949/1950 and 1953/1954*

It will be recalled that a similar series of tests was carried out on 30 circuits during the winter and spring of 1949/1950. Table 1 gives a comparison of the results on all circuits for the two series of tests.

It should be pointed out that the limits used for the calculation of the mean value and standard deviation of the equivalent were not exactly the same in 1953/1954 as in 1949/1950; the range between the limits being greater in 1953 by 0.09 nepers. Consequently it is not possible to make *direct* comparisons between the results calculated for those two series of measurements. To make this clear in Table 1 the results for the two series of tests which are not directly comparable have not been shown directly underneath each other.

TABLE 1

Variation of equivalent

Particular of test	Number of measurements	Measurements outside range: % outside limits — 0.8−0.5N to 0.8+0.5N (1949/1950)	Measurements outside range: % outside limits — 0.8−0.55N to 0.8+0.54N (1953/1954)	Measurements within range: Mean (neper) — 0.8−0.5N to 0.8+0.5N (1949/1950)	Measurements within range: Mean (neper) — 0.8−0.55N to 0.8+0.54N (1953/1954)	Measurements within range: Standard Deviation (neper) — 0.8−0.5N to 0.8+0.5N (1949/1950)	Measurements within range: Standard Deviation (neper) — 0.8−0.55N to 0.8+0.54N (1953/1954)	Approximate average length of circuit (km)
At 800 *p/s*								
1949/1950 .	8 925	7.17		0.76		0.19		960
1953/1954 .	16 679		5.53		0.80		0.22	1 064
At 2000 *p/s*								
1949/1950 .	8 919	11.86		0.80		0,21		960
1953/1954 .	16 666		8.01		0.80		0.24	1 064

It may be thought possible to make a correction to take account of the widening of the limits both for the percentage of measurements outside limits and for the standard deviation of the equivalent, but such a correction is difficult to carry out as the distribution of the results is far from following a normal law at the limits of the range of measurements considered. Referred to limits used in 1949/1950 the result of this correction would be to increase the percentage of measurements outside the limits used in 1953/1954 and to decrease the standard deviation; in both these cases the values calculated in 1953/1954 would approach nearer those obtained in 1949/1950. In the case of the percentage of measurements outside limits it is reasonable to suppose, even though the conditions were assumed to be much more unfavourable than those corresponding to a normal law of distribution, that such a correction would still make the percentage of measurements outside limits, lower than that calculated for the series of measurements taken in 1949/1950, especially for measurements taken at 2000 c/s.

The results of the series of measurements made in 1949/1950 and in 1953/1954 are therefore in very close agreement. It is pointed out that :

(a) The accuracy of measurement is limited in spite of the precautions taken, such as the use of the same measuring set or the carrying out of measurements by the same member of the staff. An accuracy of 0.01 nepers is relatively difficult to obtain ;

(b) The passing of information concerning the value of the equivalent by the distant station to the control stations was sometimes inaccurate due to language difficulties.

The differences observed between the results of the two series of measurements cannot therefore be considered as really significant and it must be considered that so far as the variation of the equivalent as a function of time is concerned the state of the European network remains the same as it was in 1949/1950, and that the improvement that was hoped for has not in fact occurred. One can however say that the percentage of measurements outside limits is slightly less and that the mean value of the equivalent has become exactly 0.80 nepers.

The following observations are made on these results :

1. A large number of circuits have been established on newly-installed carrier plant which has not yet had time to settle down properly, and of which the permanent installation is not yet complete, for example, automatic level regulators and pilot equipment for long-distance groups and supergroups are not yet generally in service.

2. The routing of several of the circuits has unavoidably been changed during the course of the tests. This is bound to have an unfavourable effect on the stability of the overall equivalent.

3. The tests have been carried out at a time when many new cables and much new equipment is being installed throughout the European network. It is probable that many more " working party " faults have occurred than would have normally been the case.

4. The average length of circuit in the present series of tests is 1,064 km, compared with 960 km in the previous tests. No direct correlation between circuit length and standard deviation has been established though in general the longer the circuit the greater the standard deviation, as the attached graph (Figure 1) shows.

5. The fact that the percentage of measurements outside the limits is, even after adjustments for the different limits has been made, smaller than in the previous series of tests would indicate that there are fewer intermittent faults causing large changes of level. This may well have been the result of the vibration testing and level recording that has been carried out within the European network.

6. It is noted that the mean value of the equivalent at 800 c/s now coincides with the nominal value of 0.80 N. As the tests in 1949/1950 and 1953/1954 were carried out at much the same time of the year, it would appear that the adjustment of the overall value of the equivalent of a circuit to its nominal value during a routine test (regardless of whether it is outside the limits) has contributed to this improvement.

6. *Noise measurements.*

No analysis of the noise measured on the circuits has been made.

7. *Conclusions.*

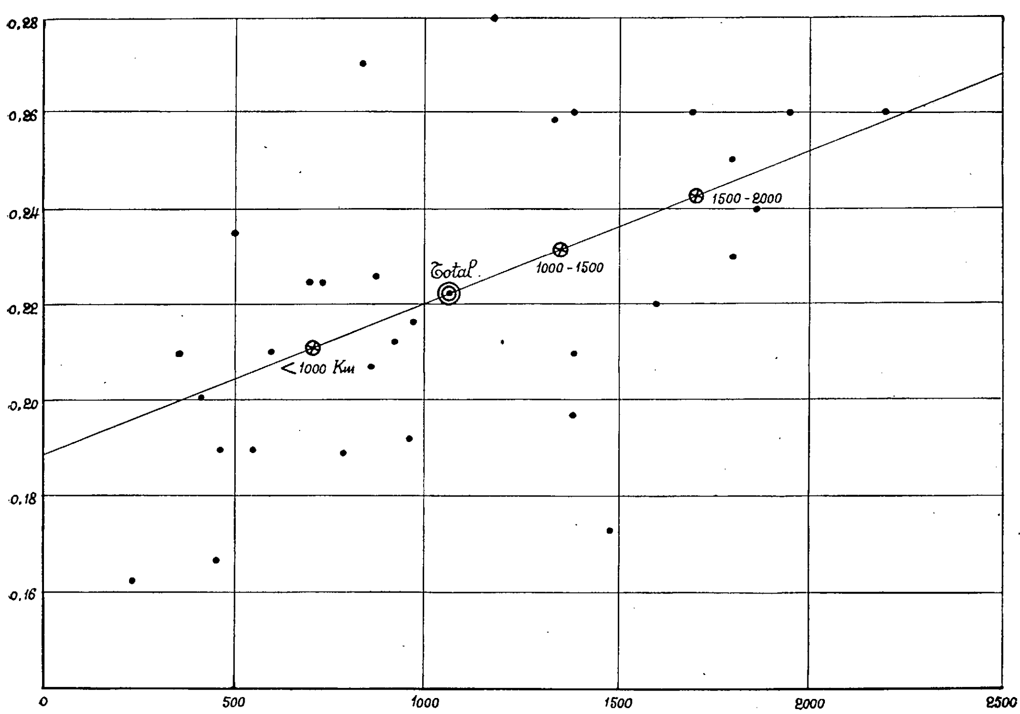
The following conclusions can be drawn from this series of tests :

1. As far as the variation of the equivalent with time is concerned the state of the European network remains the same as it was in 1949/1950 and the hoped-for improvements have not been realized.

2. One can attribute this, among other things, to the extremely rapid evolution of the European network and to the fact that on carrier systems the regulation of groups and supergroups has not yet taken place.

3. It should be noted that the number of measurements outside limits appears to have diminished since the first series of tests and it is probable that this is due to the vibration testing and level recording that has been carried out by Administrations.

FIGURE 1



Standard deviation of variation of equivalent as a function of the length of the circuits

Legend: • represents the standard deviation for particular circuits. The standard deviation has also been determined for groups of circuits having lengths l.

$$l < 1000 \text{ km.}$$
$$1000 < l < 1500 \text{ km.}$$
$$1500 < l < 2000 \text{ km.}$$

The three values are shown by the mark × on a straight line on which the point corresponding to the standard deviation for the whole of the circuits is also found.

TABLES 2 AND 3

Special Tests 1st December, 1953, to 30th May, 1954. Variation of Circuit Equivalent with Time Summary of Test Results for all Countries

Table 2. — *Tests at 800 c/s*

Circuits	Number of measurements	% of measurements outside range (0.8 — 0.55 N, to 0.8 + 0.54 N)	Measurements within range (0.8 — 0.55 N, to 0.8 + 0.54 N)		Approximate average length of circuit (km)
			Mean (Nepers)	Standard Deviation (Nepers)	
GERMANY (Federal Republic)					
København-Frankfurt 1 & 2	572	4.35	0.85	0.22	965
Frankfurt-Stockholm 1 & 2 .	531	9.05	0.82	0.24	1 650
Frankfurt-Wien 1 & 2 . . .	584	1.55	0.85	0.19	955
Frankfurt-Zürich 1 & 4 . . .	577	1.1	0.79	0.17	453
All circuits	*2 264*	*4.0*	*0.83*	*0.21*	*1 005*
AUSTRIA					
Bruxelles-Wien 1 & 2	588	5.42	0.75	0.20	1 388
Wien-Zürich 3 & 4	572	5.08	0.83	0.21	852
All circuits	*1 160*	*5.25*	*0.79*	*0.21*	*1 120*
BELGIUM					
Bruxelles-Frankfurt 1 & 2 . .	548	2.19	0.81	0.20	418
Bruxelles-Zürich 5 & 6 . . .	228	1.75	0.80	0.19	787
All circuits	*776*	*1.97*	*0.81*	*0.20*	*602*
DENMARK					
København-Wien 1.	*286*	*8.0*	*0.78*	*0.21*	*1 423*
FRANCE					
Amsterdam-Paris 1 & 13 . .	562	7.5	0.71	0.21	600
Bruxelles-Paris 35 & 43 . . .	580	1.0	0.83	0.18	360
København-Paris 1 & 3 . . .	558	4,1	0.80	0.21	1 400
Frankfurt-Paris 7 & 12 . . .	528	4.0	0.77	0.22	725
Oslo-Paris 1 & 2	422	6.2	0.75	0.23	1 800
Paris-Stockholm 3 & 4 . . .	512	10.3	0.85	0.26	2 200
Paris-Wien 1 & 2	550	3.1	0.80	0.22	1 647
Paris-Zürich 5 & 6	476	4.2	0.77	0.22	700
All circuits	*4 188*	*5.0*	*0.79*	*0.22*	*1 174*
NORWAY					
Oslo-Zürich 1	*90*	*10.0*	*0.82*	*0.27*	*1 600*
NETHERLANDS					
Amsterdam-Bruxelles 1 & 15	578	0.00	0.82	0.16	245
Amsterdam-København 2 & 3	575	4.96	0.82	0.21	920
Amsterdam-Frankfurt 3 & 5	549	5.67	0.88	0.23	500
Amsterdam-Oslo 2	220	3.63	0.80	0.26	1 320
Amsterdam-Wien 1	287	0.69	0.78	0.17	1 478
Amsterdam-Zürich 1 & 6 . .	388	0.20	0.84	0.23	870
All circuits	*2 597*	*2.53*	*0.82*	*0.21*	*787*

Circuits	Number of measurements	% of measurements outside range (0.8−0.55 N, to 0.8+0.54 N)	Measurements within range (0.8−0.55 N, to 0.8+0.54 N) Mean (Nepers)	Standard Deviation (Nepers)	Approximate average length of circuit (km)
UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND					
Amsterdam-London 1 & 2	560	1.43	0.84	0.19	550
Bruxelles-London 7 & 9	563	3.91	0.85	0.21	370
København-London 1 & 4	546	10.81	0.81	0.26	1 390
Frankfurt-London 4 & 10	562	13.52	0.80	0.27	840
London-Oslo 2 & 4	425	10.36	0.86	0.26	1 700
London-Paris 52 & 60	572	2.44	0.72	0.19	470
London-Stockholm 1 & 4	546	14.1	0.81	0.25	1 800
London-Wien 1 & 2	554	7.58	0.79	0.24	1 870
London-Zürich 2 & 5	430	12.56	0.85	0.28	1 180
All circuits	*4 758*	*8.32*	*0.81*	*0.24*	*1 130*
SWEDEN					
Amsterdam-Stockholm 1 & 2	*560*	*6.1*	*0.76*	*0.24*	*1 560*
ALL COUNTRIES	*16 679*	*5.53*	*0.80*	*0.22*	*1 064*

Table 3. — *Tests at 2000 c/s*

Circuits	Number of measurements	% of measurements outside range (0.8−0.55 N, to 0.8+0.54 N)	Measurements within range (0.8−0.55 N, to 0,8+0.54 N) Mean (Nepers)	Standard Deviation (Nepers)	Approximate average length of circuit (km)
GERMANY (Federal Republic)					
København-Frankfurt 1 & 2	573	8.57	0.81	0.24	965
Frankfurt-Stockholm 1 & 2	530	12.55	0.79	0.24	1 650
Frankfurt-Wien 1 & 2	560	1.30	0.76	0.23	955
Frankfurt-Zürich 1 & 4	579	1.02	0.87	0.20	453
All circuits	*2 242*	*5.86*	*0.81*	*0.23*	*1 005*
AUSTRIA					
Bruxelles-Wien 1 & 2	588	5.10	0.74	0.19	1 388
Wien-Zürich 3 & 4	572	5.08	0.81	0.21	852
All circuits	*1 160*	*5.09*	*0.78*	*0.20*	*1 120*
BELGIUM					
Bruxelles-Frankfurt 1 & 2	548	6.06	0.78	0.26	418
Bruxelles-Zürich 5 & 6	227	3.08	0.75	0.19	787
All circuits	*775*	*4.57*	*0.77*	*0.24*	*602*

Circuits	Number of measurements	% of measurements outside range (0.8 − 0.55 N, to 0.8 + 0.54 N)	Measurements within range (0.8 − 0.55 N, to 0.8 + 0.54 N)		Approximate average length of circuit (km)
			Mean (Nepers)	Standard Deviation (Nepers)	
DENMARK					
København-Wien 1.	*286*	*19,9*	*0,77*	*0,25*	*1 423*
FRANCE					
Amsterdam-Paris 1 & 13 . .	562	7.1	0.79	0.22	600
Bruxelles-Paris 35 & 43 . . .	580	1.0	0.82	0.18	360
København-Paris 1 & 3 . . .	558	6.0	0.74	0.24	1 400
Frankfurt-Paris 7 & 12 . . .	528	7.8	0.94	0,20	725
Oslo-Paris 1 & 2	422	8.0	0.74	0.26	1 800
Paris-Stockholm 3 & 4 . . .	512	13.7	0.79	0.26	2 200
Paris-Wien 1 & 2	550	5.1	0.87	0.25	1 647
Paris-Zürich 5 & 6	476	8.4	0.89	0.21	700
All circuits	*4 188*	*7.14*	*0.82*	*0.24*	*1 174*
NORWAY					
Oslo-Zürich 1	*90*	*15.6*	*0.79*	*0.281*	*1 600*
NETHERLANDS					
Amsterdam-Bruxelles 1 & 15	578	0.00	0.78	0.16	245
Amsterdam-København 2 & 3	575	4.41	0.72	0.22	920
Amsterdam-Frankfurt 3 & 5	549	2.81	0.84	0.23	500
Amsterdam-Oslo 2	220	7.27	0.70	0.27	1 320
Amsterdam-Wien 1	287	0.70	0.70	0.17	1 478
Amsterdam-Zürich 1 & 6 . .	388	0.40	0.73	0.18	870
All circuits	*2 597*	*2.6*	*0.76*	*0.21*	*787*
UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND					
Amsterdam-London 1 & 2. .	560	1,43	0.84	0.18	550
Bruxelles-London 7 & 9 . .	563	3.91	0.74	0.24	370
København-London 1 & 4 .	546	20.25	0.87	0.26	1 390
Frankfurt-London 4 & 10 . .	562	17.98	0.76	0.29	840
London-Oslo 2 & 4	425	12.22	0.75	0.26	1 700
London-Paris 52 & 60 . . .	572	2.27	0.74	0.22	470
London-Stockholm 1 & 4 . .	546	30.75	0.94	0.26	1 800
London-Wien 1 & 2	554	11.75	0.73	0.24	1 870
London-Zürich 2 & 5 . . .	430	13.95	0.90	0.26	1 180
All circuits	*4 758*	*12.61*	*0.80*	*0.25*	*1 130*
SWEDEN					
Amsterdam-Stockholm 1 & 2	*560*	*6.6*	*0.79*	*0.26*	*1 560*
ALL COUNTRIES	*16 666*	*8.01*	*0.80*	*0.24*	*1 064*

ANNEX 2
(to Question No. 1)

Study carried out by the Bell System in the United States of America on variations of the equivalent of telephone circuits in view of automatic trunk operation

1. Some years ago, when plans for nation-wide dialing were starting to be formulated in the Bell System, it was apparent that, from the transmission standpoint, there were two principal problems ;

(a) How to design the circuits so that the nominal transmission would be good on all of the possible connections called for by the switching plan.

(b) How to keep the variations in the circuit loss small enough so that, on the one hand, the increase in loss from nominal would not become so great as to prevent satisfactory conversation, and, on the other hand, the decrease from nominal value would not become so great as to result in excessive echo or crosstalk, or in singing.

2. The problem of how to establish the nominal losses of circuits has been fairly well solved *. However the second problem (the maintenance of small circuit loss variations) has turned out, not unexpectedly, to be more difficult than the first.

3. It was recognized at the outset that, since we were dealing with a situation in which ultimately as many as 8 trunk circuits could be switched, we would have to use statistical methods to analyse conditions. Two types of statistical analysis were and are still used :

(a) A statistical statement of the variations from nominal which exist at any one time in a group of circuits.

(b) A statistical analysis of the variations in loss of particular circuits with time.

4. The first analysis is of particular importance in estimating the probability of getting good, bad, or indifferent transmission on a switched connection between two particular points. For example, suppose we are interested in calls between two points A and C which involve a switch at an intermediate point B. Assume also that there are a number of circuits between A and B, one of which will be selected at random, and that there are a number of circuits between B and C, one of which will also be selected at random to make up the complete connection. The only practical way to make an estimate of the probability of encountering a particular magnitude of loss on the complete connection (or of estimating the relative frequency of occurrence of different losses on all of the calls from A to C) is by combining the distributions of actual losses in the two circuit groups (A-B and B-C) by statistical methods.

5. The second analysis (i.e. variation with time of losses of particular circuits) is more in the nature of determining causes. We have found that a very useful method of obtaining such data is by means of recording meters, the results which are also analysed statistically.

6. After we had analysed 50,000 to 100,000 individual measurements, and many thousand feet of recording meter charts we came to certain conclusions, two of which were :

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* See " Transmission Design of Intertoll Trunks " B.S.T.J., Sept. 1953.

(a) For full dial operation, the standard deviations of the difference between measured and nominal losses (which were in the order of 1.5 to 2.5 db) would have to be reduced in the order of 2 to 1 to ensure satisfactory transmission on a very large percentage of the connections.

(b) The circuits and the transmission systems had not read the documents of the C.C.I.F. or even the documents which we had prepared, in New York. Some of the older types of circuits which had no regulating systems at all or had only old-fashioned ones, apparently did not know that they were supposed to perform badly and showed up as among the best of the lot. On the other hand some of the newer systems, on whose regulating systems much time and money had been spent, did not know how good they were supposed to be and were among the worst of the lot.

7. There was no consistent relationship between performance and length. Different channels in the same 12-channel group had markedly different stabilities.

This fact left us in a somewhat unsettled frame of mind ; should we design and install even more elaborate regulating systems or were we simply in a position where we were not making effective use of the regulating systems we had ? We decided that the only way to find out was to select a few points and see if we could not, in a few places at least, do a much better job with what we had.

The first thing we did was to introduce statistical methods of analysis and control in two large test centers. We put these methods in the hands of the personnel who were actually doing the testing and adjustment work. We supplemented this by education of these people in " why " circuit loss variations must be kept low and paid only minor attention to education in " how " to do it—because we did not how ourselves.

This experiment demonstrated several important points :

(a) That, for most types of circuits, the inherent stability is good enough so that if test room people know why, they can maintain variation within a standard deviation in the order of 1 db. (I might point out that in our statistical analyses we do not exclude any measurements regardless of whether they do or do not fall within some designated band).

(b) A very important fact is that the carrier and other transmission systems must be put into good condition, and that there must be no maladjustments in one place which are compensated for by maladjustments in other places.

(c) It is a long, tedious business to get circuits and systems into good condition, and it requires eternal vigilance to keep them that way.

(d) The most important factor is the degree of enthusiasm with which test people tackle the job.

8. Our general conclusions is that with the possible exceptions of very long coaxial and radio relay systems, adding more elaborate automatic regulation than we now have in the Bell System is not necessary ; in fact, it might provide even more opportunity for maladjustments.

(a) The reason why we are not sure of the adequacy of regulating systems in the case of circuits on long coaxial systems is that these circuits get so complicated that we are not yet able to determine whether it will be practicable to keep all compensating maladjustments out. Also, the problem of regulating a band of frequencies covering several octaves with a few pilots is a very difficult one.

(b) Even though we have more than 5,000,000 miles of telephone circuit in operation on radio relay systems, our experience has not yet been sufficient to permit us to state definitely how good a job we will be able to do in this case.

The statistical method of analysis and control and the educational work are now in the process of being applied universally in the Bell System. We have developped relatively simple methods of deriving " average " and " standard deviation " for use in the test room and we also use deviations from " normal " probability distributions to assist in determining whether variations measured on a group of circuits are random or have assignable causes. Also, as the result of experience, we are changing many of our detailed practices and are planning to use automatic testing in some of the larger places.

We realise that it will be a very difficult job to bring the improvement program along at a rate consistent which the growth in dialling and automatic alternate routing but we are sure that we will be able to do it.

Question No. 2.

(9th Study Group in co-operation with the 3rd S.G.) (Category A 2 [urgent] (new Question)

What are the causes of the long term variation as a function of time of the circuit equivalent ? In particular, state what are the causes of the changes of the equivalent between two maintenance measurements.

Note. — For determining these causes, tests should be carried out.

The object of the tests is to discover how far the stability of the equivalent is influenced by the different measures envisaged to improve the situation.

These tests should be carefully carried out and in a progressive manner, consideration being given in the first series of tests only to short or medium-length circuits between neighbouring countries.

The experience gained in the course of the first series of tests will be used either to extend the tests to include longer circuits passing through several countries or to specify further tests to find out the possible relationships between maintenance measures and variations of the equivalent.

The XVIIth Plenary Assembly decided to entrust the task of carrying out these tests to a Working Party composed of certain of the members of the 9th S.G.

The first series of tests will start at the beginning of 1955 in accordance with the arrangements given in the Annex. The tests would consist essentially of a permanent recording of the level at each end of the circuit ; as a check, the equivalent of the circuit would be measured with the greatest accuracy. A second series of tests could be carried out between the month of June and the meeting of the 9th S.G. in October 1955. Thus the S.G. will see during this meeting whether a 3rd and if necessary a 4th series of tests will be necessary.

ANNEX
(to Question No. 2)

Arrangements for the first series of tests (January-March, 1955)

Methods of test.

1. Level recordings and measurements of the equivalent of the circuit will begin on a date to be decided by agreement between Administrations during the middle of January, 1955 (Monday the 17th of January is suggested) and will last for two months.

2. Measurements will be carried out between the following countries :

Germany (Federal Republic)—France	Denmark—Holland
Germany (Federal Republic)—Holland	Denmark—Sweden
Germany (Federal Republic)—Switzerland	France—Italy
Belgium—France	France—United Kingdom
Belgium—Holland	France—Switzerland
Belgium—United Kingdom	Holland—United Kingdom

3. The circuit to be used between the countries concerned will be chosen by agreement between them according to the availability of plant.

4. The circuits used for this series of tests will be carrier plant with the minimum number of intermediate modulations and demodulations, and should not be reduced to audio frequencies at intermediate points.

5. The detailed composition of the circuits will be forwarded to the Secretariat of the C.C.I.F. at the same time as the results of the tests.

6. Any interruption on the circuit must be reported to the control station and to the station situated at the distant end of the circuit.

Level recordings.

7. A level recording will be carried out at each extremity of the circuit for each of the two directions of transmission.

8. The level recording will be carried out by transmitting a test signal of 800 c.p.s. at a level of -6 db at a point of zero relative test level.

9. The level recording will be carried out continuously if the circuit is not required for traffic. Otherwise the recording will be carried during the night and during the time that it can be released from traffic.

Additional Measurements.

10. In order to check the level of 800 c.p.s. recording a daily measurement of the equivalent will be carried out at 800 c.p.s. at a time to be agreed between Administrations. This measurement will be carried out in the normal manner using a sending level of 1 mW at a zero relative test level.

11. The measurement of the equivalent will be carried out for each direction of transmission. A loop measurement will also be carried out by agreement between Administrations (in establishing the loop an attenuator will be inserted if necessary to maintain the correct transmission levels in each direction of transmission).

12. The measurements will be carried out as accurately as possible using the same measuring equipment throughout the period of the tests. Measurements should be accurate to 0.1 db and periodic checks of the 800 c/s sending level should be made by means of a calibration unit.

13. Each day, immediately before proceeding to measure the level of a circuit the level of the pilot of the group (or of the supergroup or of the line system) on which the circuit is routed should be measured when this can be done without difficulty, in order that pilot variations can be correlated with circuit variations.

Carrying out of the tests.

14. While these tests are being carried out the circuits and the groups and supergroups on which they are routed will be subjected to normal maintenance measures.

15. Each time that the recorders indicate a level change of more than 3 db an alarm should be given, and the causes of the variation should be established ; this will be done by the control station taking such steps as it thinks necessary. Adjustments of the circuit, or group, or supergroup concerned will be carried out if necessary to correct the cause of the variation.

Presentation analysis of the results.

16. The analysis of the results will be carried out by a working party composed of representatives of the Administrations taking part in the tests.

17. Within two weeks of the conclusion of the tests each Administration should send to the Secretariat of the C.C.I.F. characteristic extracts from the recorder runs showing any variations stating the causes of them. The extracts should be limited in number and should cover 3 or 4 pages of the size of paper used by the C.C.I.F.

18. These extracts and the comments of the Administrations will be forwarded to members of the working party two weeks before its meeting to enable them to examine and study them.

19. The results of these tests will be examined by the working group during its meeting in Geneva at the beginning of June, 1955.

Question No. 3.

(9th Study Group in co-operation with the 3rd and the 8th S.Gs. and the 2nd S.G. of the C.C.I.T.) (Category A 2) [urgent] (continuation of Question No. 8 of the 3rd S.G. studied in 1952/1954)

(a) Statistical study of the duration, amplitude and frequency of occurrence of abrupt variations of the equivalent of an international telephone circuit.

(b) Research into the most likely causes of these variations.

Notes on part (a) *of the question*

1. The study of this question should :

(a) Enable the C.C.I.T. to determine the scale and frequency of these breaks in circuits and sudden variations of equivalent : these disturbances, in addition to causing errors in the characters, result in false calls, errors in routing or loss of connections in the automatic switched telegraph network (see recommendation B-42 of the C.C.I.T., page 25 of the Arnhem Documents).

(b) Provide very useful information concerning the transmission of signals in the international automatic switching telegraph network.

2. In accordance with the arrangements given in recommendation B-41 of the C.C.I.T. (see pages 93 and 94 of the Arnhem Documents) and on the other hand the request by the 8th Study Group of the C.C.I.F., the breaks in transmission and sudden variation of equivalent should be counted and classified in the following categories :

(a) Duration of less than 5 milliseconds
(b) Duration between 5 and 20 milliseconds
(c) Duration between 20 and 100 milliseconds
(d) Duration between 100 and 300 milliseconds
(e) Duration greater than 300 milliseconds

3. Each Administration will use the apparatus it has available for the measurements ; the Permanent Maintenance Sub-Commission in October, 1954, considered it unnecessary to give detailed information on the method of carrying out the counting of the breaks. This Sub-Commission pointed out that in the case of circuits on carrier systems, meters operating on the telegraph channels or on the telephone channels give more representative results than metering the interruptions in the transmission of the pilot frequencies. The results given in 1953/1954 showed in effect that there was a considerable difference between the number of interruptions of a pilot frequency and the corresponding number obtained from metering at a frequency within a telephone channel or a voice-frequency telegraph channel, the second number being about ten times greater than the first.

4. The information used in the study of this question in 1952/1954 is given in the following documents " C.C.I.F. — 1952/1954 — 3rd Study Group..."

Document 4. — Swedish Administration (pages 3 and 4)
Document 30. — French Administration (pages 2 and 3)
Document 42. — Report of the permanent maintenance Sub-Commission October, 1953 (pages 13 to 32).

(This document reproduces as annexes information contained in the two documents 4 and 30 above, as well as the results of observations carried out by the British Administration before the XVIth Plenary Assembly of the C.C.I.F. and a study made by the Netherlands Administration for the VIIth Plenary of the C.C.I.T., Arnhem, 1953).

Document 58. — French Administration
Document 63. — Swiss Administration
Document 70. — Swedish Administration
Document 79. — Administration of the Federal German Republic
Document 87. — Irish Administration.

5. An extract of the essential results of these documents is given in Annexes 1-6 which follow. For more detailed information on the way in which these observations were carried out reference should be made to the documents themselves.

6. It was possible in 1954 to make certain comparisons between the results of the observations given in these documents even though they were not all made following the same principles : it can be stated that in many cases there is good agreement between the measurements carried out by the countries concerned. It is interesting to note for example from information supplied by the French, Federal German Republic and Irish Administrations that the number of interruptions observed on carrier circuits is approximately 2 to 3 interruptions per 100 km per day.

Notes on part (b) *of the question*

1. The following may be mentioned as the main causes of faults giving rise to a succession of breaks and series of noise pulses (excluding such cases as faulty cords used for patching in a spare repeater) :

— bad contacts and faulty soldered joints
— microphony in valves
— momentary overloading of old-type repeaters
— on carrier systems, changes in carrier frequency generators due to sudden power changes
— interference to equipment from external sources (e.g. fluorescent lighting).

2. In the preamble to recommendation B-41 of the C.C.I.T. (page 94 of the Arnhem Documents) mention is also made of the most frequent causes of interruptions.

3. During the course of the discussion the Permanent maintenance Sub-Committee expressed the opinion that the diagram submitted by the Netherlands Administration at the meeting of the Sub-Committee at Geneva in October, 1953, was fully representative of the conditions which are generally encountered. This diagram is reproduced hereinafter.

The distribution of interruptions in transmission during the different times of the day as well as the distribution during the different days of the week show that these interruptions take place principally during the time that staff are on duty. There is no denying that intervention by maintenance staff plays a very important part from this point of view. But other causes also play their part, i.e. mechanical faults (for example vibration affecting valveholders or defective potentiometers) and electrical faults (variations in power supplies or the overloading of certain repeaters during traffic peaks).

4. The Sub-Committee examined whether any correlation can be established between the number of interruptions and the number of repeater sections. It has not appeared possible to draw any conclusion at present on this point. Whereas some administrations believe that such a correlation exists and that a circuit on a coaxial system is, for example, subject to more interruptions than a circuit on a symmetrical pair system, which is itself subject to more interruptions than a circuit routed entirely on audio plant, some administrations believe, on the other band, that the meticulous inspection of equipments (see the reply to Question No. 8 *bis*) carried out during the manufacture and installation of modern systems leads to a very considerable reduction in the number of interruptions of transmission due to the equipment itself.

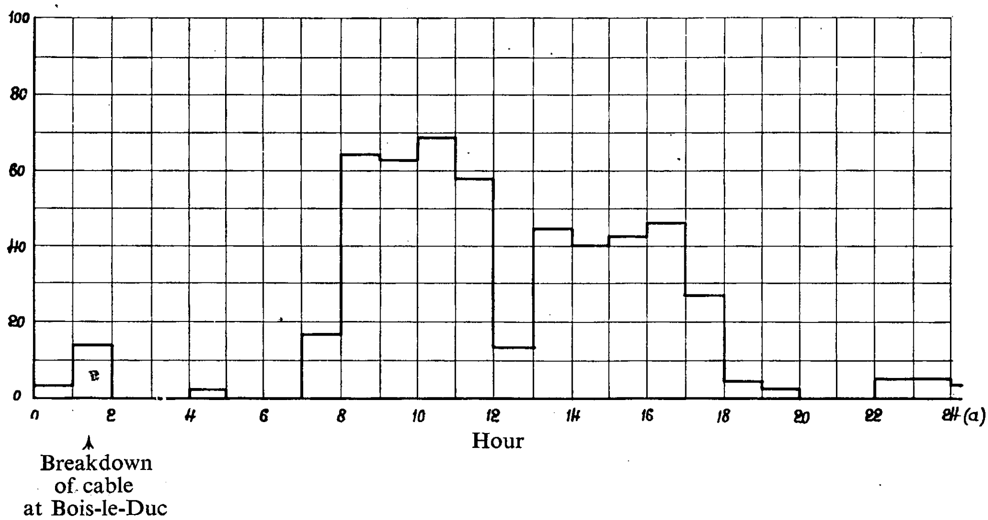

FIGURE 1. — *Interruptions on 35 VF telegraph systems at Amsterdam as a function of the time of day (November, 1952)*

ANNEX 1

Tests made by the British Administration in 1946/1947

Table summarizing the number of false operations per day per telegraph channel
(from the 1st of January, 1946 to the 3rd of February, 1947)

Voice frequency telegraph system and channels observed	Length in miles (1 mile = about 1609 m.)	Number of false operations (excluding large groups of faults)							
		With tone on : number of variations of level > 4.5 db				No tone on : number of operations of the telegraph relays			
		12 ms < duration < 40 ms		40 ms < duration		12 ms < duration < 40 ms		40 ms < duration	
		Number per day	per 100 km of circuit per day	Number per day	per 100 km of circuit per day	Number per day	per 100 km of circuit per day	Number per day	per 100 km of circuit per day
BM « A » 4	110	4.7	1.33	3.8	1.07	2.3	0.65	0.9	0.25
5	110	4.8	1.36	4.0	1.13	4.8	1.36	2.9	0.82
BS « D » 7	122	3.5	0.89	2.1	0.54	6.1	1.55	2.9	0.74
15	122	3.2	0.82	2.2	0.56	1.8	0.46	0.4	0.10
EH « B » 1	407	26.3	2.01	14.1	1.08	11.2	0.85	3.2	0.24
GW « E » 7	456	13.5	0.92	5.5	0.38	17.7	1.21	10.1	0.69
LS « A » 18	227	7.1	0.97	5.6	0.77	5.3	0.73	2.6	0.36
LS « C » 17	239	4.6	0.60	3.4	0.44	3.9	0.51	1.5	0.20
18	239	4.7	0.61	3.6	0.47	1.9	0.25	0.3	0.04
LV « D » 10	202	7.5	1.15	4.7	0.72	6.9	1.06	2.2	0.34
11	202	6.5	1.00	5.0	0.77	7.5	1.15	2.4	0.37
MR « B » 13	230	3.5	0.47	2.2	0.30	8.0	1.08	1.4	0.19
PZ « A » 1	325	9.9	0.95	5.8	0.56	14.0	1.34	2.9	0.28
16	325	5.7	0.55	3.6	0.34	4.4	0.42	1.1	0.11
18	325	7.2	0.69	6.3	0.60	7.3	0.70	1.6	0.15
Means . . .			*0.95*		*0.65*		*0.89*		*0.33*

ANNEX 2

Tests made by the Swedish Administration in 1952 (Observations on VF telegraph channels)

Table summarizing the number of level variations > about 0.7 N (large groups of faults excluded)

Circuit	Length in km	Hours	Duration of tests in hours	Number of operations of the meter: 20-150 ms Total	20-150 ms Per hour per 100 km	150-300 ms Total	150-300 ms Per hour per 100 km	> 300 ms Total	> 300 ms Per hour per 100 km
A	617	21-5 (night)	560	7	0.0020	6	0.0017	44	0.0128
		5-21 (day)	1120	17	0.0025	8	0.0012	23	0.0033
B	389	21-5 (night)	536	3	0.0015	1	0.0005	4	0.0019
		5-21 (day)	1072	5	0.0012	2	0.0005	10	0.0024
C	1128	21-5 (night)	408	55	0.0119	12	0.0026	29	0.0063
		5-21 (day)	820	438	0.0475	106	0.0116	241	0.0260
D	305	21-5 (night)	466	101	0.0711	4	0.0028	48	0.0338
		5-21 (day)	926	166	0.0588	16	0.0057	65	0.0230

A. Audio circuit
B. Audio circuit
C. Carrier circuit (8 + 8) system on symmetrical pairs
D. Carrier circuit, coaxial system

ANNEX 3

Tests made by the Dutch Administration in 1952/53

Interruptions on VF telegraph systems

Telephone circuit	Number of days	Total number of interruptions	Percentage of the total faults							Interruptions per day
			5-30 ms	30-50 ms	50-70 ms	70-90 ms	90-110 ms	110-300 ms	> 300 ms	
Systems on audio frequency circuits										
A	69	194	53.5	11.2	6.7	1.5	1.5	2.6	23	2.80
B	69	309	47	14	9	3.8	2.8	9	14.4	4.50
C	15	58	12	5	0	1	4	10	68	3.87
D	15	26	58	7.5	4	0	3.5	0	27	1.74
Total or mean . .	168	587	42.5	9.4	4.9	1.5	3.0	5.4	33.3	3.23
Systems on carrier-system circuits										
E	69	108	19.5	20	17.5	3.0	2.0	12	26	1.56
F	69	104	31	14	5.5	2.0	1.0	4.5	42	1.50
G	69	112	30	11	6.0	2.0	1.0	9	41	1.62
H	15	199	49	8	8	3.5	4.0	7.5	20	13.25
I	15	4	50	0	0	0	0	25	25	0.27
J	15	46	39	6.5	8.5	2	0	2	42	3.00
Total or mean . .	252	573	36.5	10	7.5	2	1.5	10	32.5	3.50

ANNEX 4

Tests made by the French Administration in 1954

Interruptions and short-duration disturbances on telephone circuits (large groups of faults excluded).

Circuit		Length in kilometres	Mean number of interruptions per day								Mean number of disturbances per day *							
			8 to 20 ms		20 to 50 ms		50 to 100 ms		> 100 ms		8 to 20 ms		20 to 50 ms		50 to 100 ms		> 100 ms	
			circuit total	per 100 km	circuit total	per 100 km	circuit total	per 100 km	circuit total	per 100 km	circuit total	per 100 km	circuit total	per 100 km	circuit total	per 100 km	circuit total	per 100 km
Table I. — *Audio circuits or circuits on 1+2 carrier systems*																		
4 wire audio circuits	A	250	1.5	0.6	0.8	0.32	2.6	1	0	0	1.5	0.6	0.3	0.12	0.3	0.12	0.2	0.08
	B**	260	2.5	1	1.3	0.5	1.3	0.5	4	1.54	1.1	0.42	0.5	0.2	0.12	0.05	0	0
	C	850	10.2	1.2	4	0.47	0.5	0.06	13	1.5	0.5	0.06	1	0.12	11	1.6	0.8	0.95
1+2 system	D	1200	0.4	0.03	1	0.08	2	0.17	5	0.42	4	0.33	4.8	0.4	4.3	0.36	0.95	0.08
Table II. — *Circuits on coaxial systems*																		
***	A	260	0.2	0.08	0	0	0	0	0.8	0.3								
	B	520	8	1.6	1.2	0.23	0	0	1.2	0.23								
	C	880	10	1.1	1.2	0.13	0	0	2	0.23	8	0.9	2.2	0.25	0.5	0.06	0.2	0.02
	D	840	16	1.9	4.2	0.5	1.5	0.18	3.4	0.4	3.4	4	1	0.12	1	0.12	0.4	0.05

* The disturbances shown in the right-hand part of Table 2 consist of :
- — sudden increases in equivalent of at least 1 neper.
- — disturbances giving a level at the output of the VF telegraph channel-filter of 4 nepers at a point of zero relative level.

** *Note.* — On circuit B the interruptions longer than 100 milliseconds were made up as follows.
duration 100 to 300 ms. : 2.6 (1 per 100 km)
duration 300 ms. : 1.4 (0.54 per 100 km)

*** *Note.* — On circuit A the observations were made on the coaxial system pilot ; on circuits B, C and D they were made on looped channels.

ANNEX 5

Tests made by the Administration of the Federal German Republic in 1954

(Tests made on VF telegraph channels on various circuits.
Variations of equivalent > 0.7 neper were recorded. Large groups of faults are excluded)

Circuit	Length km	Duration of tests (in days)	Mean number of interruptions per 100 km per day					
			2 to 8	8 to 20	20 to 100	100 to 300	> 300	Total
A	490	32	0.27	0.31	0.49	0.19	0.36	1.62
B	408	32	0,70	0.10	0.16	0.07	0.46	1.49
C	430	11	1.08	2.90	1.95	0.19	0.87	6.99
D	430	11	0.19	0.11	0.74	0.19	0.36	1.59
E	490	11	1.45	0.61	0.13	0.06	0.43	2.68

ANNEX 6

Tests made by the Irish Administration in 1954

Interruptions on a coaxial-pair carrier-system telephone channel (observations lasted, all in all, 915 hours)

Duration of interruption	< 5 ms	5-20 ms	20-100 ms	100-300 ms	> 300 ms	Total
Number per 100 km per day	0.074	1.77	3.40	2.47	3.54	11.25

Question No. 4.

(8th and 9th Study Groups in co-operation: Question No. 5 of the 8th S.G.) (Category A 2) [urgent] (new Question)

Supposing that the statistics to be presented to the 9th Study Group on the frequency and duration of sudden impulses at frequencies in the band liable to cause signal receivers to operate (" hits ") indicate a real danger of false operation of signalling equipment.

Supposing that it is not possible to obtain an assurance that the situation can be rectified, what arrangements should be provided to ensure elimination of false operation on this account ?

Note. — The only interest of the 9th Study Group in this question is to obtain information on the probability of these " hits " occurring.

Question No. 5.

(Category A 2) [urgent] (continuation of Question No. 32 of the 3rd S.G. studied in 1952/1954)

A. (1) What arrangements should be recommended concerning :—

(a) The direction of operations for establishing long international circuits routed over several carrier systems ?

(b) The direction of operations for periodical maintenance on these long circuits ?

(2) What measuring equipment should be provided ?

B. How should the " Instruction for setting up and maintaining international carrier systems providing at least twelve commercial telephone circuits " be extended, in particular to take account of the arrangement recommended by the C.C.I.F. in a supergroup derivation station (reply to Question 29 studied by the 3rd S.G. in 1952-54).

Note. — For part B, the replies to Questions 6 and 7 which follow should be taken into account.

Question No. 6.

(9th Study Group in co-operation with the 3rd S.G.) [urgent] (Category A 2) (new Question)

(a) Are additional measuring frequencies necessary for reference measurements or for maintenance measurements on symmetrical-pair line-regulated sections providing 12, 34, 36, 48 and 60 circuits ?

(b) If so that frequencies and levels should be recommended ?

Note. — For maintenance the Permanent Maintenance Sub-Committee suggested level measurements at the following frequencies :

$$12 - \delta,\ 60,\ 108 + \delta,\ 156 + \delta,\ 204 + \delta \text{ kc/s}$$
(with $\delta = 0.080$ or 0.140 kc/s) and the 2nd pilot frequency

The 3rd Study Group in September, 1954, however, considered that having no recommendation or standardization on this matter it is desirable to put a question to be studied on this particular point.

Question No. 7.

(Category A 1) [urgent] (continuation of Question No. 31 of the 3rd S.G. studied in 1952/1954)

In the case of group links and supergroup links routed over a large number of carrier systems in tandem, what precautions should be taken for the reference pilot (for the group link or supergroup link) to avoid interference due to the pilot of another link?

(a) Precautions to be taken for the group reference pilot.

(b) Precautions to be taken for the supergroup reference pilot.

Note. — In the case of a group routed on several carrier systems in tandem the group reference pilot provides for the regulation of the group (see the recommendation on page 134 of Volume III *bis* of the *Yellow Book* and in particular Figure 30).

In the case of a supergroup routed on several carrier systems in tandem the supergroup reference pilot provides a similar regulation for the supergroup.

It is, however, necessary to take certain precautions to avoid interference between pilots on different links. The following annex gives by way of information the precautions taken by the French Administration.

ANNEX

Method proposed by the French Administration to avoid mutual interference between group and supergroup reference pilots

1. There is need to take precautions so that the reference pilot of one supergroup link does not interfere with the pilot of another supergroup link.

This difficulty can arise :

(a) If the same group link occupies the position of group 3 in two different supergroup links.

This difficulty could be avoided by :

(i) *Either* systematically stopping the supergroup reference pilot at the end of each supergroup link, before or after separating and demodulating the groups.

(ii) *Or* by stopping the pilot only when the condition mentioned above occurs. In this case the routing of a group link over group 3 of two successive supergroup links should be avoided as far as possible. This is the method at present used in France.

(b) If a channel occupies the position 408-412 kc/s in two successive groups.

2. Similar interference can also occur between a supergroup reference pilot and a group reference pilot or between two group reference pilots.

3. If therefore appears desirable to have at least 4.6 nepers (40 decibel) attenuation at the frequencies corresponding to 3860 and 3920 c/s as the channels pass through the channel demodulating and modulating equipment. This requirement is generally met by the equipment standardized by the French Administration.

Question No. 8.

(9th Study Group in co-operation with the 3rd S.G.) (Category A 2) [urgent] (continuation of Question No. 30 of the 3rd S.G. studied in 1952/1954)

In all countries the practice is growing of comparing, either directly or indirectly, but independently of other countries, the master oscillators of carrier systems in coaxial cables (and if necessary on radio links) with a national frequency standard. Considering a telephone circuit routed over several carrier systems on coaxial pairs or radio links, and used for V.F. telegraphy, then the overall frequency error on the circuit should not exceed 2 c/s. This is a very difficult problem, particularly if the higher numbered supergroups are involved. For this reason the following points require study :

A. Is it not possible to recommend, in the case of telephone circuits routed over several carrier systems on coaxial pairs or radio links, a procedure for direct comparison from time to time, of the master oscillators (situated in different countries) of these systems ?

B. What methods are recommended for this comparison ?

(a) Either a method consisting of transmitting from end to end a pilot (in the space between supergroups) for the control of these frequencies (and in this case what should be the frequency) ?

(b) Or any other method, e.g. a method consisting of transmitting on a telephone channel a pilot of a frequency to be determined and modulated if necessary ?

C. How often should these comparisons and adjustments between master oscillators be made ?

Question No. 9.

(9th Study Group in co-operation with the 3rd and 5th S.G. of the C.C.I.F. and with C.C.I.R.) (Category A 1) [non-urgent] (continuation of Question No. 34 of the 3rd S.G. studied in 1952/1954)

(a) As a method of measuring intermodulation effects on a carrier system, should a method be recommended in which the system to be measured is loadep with " white noise " ?

(b) In what cases and in what precise conditions should this method of testing be used ?

(c) Is there need for a given method to fix limits for the results of such intermodulation measurements ?

Note 1. — Distinction should be made between the cases of carrier current systems on metallic lines and systems on radio links where the conditions for using this method may be different.

Note 2. — Annex 1 reproduces a memorandum by the Australian Telephone Administration which describes in detail such a testing method and at the same time proposes permissible limits for intermodulation noise.

Annex 2 is a memorandum by the Dutch Administration on the subject of this testing method.

ANNEX 1

(to Question No. 9)

Note by the Australian Telephone Administration on intermodulation testing of multi-channel carrier system and of radio links by the use of random noise

Introduction — General nature of the test

The general nature of the measurement of the intermodulation caused by the application of noise can be explained with the aid of a block schematic diagram, Figure 1 attached. The essential elements are :—

— a generator of continuous spectrum random noise ;
— band stop and band pass filters ;
— measuring instruments ;
— the system to be tested.

These elements are connected as shown in the schematic diagram of Figure 1 which also shows the frequency spectrum of the noise energy used as a test signal, at various points in the circuit.

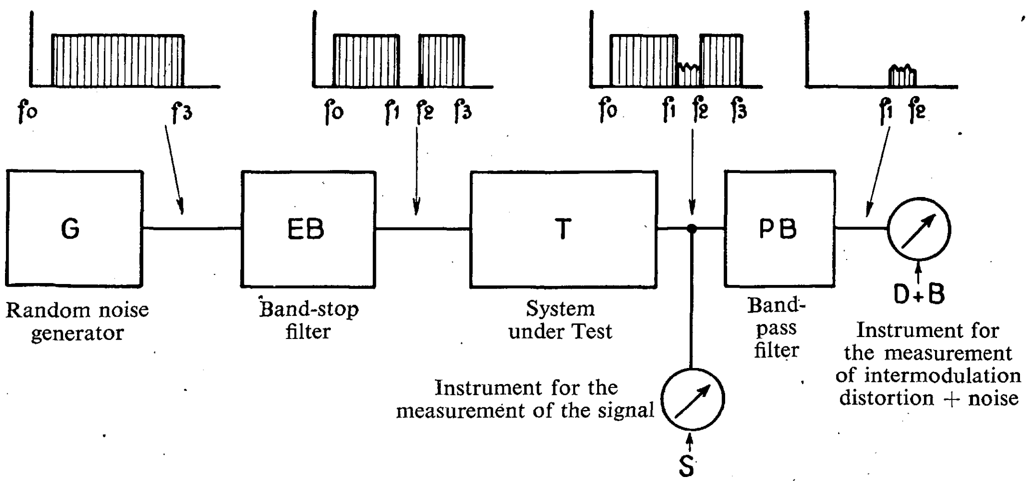

FIGURE 1. — *Block schematic of the arrangement of equipment used for the measurement of intermodulation by the application of noise*

The signal output from the random noise generator would normally have a spectrum with constant energy in all frequency components between frequencies f_0 and f_3 as shown. The limits f_0 and f_3 are adjusted to be approximately the same as those of the speech signals or speech modulated carrier waves normally applied to the system. The frequency spectrum may be altered by means of equalizers to give other distributions if desired.

The band-stop filter shown in Figure 1 greatly attenuates all frequency components between the frequencies f_1 and f_2. The band f_2-f_1 is made 4000 c/s or thereabouts, so as to simulate approximately one quiet speech channel.

Non-linear distortion and undesired noise sources (such as cable resistance noise, valve noise, etc.) within the communication system give rise to an increase in the noise signal in the band f_1—f_2, as shown in the spectrum diagram.

The combined amplitude of these distortion components is then measured by means of the band-pass filter and measuring instrument shown in Figure 1. A second measuring instrument is used to measure the total energy of the random noise signal transmitted out of the communication system under test. The amount of non-linear distortion in the band f_1 to f_2 is a function of the amplitude of the output signal of the transmission system; this may be adjusted to certain definite values representing certain conditions of speech traffic loading, or it may be varied over a range of values if it is desired to find the loading which gives maximum signal to noise ratio.

Advantages of the measurement of intermodulation, by the application of noise when applied to multi-channel carrier telephone systems

The particular advantage of this method of measurement is that it simulates actual speech loading conditions. The band-stop, band-pass filter arrangement is equivalent to the equipment arrangement in a carrier system, and in fact it is desirable in many cases to make use of existing channel translating equipment to carry out this test. In such a case, individual noise generators would be applied to all channels except one, and the resulting distortion products measured (with a C.C.I.F. psophometer) in the quiet channel at the far end.

The complex signal resulting from the combination of the speech signal in a frequency-division multi-channel telephone transmission system has a random character which can be simulated by continuous spectrum noise from a random noise generator.

Figure 2, which follows, shows the statistical distribution, as a function of time, of random noise peaks and compares them with the statistical distribution as a function of time, of peaks in a multi-channel telephone system (this figure is reproduced from an illustration in an article by E. Peterson in Bell Laboratories Record, November, 1939).

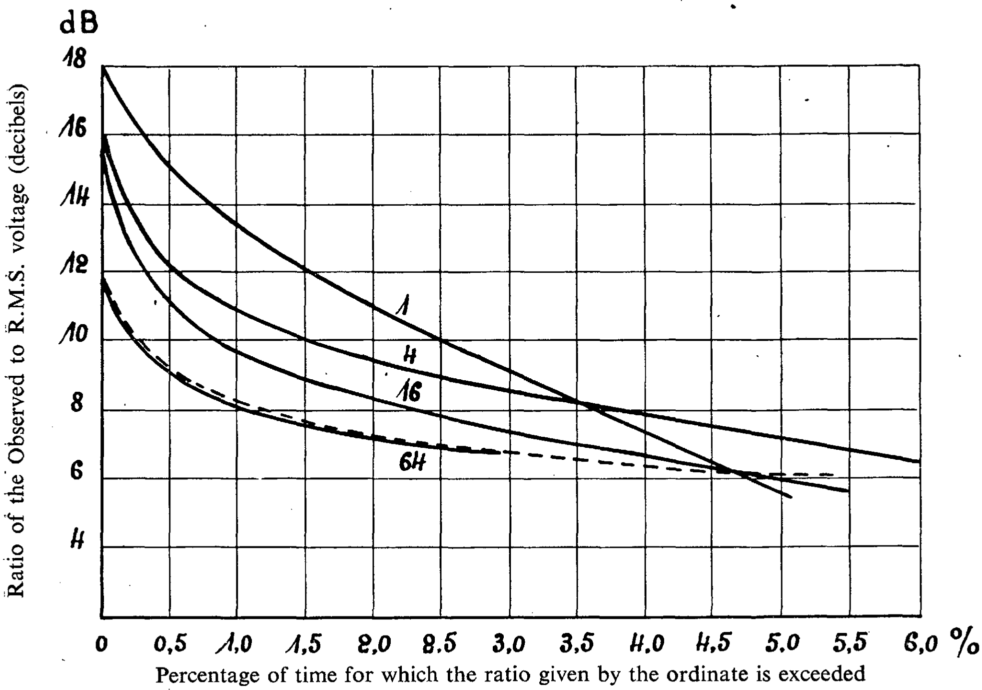

Figure 2. — *Statistical distribution of the voice currents produced by a group of talkers*

The power level during the busy hour due to the speech currents in a multi-channel telephone system is given in Figure 3 for various numbers of channels. Figure 3 is based upon Figure 6 in a paper by Holbrook and Dixon in the *Bell System Technical Journal*, October, 1939. Holbrook and Dixon's data are based upon a mean talker volume at a point of zero relative level of −16.0 db relative to " reference volume " (equivalent to " *puissance vocale normale* " used with the S.F.E.R.T. in the C.C.I.F. Laboratory). For estimating the load of a carrier system " reference volume " is taken as representing an average power in continuous speech of 1.66 mW (+2.2 db). The standard deviation of talker levels is 5.8 db *. A mean channel activity, during the busy hour, of 25% is assumed.

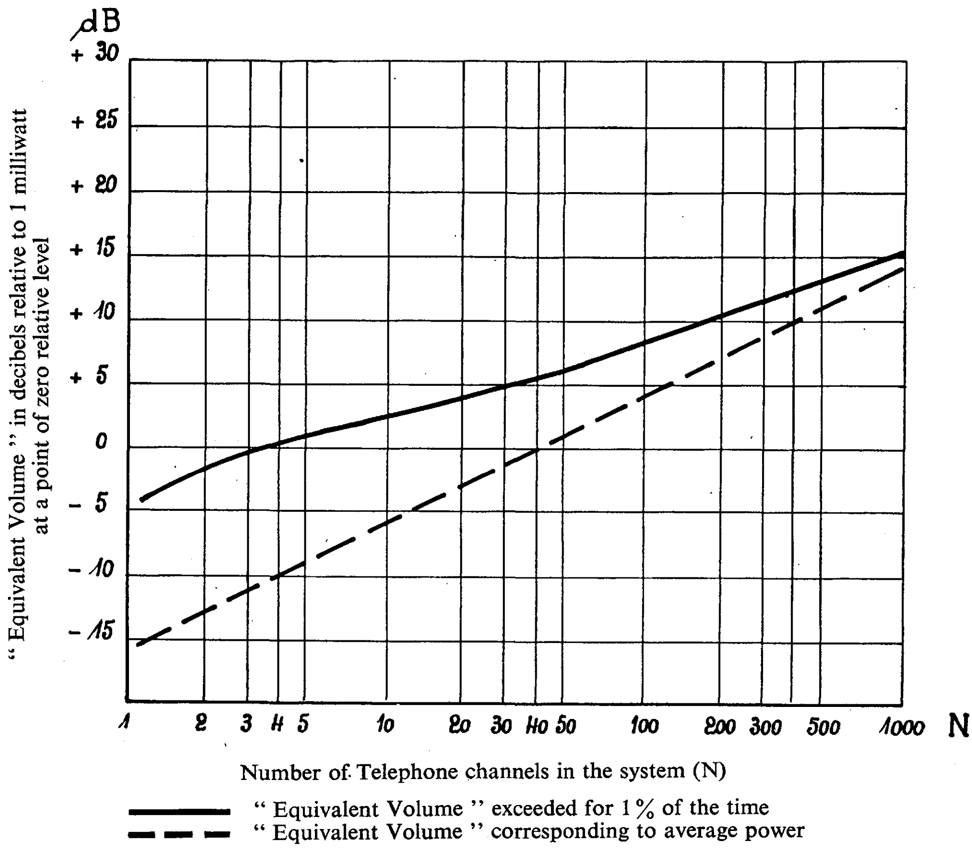

FIGURE 3. — " *Equivalent volume* " *for carrier systems of N channels*

In carrying out intermodulation tests by the random-noise method, the power level of the noise signal at a point of zero level is adjusted to a value given by the curves of Figure 3, the " 1 per cent " or " average power " curve being used according to the information desired.

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* There are several indications that the voice power levels given in the article by Holbrook and Dixon have changed ; the mean volume of speech produced by a subscriber in the Bell System is about 4 db less than the value given and has a little less spread.

As mentioned above, when individual channels in a carrier system are loaded with separate noise generators, the distortion products are measured by means of a psophometer in the idle channel. When testing a high frequency repeatered line or similar system, the bandwidth of the bandpass filter used should preferably be equal to the equivalent noise bandwidth of the C.C.I.F. psophometer (1780 c/s).

Application of the test to particular groups of channels in carrier systems on coaxial pairs

(a) 12-channel basic groups. — In testing a complete carrier system comprising of one 12-channel group, it is most convenient to connect independent random noise generators to 11 of the 12 channels, the power level being adjusted to an absolute level of −8 db per channel at a point of zero relative level, if the equivalent volume exceeded during 1% of the time is to be simulated. If " average power " conditions are to be simulated, the corresponding absolute level of the noise signal would be −16 db, on each channel at a point of zero relative level. The noise level at a point of zero level in the unoccupied channel at the end of a system 2500 km long should not exceed −50 db (psophometric power of 10.000 pW) when measured with the standard C.C.I.F. psophometer.

(b) 60-channel supergroups. — In the case of 60 channel supergroups it seems appropriate to carry out tests independently of the channel translating equipment, using a single wide-band noise generator and sets of band-stop and band-pass filters. The bandwidth of the noise generator should be adjusted to 312 kc/s - 552 kc/s, the bandwidth of the standard supergroup. The power level would be set to an absolute level of +6.5 db at a point of zero relative level, to simulate the equivalent volume exceeded 1% of the time and to a level of +1.5 db to simulate the equivalent volume corresponding to average power.

The bandpass filter at the receiving end should preferably have an effective bandwidth for noise corresponding to that of the standard C.C.I.F. psophometer. In cases where the bandpass filter has some other bandwidth, its value should be measured and an appropriate correction made.

The maximum permissible level of unwanted noise and distortion depends upon the proportion to be allocated to the terminal channel translating and group modulating equipment, but generally this is so small (see *Yellow Book*, Volume I *bis*, pages 321-327, reply by the British Administration to Question No. 25 studied in 1950/1951) that for practical purposes a limit of an absolute level of −50 db (10,000 pW) at a point of zero relative level in a circuit of length 2500 km can be applied.

(c) Groups of 600 channels or more. — The procedure in this case is exactly similar to that described above for a 60-channel supergroup. The bandwidth of the noise generator is adjusted to the appropriate value and the power level to be used is determined from Figure 3. The limit to be applied to the unwanted distortion and noise depends upon the limits assigned to the terminal channelling and the group and supergroup modulation equipment, as discussed under *(b)* above. This latter limit is generally small so that it is again practical to apply, for the noise measured at the end of a circuit of 2500 km, the value corresponding to an absolute level of −50 db (psophometric power of 10,000 picowatts) at a point of zero relative level.

Comments on the technical requirements of the equipment used for the measurement of intermodulation by the application of noise

(a) *Random noise generators.*

The primary requirement is that of uniform spectrum energy per cycle (equal power in each frequency band of 1 c/s) throughout the transmission band, with purely random phase relationship between the frequency components. Normally the noise generator itself operates at a low power level, and amplification is necessary. The overload level of the amplifier should be sufficient to enable a signal with a peak-to-r.m.s. ratio of at least 12 db to be amplified without peak clipping.

For noise generators supplying a voice-frequency spectrum only, it has been found convenient to use gas-tube noise generators, because of their high output level. For wideband noise generators, a temperature limited diode developing " shot " noise is more satisfactory because of its relative stability and uniformity of frequency spectrum.

(b) *Filters.*

A primary requirement is that the filters themselves shall not produce non-linear distortion. Air-cored inductors are therefore desirable but iron dust cores of permeability 2 or 3 have been used, in certain cases, with entire success.

The frequency spectra shown in Figure 1 have been drawn on the assumption that filters with rectangular attenuation/frequency characteristics are used. In practice it is convenient to use a band-pass filter with a response curve having a rounded top and sloping sides. The bandwidth of the band-stop filter must be not less than that of the band-pass filter. The band-pass and band-stop filter connected in cascade should have an attenuation of the order of 70-80 decibels or better at all frequencies.

ANNEX 2
(to Question No. 9)

Note by the Dutch Telephone Administration

With reference to the note by the Australian Administration (Annex to Question No. 34), the Netherlands Administration draws attention to the following method of measurement by which the use of a noise generator and of different bandpass filters and of different band-stop filters can be avoided.

In the method in question, one or more amplifiers with linear characteristics, and taken from the same system (e.g. the amplifier from the other direction of transmission) are used as a noise generator ; while the necessary filtration is obtained by means of the band-pass filters used for the various channels of the system. The method of operation may be clarified with the aid of a simplified schematic which illustrates the measurement on a radio link (see Figure 1).

The thermal noise, amplified in the amplifiers with linear characteristics, is separated into different frequency bands by the receive side of the auxiliary multiplex apparatus (channel equipment). The low-frequency 4-wire outputs thus provide 12 sources of incoherent noise having a noise energy which may be equalized as necessary in the different channel amplifiers.

The system to be measured may be loaded by the noise provided by these " incoherent noise " sources.

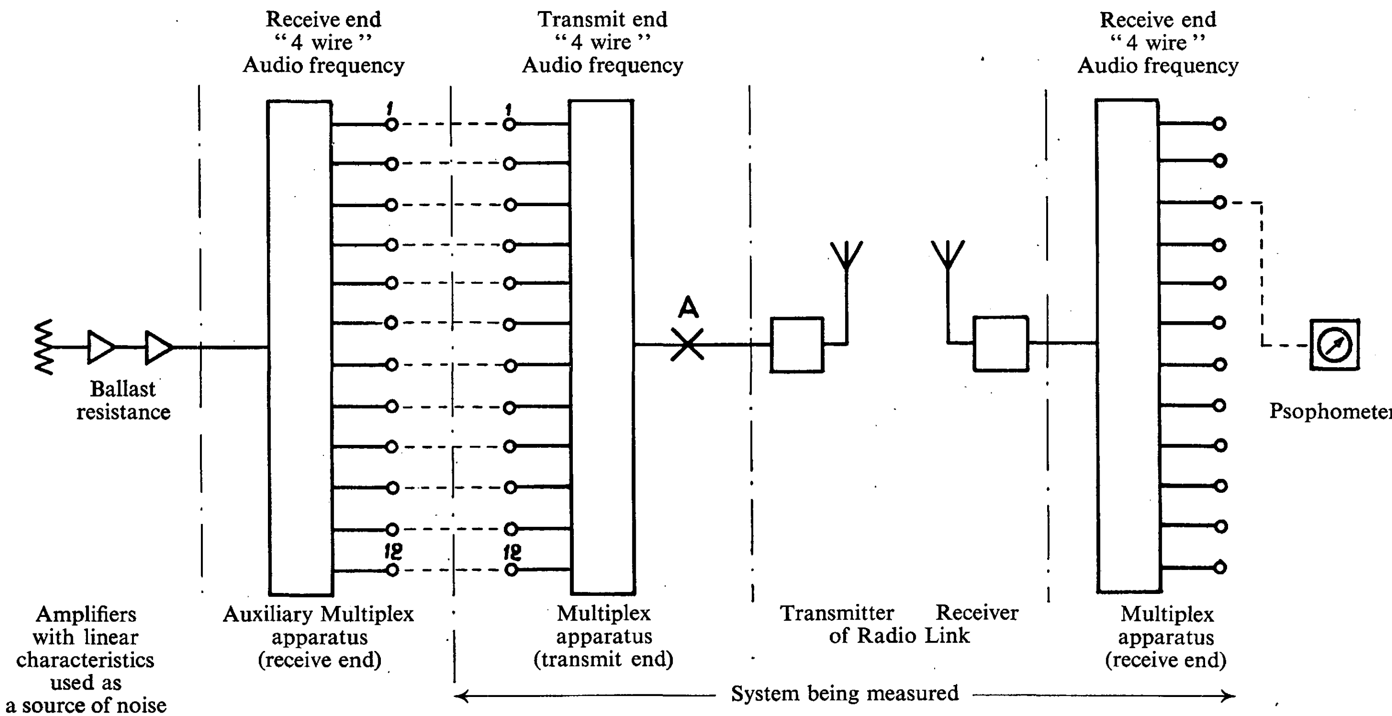

Receive end
" 4 wire "
Audio frequency
Transmit end
" 4 wire "
Audio frequency
Receive end
" 4 wire "
Audio frequency
1
1
12
12
A
Ballast resistance
Psophometer
Amplifiers with linear characteristics used as a source of noise
Auxiliary Multiplex apparatus (receive end)
Multiplex apparatus (transmit end)
Transmitter
Receiver
of Radio Link
Multiplex apparatus (receive end)
System being measured

FIGURE 1

The noise resulting from this loading is measured by means of a psophometer on the receive end of a channel, provided that the transmit end is not connected to a source of noise. As there is complete freedom in the choice of the channel on which to measure (channel 3 in the example of Figure 1), as well as the channels to which noise is applied, the component in each individual channel may readily be observed for any combination of loading of the channels.

Note 1. — In favourable circumstances, the receive end of the multiplex apparatus to be tested, which is already available in the station given as an example, may be used in place of the auxiliary multiplex apparatus. For this to be possible, it is necessary for the near-end reflected crosstalk (echoes) between the receive and transmit ends to be sufficiently good, because this near-end crosstalk also introduces noise in the channel to be measured. It goes without saying that this latter noise should be negligible compared with the noise it is desired to measure.

Note 2. — It can be seen that when a 24 channel link is measured, 12 sources of " incoherent noise " are sufficient if each of them is connected to two 4-wire transmit ends of the system to be measured.

The mean apparent power can be checked by measuring at point A with a voltmeter having a square law addition. If the increase of apparent power is proportional to the increase in the number of channels loaded with noise, it follows that the correlation between the loading of the different channels is sufficiently small.

Question No. 10.

(8th and 9th Study Groups in co-operation) (Category A 1) [urgent] (Question No. 10 of the 8th Study Group) (resumption of the study of Question No. 3 of the 3rd S.G. in 1952/1954)

Given the possibility that a large number of international circuits may in the future be operated semi-automatically, what measures should be recommended for the " general maintenance " of such circuits, including the verification of the correct operation of the signalling equipment ?

Note 1. — The term " general maintenance " should be understood to include the setting-up of the international circuits, their routine maintenance, rapid tests of the circuits and the localisation of faults.

The measures to be adopted for the general maintenance of international telephone circuits form the subject of the " Maintenance Instructions " appearing in the 5th part of Volume III of the *Yellow Vook* of the C.C.I.F.

These arrangements were set up on the basis of a manual service, in which operators can make periodic tests of signalling and speech directly from the multiple. When access to international circuits is obtained indirectly via automatic switching equipment, this method will no longer be possible and a different method will be required. Further, since with voice-frequency signalling systems for automatic operation, the signalling is carried out over the same transmission path as is used for voice currents, faults will in general reveal themselves in the form of signalling peculiarities.

The internal organization of the general maintenance services in certain Administrations may be such that a distinction exists between the maintenance of automatic signalling equipment and line maintenance, so that a procedure considerably different from that now employed (for routine tests and for the clearance of faults) may be necessary.

Note 2. — The maintenance instructions which will be drawn up after the XVIIth Plenary Assembly by a working party to be set up by the Sub-Commission for Rapid Operating Methods (a working party composed of individuals responsible for the maintenance of international switching equipment, individuals responsible for the maintenance of transmission equipment, and perhaps one or two representatives from the operating services) will serve as a basis for the final text of the " Instructions for maintenance of semi-automatic circuits ".

Question No. 11.

(9th Study Group in co-operation with the 6th and 7th S.G. of the C.C.I.F. and with the C.C.I.R., E.B.U. and I.B.O.) (Category A 2) [urgent] (continuation of Question No. 13 of the 3rd S.G. studied in 1952/1954)

Revision of the " Recommendation for setting up a link to be used for a programme transmission and subsequent restoration of the link to its normal traffic condition ".

Question No. 12.

(9th Study Group in co-operation with the 3rd S.G. of the C.C.I.F. and with the C.C.I.R., I.B.O. and E.B.U.) (Category A 2) [non urgent] (continuation of Question No. 19 of the 3rd S.G. studied in 1952/1954)

What recommendations should be embodied in an instruction for the setting-up and maintenance of a international circuit for television transmissions ?

Question No. 13.

(9th Study Group in co-operation with the 5th S.G. of the C.C.I.F. and Commission IX of the C.C.I.R.) (Category A 2) [urgent] (continuation of Question E of the 3rd S.G. studied in 1952/1954) (Question 96 of the C.C.I.R.)

Preparation of a draft " Instruction for periodic maintenance, localization and clearance of faults on radio relay links forming part of the general telephone network ".

Note 1. — It is desirable that the instructions for periodical maintenance, localisation and clearance of faults, applicable to land lines and to radio relay links should be as homogeneous as possible.

It is also important that designers of radio links for use in the telephone network take account of the requirements for the general maintenance of telephone circuits.

Note 2. — The recommendations contained in the annex which follows were made to the C.C.I.R. in 1954 following the study of Question E by the 3rd and 5th Study Groups and the permanent maintenance Sub-Commission of the C.C.I.F., in order to determine the general principles on which the maintenance of radio links should be based.

So far as the requirements for the radio links are concerned there is not yet sufficient experience to make a recommendation ; Annex 2 which follows gives by way of information methods and measuring equipment proposed in 1953 by the French Administration. It should be mentioned that Annex 2 deals with the maintenance of radio links which is the concern of the C.C.I.R., but it appeared useful to indicate to the C.C.I.R. that in the frequency spectrum (base band for the radio link) recommended by the C.C.I.F. there are for example spaces available between groups, etc.

ANNEX 1

(to Question No. 13)

Recommendations proposed by the C.C.I.F. on the principles for maintenance of radio links

1. *Independent Radio Link.*

For an independent radio link, that is, one in which there is demodulation and modulation to voice frequency at the terminal stations, the same maintenance arrangements should be applied as for cable circuits. At least one station of the radio link, or a station locally associated with it, should be attended. This station (or the neighbouring associated station) will be considered as the control station for the radio link and as sub-control station for the telephone circuits which are transmitted by the radio link.

Since the radio link is reduced to audio frequencies, no pilot from a carrier line system should enter the radio system and vice versa. The C.C.I.R. are asked to ensure that in the radio stations, all equipments necessary for making such measurements as are required by the C.C.I.F. for maintenance are provided.

2. *Radio link extending an important section of a carrier cable system or carrier cable system extending an important radio link.*

In the case where a radio link is an extension of an important cable system, the control station of the radio link should be the last station of the carrier system and this station should have the necessary control and supervisory equipment associated with the radio link ; vice-versa, in the case of a cable system extending an important radio link the " high frequency sub-control " station should be the terminal station of the radio link or another radio station suitably chosen. In either case it is possible to place the control and supervisory equipment for the radio link in a neighbouring station where personnel may be located.

3. *Radio link inserted in a cable network and on which groups of 12 or super-groups of 60 circuits can be transmitted without demodulation to voice frequency.*

If a radio link is inserted in a cable network, it will be considered between its terminal stations as a " line-regulated section ".

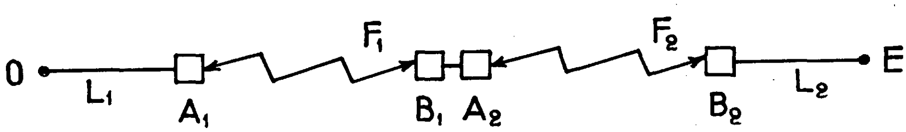
If the radio link uses amplitude or frequency modulation it should conform to the frequency allocation arrangements recommended by the C.C.I.F. for carrier systems (systems on symmetrical-pair or coaxial-pair cable as the case may be). If a group or supergroup provided on the cable system passes through a radio terminal station without being reduced to telephone channels or groups, it should include its group reference or supergroup reference) pilot and the radio system should accept and reconstitute these pilots, the frequencies and levels of which are given in the following table :—

Pilot signals	Frequency kc/s	An absolute level of power at a zero level point
Primary Group . . .	84.080 84.140	−20 db or −2.3 N −25 db or −2.9 N
Super-group	411.860 411.920	−25 db or −2.9 N −20 db or −2.3 N

In order to ensure sufficient flexibility of interconnection between radio systems and cable systems in the international network, it is recommended that in every radio link likely to be interconnected with the international network, provision should be made for accepting and reconstituting faithfully the group reference pilot and super-group reference pilot as recommended by the C.C.I.F. should be foreseen.

On the other hand, any frequency which may be used within the radio link for regular supervision of its operation should be suppressed at the output of the radio system according to the conditions quoted in Volume III *bis* of the *Yellow Book*, pages 131 and 133, in order that transmission on associated lines may not be affected.

4. *Case of two interconnected radio links.*



Consider the case of two radio links connected in cascade, F_1 and F_2, the control stations of which are respectively A_1 and A_2 and which are inserted in the telephone circuit OE between cables L_1 and L_2. If F_1 and F_2 are of the same type (for example, both using frequency modulation) and use channelling arrangements as recommended for carrier systems on coaxial cables and if there is a circuit, a group, or a super-group which enters directly the junction points (B_1 or A_2), station A_2 should be considered as a sub-control station for the circuit, the group, or the super-group.

It will be necessary to examine later the role played by station A_2 if more than 60 telephone circuits, that is, more than a super-group, appear directly at the junction (B_1 A_2).

ANNEX 2

(to Question No. 13)

Proposal by the French Telephone Administration on Maintenance of Radio links

Periodical maintenance of radio link equipment and localization and clearance of faults on radio links should be based according to the opinion of the French Telephone Administration on the following principles :—

1. The maintenance of a telephone or video path between terminal radio stations (or stations where the signals are modulated and demodulated) should be carried out according to the recommendations which apply to carrier-current line systems ; line levels, pilot signals, etc.

2. The maintenance of the whole video path between terminal stations is however not enough and it seems necessary to control transmission quality throughout a radio link ; for this reason it is necessary that each radio relay station should be provided with a local test demodulator which will enable the video or telephony signals to be monitored at each radio station.

3. On radio links, the overall transmission quality is most likely to be affected by the signal-to-noise ratio and this ratio is likely to give the most information on the actual condition of equipment, level of received signals, propagation characteristics, intermodulation due to non-linear distortion etc. The French Administration therefore proposes to monitor the value of this ratio at each station in the following manner ; the type of modulation used on radio systems (pulse modulation, frequency modulation) allows systems to be set up whose equivalent is practically independent of variations of high frequency signal levels since the systems themselves contain amplitude limiting devices ; in order to monitor the signal-to-noise ratio, therefore, it is sufficient to measure the energy of noise in a given band at a point of known relative level.

As a reference frequency band, it is necessary to select one in which there are no telephone signals, for example, a band 4 kc/s wide situated below 60 kc/s ; the French Administration has selected a reference band for this purpose between 48 and 52 kc/s.

For remotely controlled stations, summarized data relating to the signal-to-noise ratio can be transmitted to the control station : it may be sufficient, for example, to transmit information to the control station whenever the noise level exceeds a certain value.

4. Monitoring of the basic noise in a given bandwidth may not be sufficient, in certain instances, for localizing and recognising certain less obvious faults due, for example, to non-linear distortion. Therefore the French Telephone Administration considers that it is desirable to be able to monitor by means of an appropriate signal the non-linear distortion on any given section of a radio system without breaking down the transmission.

One way of achieving this consists of selecting an interstitial frequency which will not affect telephone signals and transmitting over the radio link a signal of this frequency, and measuring its 2nd and 3rd harmonics. The French Administration has selected a sine-wave at 64.140 kc/s as a test signal. A filter blocking the signals at frequencies of 64.140 kc/s at the terminal stations ensures that these signals are not transmitted to line carrier systems.

5. The localization of faults does not, in general, present any difficulty if all the stations are attended, but requires considerable study if stations are unattended ; if it is necessary to ensure (for example by transmission over reserve equipment) that a fault does not break down a link the French Administration considers that the faulty station should, itself, transmit information to the control station ; if there is a complete breakdown of the link, localization of the fault could perhaps be achieved by the use of the last station which is receiving the signal, from which it is possible to send information to the control station or by a control circuit on an alternative routing to the main station; the French Administration considers that it is not necessary to define with great exactitude the control system itself which may in fact vary according to the type of radio system, but considers that the principle of localization of faults should be maintained and that this localization *should be capable of being achieved without recourse to any means other than the radio link itself.*

Question No. 14.

(5th and 9th Study Groups of the C.C.I.F. in co-operation with Commission IX of the C.C.I.R.) (Category A 2) [urgent] (continuation of Question No. F of the 3rd S.G. studied in 1952/1954)

1. What channels can be used for the exchange of service information between the terminal and the intermediate stations of a radio-relay link (radio relay with frequency modulation and radio relay with pulse modulation of different types) ?

2. Should supervisory signals coming from unattended stations be transmitted to an attended station :

(a) on the radio relay network itself ?

(b) by means of a separate radio relay using the same towers ?

(c) or by means of metallic circuits ?

Note 1. — Annex 1 which follows reproduces the reply of the 3rd and 5th Study Groups to Question F studied in 1952/1954. Annex 2 which follows reproduces the contributions provided in 1953 by various Administrations.

Remark by the C.C.I.R. — In the view of the C.C.I.R., it is not necessary to formulate standards in these matters, which it is felt should be the subject of agreement between the Administrations concerned.

ANNEXES 1 and 2

(to Question No. 14)

See on pages 429 and 430 the annexes to the Question No. 9 of the 5th S.G.

Question No. 15.

(5th and 9th Study Groups of the C.C.I.F., in co-operation with Commission IX of the C.C.I.R.) (Category A 2) [urgent] (continuation of Question G of the 3rd S.G. studied in 1952/1954)

What arrangements should be made to provide for the automatic substitution of stand-by radio relay equipment in the case of failure of the normal equipment ?

Note 1. — The annex reproduces the reply of the 3rd Study Group to Question G studied in 1952/1954.

Remark by the C.C.I.R. — In the view of the C.C.I.R., it is not necessary to formulate standards in these matters, which it is felt should be the subject of agreement between the Administrations concerned.

ANNEX

(to Question No. 15)

Reply by the 3rd Study Group of the C.C.I.F. to Question G in October, 1953

The importance and nature of reserve equipment which is provided depends directly on the degree of importance which is attributed to the continuity of the international telephone service. Obviously the importance is greater for a radio link upon which is transmitted an international circuit for which there is no alternative routing than in the case of a radio link in operation in regions where there are several alternative routes for international traffic.

A solution which seems to be desirable at any rate from an initial point of view for radio links on important routes for which there is no alternative is :

(i) either to have a reserve channel in continuous operation between terminal stations and on to which either automatically or manually, any given faulty circuit of the radio system may be speedily switched.

(ii) or to provide at each relay station reserve equipment which may be rapidly switched in the case of failure of the normally operating equipment at that station.

It is good practice to alternate from time to time, at suitably chosen intervals, the use of " normal " and " reserve " equipment ; it is also desirable to make arrangements such that this switching can be readily achieved.

Question No. 16.

(5th and 9th Study Groups of the C.C.I.F., in co-operation with Commission IX of the C.C.I.R.) (Category A 2) [urgent] (continuation of Question H of the 3rd S.G. studied in 1952/1954)

Sources of normal and emergency power supply for attended and unattended stations in a radio relay network forming a part of the cable networks of Europe and the Mediterranean Basin.

Note 1. — The annex reproduces the reply by the 3rd Study Group to Question H studied in 1952/1954.

Remark by the C.C.I.R. — In the view of the C.C.I.R., it is not necessary to formulate standards in these matters, which it is felt should be the subject of agreement between the Administrations concerned.

ANNEX

(to Question No. 16)

Reply by the 3rd Study Group of the C.C.I.F. to Question H in October, 1953

Given that international telecommunication channels may provide either telephony (automatic or manual), multi-channel telegraphy, telex, phototelegraphy, etc. and given that none of these services can suffer even short breaks, the C.C.I.F. considers it desirable to provide at each power feeding station for modern systems arrangements for reserve plant which may be brought into service automatically and without interruption of the normal equipment. Under all circumstances, substitution of this reserve plant should not produce disturbances of duration longer than about 150 ms.

The preceding paragraph is an extract from the specification for power supply systems for carrier circuits on cables.

The C.C.I.R. is asked to take account of the above specification when it is considering recommendations for power supply sources for radio relay systems.

SUMMARY

of maintenance questions to be studied in 1955, 1956 and 1957 by the 9th Study Group of the C.C.I.F.

Question No.	SUBJECT	CATEGORY	STUDY GROUP (other than the 9th S.G.) or other interested international organisations	REMARKS
1	Stability of transmission in the European network	A 2	3rd S.G.	Non-urgent (continuation of Question No. 4 of the 3rd S.G. 1952/1954)
2	Causes of slow changes of equivalent	A 2	3rd S.G.	Urgent (new question)
3	Sudden changes of equivalent	A 2	3rd and 8th S.G. C.C.I.T.	Urgent (continuation of Question No. 8 of the 3rd S.G. 1952/1954)
4	Noise impulses liable to cause the operation of signal receivers.	A 2	8th S.G.	Urgent (new question)
5	Maintenance of carrier systems	A 2		Urgent (continuation of Question No. 32 of the 3rd S.G. 1952/1954)
6	Additional measuring pilots for carrier systems on symmetrical pairs	A 2	3rd S.G.	Urgent (new question)
7	Mutual interference between pilots	A 1		Urgent (continuation of Question No. 31 of the 3rd S.G. in 1952/1954)
8	Comparison of master oscillators	A 2	3rd S.G.	Urgent (continuation of Question No. 30 of the 3rd S.G. 1952/1954)
9	Measurement of intermodulation effects	A 1	3rd and 5th S.G. C.C.I.R.	Non-urgent (continuation of Question No. 34 of the 3rd S.G. 1952/1954)
10	Maintenance of semi-automatic circuits	A 1	8th S.G.	Urgent (resumption of the study of Question No. 3 of the 3rd S.G. 1952/1954)
11	Recommendations for programme transmissions	A 2	6th and 7th S.G. C.C.I.R., E.B.U., I.B.O.	Urgent (continuation of Question No. 13 of the 3rd S.G. 1952/1954)

Question No.	SUBJECT	CATEGORY	STUDY GROUP (other than the 9th S.G.) or other interested international organisations	REMARKS
12	Maintenance for television transmissions	A 2	3rd S.G. C.C.I.R., I.B.O., E.B.U.	Non-urgent (continuation of Question No. 19 of the 3rd S.G. 1952/1954)
13	Maintenance of radio links	A 2	5th S.G. C.C.I.R.	Urgent (continuation of Question E of the 3rd S.G. 1952/1954)
14	Service channels for radio links	A 2	5th S.G. C.C.I.R.	Urgent (continuation of Question F of the 3rd S.G. 1952/1954)
15	Changeover to spare equipment for radio links	A 2	5th S.G. C.C.I.R.	Urgent (continuation of Question G of the 3rd S.G. 1952/1954)
16	Power supplies for radio links	A 2	5th S.G. C.C.I.R.	Urgent (continuation of Question H of the 3rd S.G. 1952/1954)

LIST OF QUESTIONS

concerning letter and graphical symbols, the study of which should be undertaken or continued by the 10th Study Group of the C.C.I.F. in 1955, 1956 and 1957

Question No. 1.

(Category A 1) [urgent] (continuation of Question No. 7 studied in 1952/1954)

(a) Is there any need to introduce modifications or additions to the list of graphical symbols, especially in the case of uniselectors and selectors ?

(b) If so, what are these modifications ?

Note. — For the study of this question, Administrations should take note of the proposals contained in the document " C.C.I.F. 1952/54 — Symbols — Document No. 10 ".

Question No. 2.

(Category A 1) (in co-operation with the Technical Committee No. 43 of the I.S.O.) (continuation of the Question No. 2 studied in 1950/1951)

The preparation of a list of letter symbols relating to the principal constants of acoustics, in particular those concerning telephony.

Note 1. — It seems that a preliminary study of this question should be made by Technical Committee No. 43 of the I.S.O. Consequently the C.C.I.F. cannot at present decide whether or not this question is urgent.

Note 2. — For the study of this question particular examination could be made of the proposals contained in the following documents :

" C.C.I.F. — 1947/1948 — Symbols — Document No. 1 " : Remarks by the Telephone Administrations of Denmark, Norway, Czechoslovakia, Sweden and Switzerland concerning questions studied by the Letter and Graphical Symbols Committee.

" C.C.I.F. — 1947/1948 — Symbols — Document No. 4 " : Replies by the Telephone Administration of the Netherlands to questions studied by the Letter and Graphical Symbols Committee.

" C.C.I.F. — 1947/1948 — Symbols — Document No. 7 " : Replies by the Telephone Administration of Sweden and the *Sociedad Teléfonos de México* to Questions Nos. 1 and 2 studied by the Letter and Graphical Symbols Committee.

Question No. 3.

(Continuation of former Question No. 3 studied in 1952/1954) (Category A 1) [urgent] (in co-operation with the C.C.I.T. and C.C.I.R.)

1. The preparation of an introduction to the list of graphical symbols for telecommunication, fixing the guiding principles to be followed in the utilization of these symbols.

2. The preparation of a classification of all the types of diagrams used in telephony according to their use.

3. The preparation of rules to which each category of diagrams must conform so that the information they give be as clear as possible.

Note 1. — This question should be studied by the C.C.I.F. in co-operation with the C.C.I.T. and C.C.I.R.

Note 2. — For the study of this question, the following documents will be taken into account :

" C.C.I.F. — 1950/1951 — Symbols — Document No. 1 " : Observations by the Dutch Administration concerning questions studied by the Letter and Graphical Symbols Committee of the C.C.I.F. in 1950/1951 (Letter of 16 May, 1951).

" C.C.I.F. — 1950/1951 — Symbols — Document No. 3 " : Observations by the British Telephone Administration to Questions No. 1, 3 and 5, studied by the Symbols Committee of the C.C.I.F. in 1950 and 1951 (letter of August, 28th, 1951).

" C.C.I.F. — 1952/1954 — Symbols — Document No. 1 " : Rules for the preparation of telecommunication diagrams (contributions by the Telephone Administration of the Netherlands to the study of Question No. 3 of the Symbols Committee of the C.C.I.F.).

The following Annex will also be taken into account.

ANNEX

(to Question No. 3)

Introduction to the list of graphical symbols for " light "-current installations

A. *General.*

In the choice of symbols for light-current symbols Study Group No. 3 of the International Electrotechnical Commission has adopted the following guiding principles :

The symbol should be as simple as possible in order to facilitate drawing and to avoid loss of time.

It should be clear and avoid confusion with other symbols.

The mechanical construction of apparatus or of parts of apparatus is of secondary importance; thus the same symbol is employed for all types of relays *which fulfil the same function* although their construction may be very different.

The symbols for telephony, telegraphy and radio form an undivided whole, in which unnecessary repetition should be avoided. The numbering is continuous throughout.

The light current symbols numbered E-1 to E-1000 are divided into 4 sections.

Section 1. — Symbols common to Telecommunications
Section 2. — Telephony symbols
Section 3. — Telegraphy symbols
Section 4. — Radio symbols

In each section the arrangement is as follows :

Symbols for circuit diagrams
Symbols for block schematic diagrams
Symbols for plans and maps.

To complete the book in an orderly manner numbers have been reserved between different sections and between groups of symbols of a like nature.

A figure in brackets gives the number of the same symbol in publication 35 of the International Electrotechnical Commission, graphical symbols for heavy-current installations.

Motor generators and other heavy-current equipment used in light-current installations will be shown by the symbols in booklet 35 of the C.E.I.

B. *Representation in schematic drawings of moving parts.*

All schematic drawing should show the equipment in the unoperated position (without any current) unless specifically stated otherwise.

In drawing keys, relays and other switching devices it is permissible :

1. To show the springs immediately adjacent to the controlling device (button, coil, etc.).

2. To space out the springs from the controlling device and draw them parallel to and in alignment with it.

3. To disperse the springs in the diagram using reference letters corresponding to the controlling device.

C. *Use of general symbols and special symbols.*

1. A general symbol represents a group of components having common characteristics.

When this group can be divided into different categories a symbol particular to each category can be used either by adding to the general symbol a particular sign (sign, letter or group of letters) or when possible by associating with the general symbol a basic symbol defining the characteristic of the category concerned.

Certain of the symbols thus derived way he treated as general symbols from which may be derived by a similar process, further special symbols.

2. The use of special symbols is not obligatory when the information can be made sufficiently clear in some other manner (title, note, reference to a specification) or when the type of diagram indicates the special requirement.

3. In principle, only the information essential to the understanding of the diagram should be included.

4. If several variants are shown under the same title, the user may select the one preferred.

5. It is not always necessary to show the connecting lines to the symbols as drawn in the text. There is, however, often a general practice established by usage which should be respected.

6. In general, the symbols may be drawn at any angle or as a mirror image.

7. The more important parts may be indicated by thicker lines or by symbols drawn to a larger scale. The less important parts may be drawn to a smaller scale.

Question No. 4.

(8th Study Group in co-operation with the C.C.I.F. Symbols Committee, C.C.I.F. and C.E.I.) (Question No. 9 of the 8th S.G.) (Category A 1) [urgent] (continuation of Question No. 4 studied in 1950/1951)

1. Is it desirable to standardize diagrams showing the operation of relays in switching circuits ?

2. If so, what method is recommended ?

Note 1. — Different methods of drawing such diagrams are used by various firms and Administrations, so the question to be decided is :

(a) If the use of such diagrams is to be recommended.

(b) If so, is it desirable to recommend a standard method? It is only if there was an affirmative reply to these two questions of principle that a standardized method should be selected.

It should be noted that such diagrams could be used also in telegraphy and in other electrotechnical fields ; consequently this question should be studied by the C.C.I.F. in cooperation with the C.C.I.T. and C.E.I.

Note 2. — For the study of the question, it would be useful to take into consideration the following documents :

" C.C.I.F. — 1950/1951 — Symbols — Document No. 1 " : Remarks by the Dutch Administration concerning questions studied by the C.C.I.F. Study Group for letter and graphical symbols, in 1950/1951 (letters of 16 May 1951).

" C.C.I.F. — 1952/1954 — Symbols — Document No. 4 : Replies by the 8th S.G. (Geneva, October, 1953) to its Question No. 9 concerning the standardization of diagrams showing the successive operation of relays in switching diagrams (Question No. 4 of the Symbols Committee).

Question No. 5.

(In co-operation with the C.C.I.R.) (Category A 1) [urgent] (continuation of Question No. 5 studied in 1950/1951)

Wave-guide symbols.

Note 1. — For the study of this question, the proposals made by the British Administration reproduced in the attached Annex (Supplement No. 2 to British Standards No. 530, 1948) will be particularly considered.

In addition, account will also be taken of the Document " C.C.I.F. — 1952/1954 — Symbols — Document No. 7 " : Reply by the telephone Administration of the Federal German Republic to Question No. 5 of the C.C.I.F. Study Group for letter and graphical symbols.

Note 2. — This question must be studied by the C.C.I.F. in co-operation with the C.C.I.R.

ANNEX
(to Question No. 5)

Waveguide symbols to be used in diagrams
(Proposals by the British Administration)

The British Standards Institution has now published symbols for waveguides in Supplement No. 2 of BS 530, 1948. This document makes certain changes as compared with the joint draft given in the Annex to the present Question (*Yellow Book*, Volume I *bis*, pages 448 to 457).

This supplement is divided into two sections.

In *Section 1* (Symbols for use in circuit diagrams), two symbols are shown for each item.

The first symbol, in which the waveguide itself is represented by a pair of parallel lines, is recommended for use particularly in diagrams of actual apparatus (see example in Fig. 1).

The second symbol, in which the waveguide itself is represented by a single line, is recommended mainly for use in theoretical diagrams. Some of the " single-line " symbols are also suitable for use in installation diagrams (see Section 2 below). The single-line symbols are based on " Standards for Abbreviations, Graphical Symbols, Letter Symbols, and Mathematical Signs,' published in the United States by the Institute of Radio Engineers in 1948 (see example in Fig. 2).

In *Section 2* (symbols for use in installation diagrams) are listed a smaller number of symbols which are intended for use in diagrams showing the actual physical arrangement of a waveguide " run ".

Section 2 is prefaced by a list of symbols from Section 1 which, in single-line form, are suitable for installation diagrams.

General Notes

1. " Variability " arrows  or pre-set symbols  can be added where appropriate.

2. Y and Z are used to indicate admittance and impedance of unknown sign. They can be replaced by symbols for

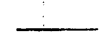
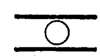
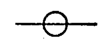
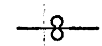
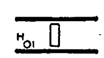
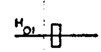
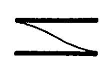
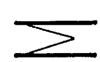
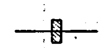
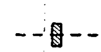
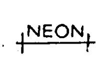
 resistance

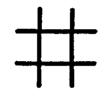
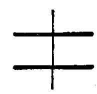
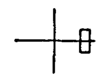
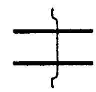
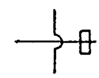
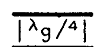
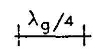
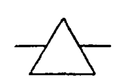
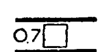
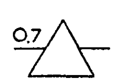
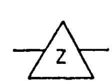
 inductance

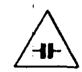
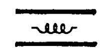
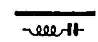
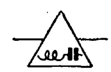
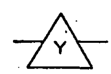
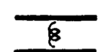
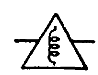
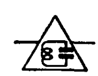
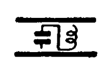
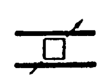
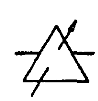
 or capacitance.

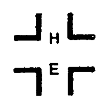
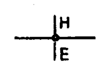
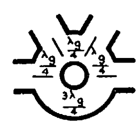
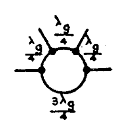
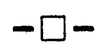
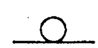
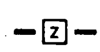
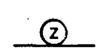
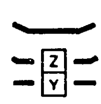
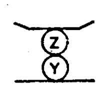
3. In the single-line symbols 112, 112 *a*, and 141 to 145, a rectangular cross-section is shown, to distinguish the waveguide from the conductor. If no confusion arises in a complete diagram, the cross-section need not be shown.

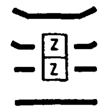
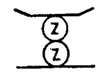
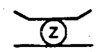
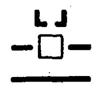
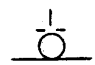
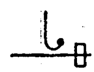
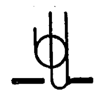
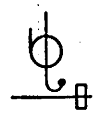
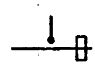
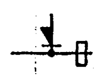
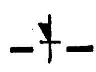
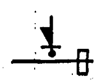
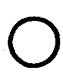
Section 1 — Symbols for use in circuit diagrams

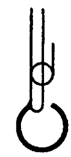
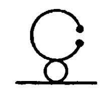
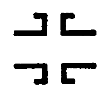
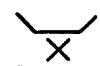
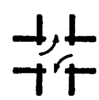
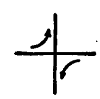
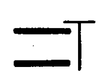
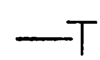
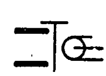
No.	NAME	SYMBOLS — Double line	SYMBOLS — Single line
	Group A. — Waveguides		
101	Waveguide *Note.* — Symbols indicating cross-section of the waveguide should be used at any change in cross-section, and may be added at any position where necessary Examples :		
102	Waveguide, rectangular		
103	Waveguide, circular		
104	Other cross-sections may be indicated, e.g. Dumb-bell		
105	Mode, indicate for example by E_{mn} or H_{mn} if necessary		
106	Twisted waveguide		
107	Tapering waveguide		
108	Waveguide, dielectric-filled Example :		
109	Dielectric waveguide, as distinct from 108 (above). Example :		
110	Waveguide, gas-filled. Indicate in words. Example :		

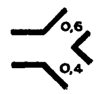
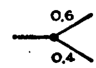
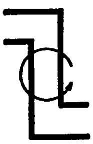
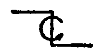
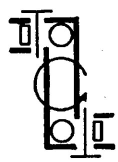
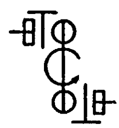
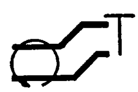
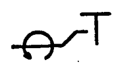
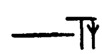
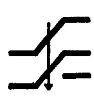
No.	NAME	SYMBOLS	
		Double line	Single line
111	Waveguides crossing on a diagram but not interconnected		
112	Lead-crossing waveguide		
112 A	Alternative symbol		
113	Special Characteristics. Indication of special characteristic (e.g. length) of part of waveguide (where necessary). Example :		
114	Changes of dimensions. These can be shown in the list of components, but are not to be shown by changes of size of waveguide in the drawing. Example : Characteristics (impedance, cut-off frequency, mode, etc.) can be inserted in the components list		 GUIDE / DIMENSIONS 1 / 3" × 1" 2 / 2" × 1"
	Group B. — Discontinuities		
115	Discontinuity		
116	*Note.* — When used as a matching device, the voltage standing wave ratio (V.S.W.R.) should be added, on the side at which power enters the device. Example :		
117	Series discontinuity, general symbol		
118 to 122	Examples (see Note 2 on p. 5)		

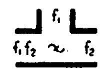
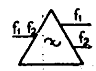
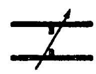
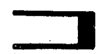
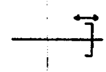
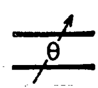
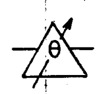
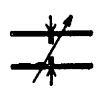
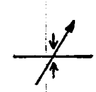
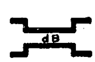
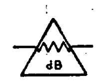
No.	NAME	SYMBOLS	
		Double line	Single line
118	Capacitive reactance		
119	Inductive reactance		
120	Infinite reactance at resonance		
121	Zero reactance at resonance		
122	Resistance		
123	Shunt discontinuity, general symbol		
124 to 128	Examples (see Note 2 on p. 5)		
124	Capacitive susceptance		
125	Inductive susceptance		
126	Zero susceptance at resonance		
127	Infinite susceptance at resonance (e.g. ring-mode filter)		
128	Conductance		
129	Variable discontinuity, general symbol *Note.* — Symbols 118-128 may also be used with " variability " arrow		

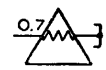
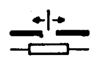
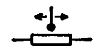
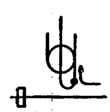
No.	NAME	SYMBOLS Double line	SYMBOLS Single line
	Group C. — Coupling and mode-changing devices		
	T-junctions. These have apertures of full waveguide size		
130	General symbol		
131	Series T		
132	Shunt T		
133	Hybrid T		
134	Hybrid ring		
	Windows, apertures of less than full waveguide size		
135	General symbol		
136	Shunt window		
137	Series window		
138	Series-shunt coupling by windows between two waveguides		

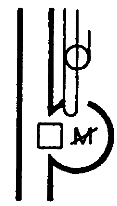
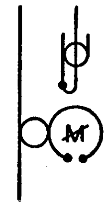
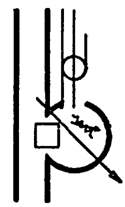
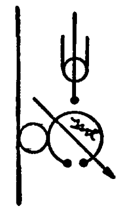
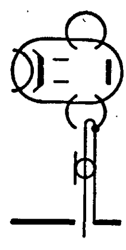
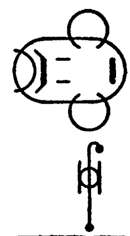
No.	NAME	SYMBOLL	
		Double line	Single line
139	Series-series coupling by windows between waveguides		
139 A	Alternative symbol		
140	Window coupling to branch waveguide *Note.* — For series or shunt coupling window insert Z or Y		
141	Coupling loop		
142	Coupling loop, showing coaxial cable		
143	Coupling probe		
144	Crystal rectifier in waveguide		
145	Crystal rectifier probe		
146	Cavity resonator *Note.* — Probes or other coupling devices should be added as required (see Nos. 184-186)		

No.	NAME	SYMBOLS	
		Double line	Single line
147	Loop coupling to cavity resonator		
148	Window coupling of cavity resonator to waveguide		
149	Choke coupling		
150	Directional coupler		
150 A	*Note.* — Directional arrows can be inserted to show direction of flow of power		
151	Mode changer		
152	Mode changer, circular to rectangular wave-guide		
153	Mode changer, waveguide to space		
154	Mode changer, waveguide to coaxial cable		
155	Mode suppressor, general symbol		

No.	NAME	SYMBOLS	
		Double line	Single line
156	Suppressed mode. The symbol of the suppressed mode (when known) may be indicated as in this example		
157	Diaphragm		
158	Power-divider : figures indicate ratio of division		
159	Rotating joint Changes in cross-section may be indicated (see example)		
159 A	Example :		
160	Crank *Note :* The portion with the arrow (indicating axis of rotation) is joined to the waveguide run		
161	Waveguide feeding aerial		
161 A	Or, if type of aerial is to be specified		
162	Switch, mechanical		

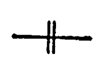
No.	NAME	SYMBOLS	
		Double line	Single line
163	Band-pass filter *Note.* — For other filters, see B.S. 530 : 1948, Nos. 207.1, 207.2 and 207,4		
164	Branching filter. Example :		
	Group D. — Adjusting and measuring Devices		
165	Iris		
166	Short circuit		
167	Piston *Note.* — The " variability " arrow or pre-set symbol, for variability or pre-set adjustment, may be added		
168	Matching rod, dielectric		
169	Matching rod, metal		
170	Line lengthener. Phase changer		
171	Squeeze section *Note.* — If necessary, add E or H to denote direction of squeeze		
172	Attenuator, cut-off *Note.* — Add number of db loss when necessary		
173	Attenuator, loss *Note.* — Add number of db loss when necessary		

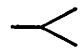
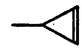
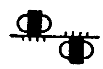
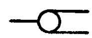
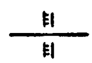
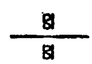
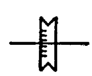
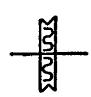
No.	NAME	SYMBOLS Double line	Single line
174	Termination *Note.* — Insert voltage standing-wave ratio (V.S.W.R.) if necessary		
175	Wedge termination		
176	Example : Water load	 WATER	 WATER
177	Slotted measuring section		
178	Sliding probe		
179	Standing wave indicator *Note.* — The abbreviation S.W.I. may be used in place of the sine-wave		
180	Bolometer mount (example showing thermistor)		
181	Wattmeter		
182	Calorimeter, water (example)	 WATER	 WATER
183	Reflectometer *Note.* — Arrow shows direction of flow of power into reflectometer		

No.	NAME	SYMBOLS	
		Double line	Single line
	Examples		
184	Resonator, with mode suppression coupled by a window to a waveguide and by a loop to a coaxial cable		
185	Resonator, with tuning and variable Q, coupled by a window to a waveguide and probe-coupled to a coaxial cable		
186	Klystron loop-coupled to coaxial cable which is probe-coupled to waveguide. (The klystron symbol is based on B.S. 530 : 1948, No. 93)		

Section 2 — Symbols for use in installation diagrams

In addition to the symbols shown below, the following single-line circuit symbols in Section 1 may be used: 101, 102, 103, 104, 106, 107, 108, 109, 143, 149, 152, 154, 159, 160, 162, 166, 167, 170, 171, 174, 175, 177, 178, 179, 181.

No.	NAME	SYMBOLS
201	Sealing material	
202	Sealed guide	
203	Shim	

No.	NAME	SYMBOLS
204	Electromagnetic horn (add *H* or *E* to indicate plane of flaring)	
205	Sealed horn	
206	Flexible guide	
207	Gas switch	
207 A	Example of use :	
208	Magnetron, simplified symbol	 MAGNETRON
	Flange Joints	
209	General symbol	
210	Flange joint, with shim	
211	Flange joint, with gasket	
	Screw couplings	
212	General symbol	
213	Screw coupling, with shim	
214	Screw coupling, with gasket	

No.	NAME	SYMBOLS
	Corners and bends A major corner or bend is in the plane of the H vector. A minor corner or bends is in the plane of the E vector.	
215	Corners, major 90° and minor 90°	90°H 90°E
216	Corners, major 45° and minor 45°	45°H 45°E
217	Bend, major 27°	27°H

FIGURE 1

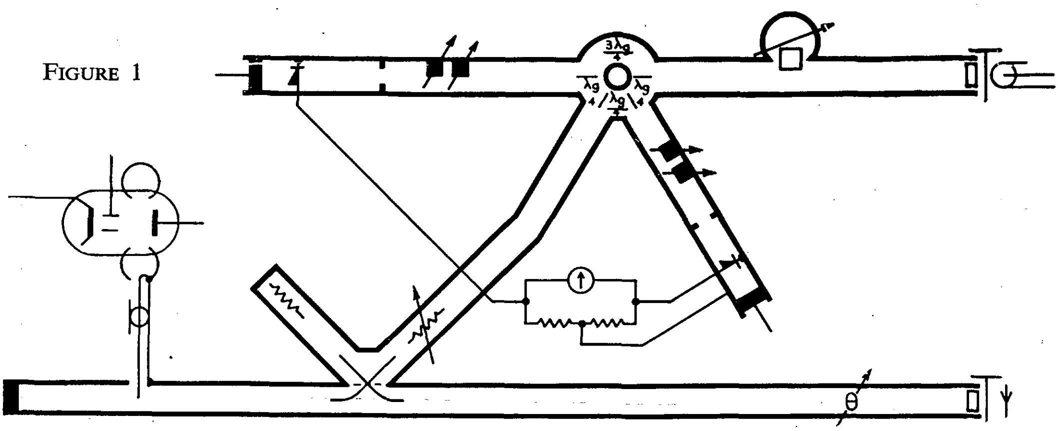
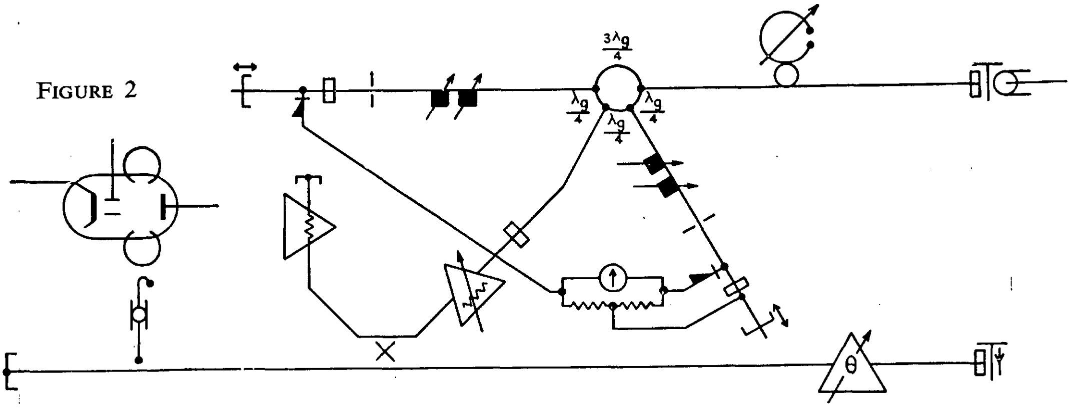


FIGURE 2



Question No. 6.

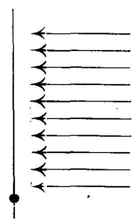
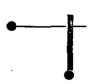
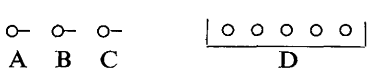
(Category A 1) [urgent] (continuation of Question No. 6 studied in 1950/1951)

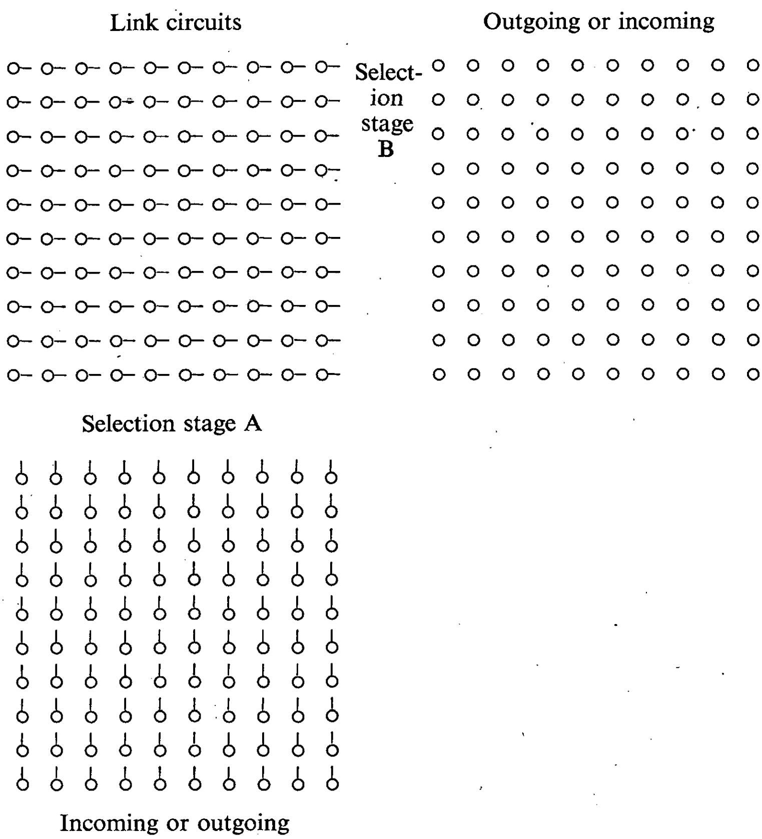
Symbols for crossbar systems.

Note. — See Annexes 1 and 2 which contain the proposals of the American Telephone and Telegraph Company and of the Swedish Administration.

ANNEX 1

Crossbar symbols used in Sweden

	Symbols	Signification	Remark
(1)		Part of a crossbar selector	For functional diagrams
(2)		Crossbar selector or unit of a crossbar selector	
(3)	○	Circuit	
(4)	○– ○ ○ ○ ○ ○	Method of showing what circuit can be connected to a particular circuit	
(5)		Method of showing that all of the circuits A, B, C are accessible to circuits D	

Symbols	Signification	Remark
(6) Selection in two stages A and B  		

ANNEX 2

" Crossbar " switching symbol used by the United States of America by the American Telephone & Telegraph Company

It has been necessary in the United States of America to have not only a graphical symbol for the crossbar switching system but also a symbol for the crossbar switch functioning as a selector.

Crossbar switch (functioning as a selector).

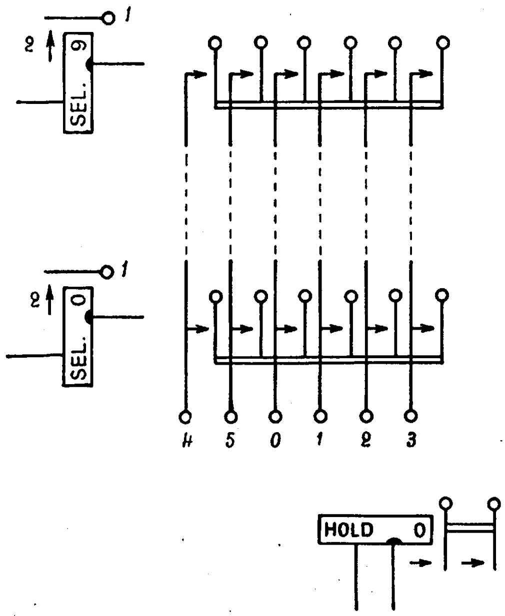
Notes:

(a) The selection relay (SEL) may be placed or the left on the right of the group of contacts in order to facilitate the drawing of cabling.

(b) The selection on holding relay contacts may be drawn on either side of the relay.

(c) The holding relay (HOLD) may be drawn underneath the selection relays (SEL) when the cabling of the terminals is effected vertically.

Crossbar switch (functioning as a selector)



SUMMARY

of the questions concerning letter and graphical symbols the study of which should be undertaken or continued in 1955, 1956 and 1957

Question No.	SUBJECT	CATEGORY	STUDY GROUP (other than the 10th S.G.) or other interested international organisations	OBSERVATIONS
1	Revision of the list of graphical symbols in Vol. IV of the *Yellow Book*	A 1		Urgent (continuation of former Question No. 7)
2	Letter symbols for the principal items in Acoustics	A 1	I.S.O. (Technical Committee No. 43)	The urgency depends on the preliminary study by the I.S.O. (continuation of former Question No. 2)
3	Guiding principles for the use of graphical symbols	A 1	C.C.I.R., C.C.I.T.	Urgent (continuation of former Question No. 3)
4	Relay operation diagrams	A 1	8th S.G. C.C.I.T., C.E.I.	Urgent (continuation of previous Question No. 4)
5	Wave guide symbols	A 1	C.C.I.R.	Urgent (continuation of previous Question No. 5)
6	" Crossbar " switching symbols	A 1		Urgent (continuation of previous Question No. 6)

LIST OF QUESTIONS

relating to definitions and the International vocabulary which the 11th Study Group of the C.C.I.F. should study in 1955, 1956 and 1957

This list includes only one question.

Question No. 1.

(11th Study Group in co-operation with the 8th S.G. of the C.C.I.F. with the C.C.I.T. and the C.C.I.R.) (Category A I [urgent] (new question)

Definitions of relay terms.

Note 1. — Document No. 3 — C.C.I.F. — 1952/1954 — Vocabulary — Contributed by the Netherlands Administration should be used as the basis for study.

Note 2. — The terms of interest in telephony which it is desirable to include in the Draft Glossary of definitions are the following :

Relay (Electrical)	Relais (électrique)
Thermal relay (electrothermal relay)	Relais thermique (électrothermique)
Static relay	Relais statique
Differential relay	Relais différentiel
Polarized relay	Relais polarisé
Shunt field relay	Relais à flux concourants
Winding	Enroulement
Coil	Bobine
Make contact	Contact de fermeture
Break contact	Contact de rupture
Changeover contact	Contact de rupture et fermeture
Armature clearance	Jeu d'armature
Contact follow	Accompagnement
Change over time	Temps de passage

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11th Study Group

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