COMITE CONSULTATIF INTERNATIONAL DES COMMUNICATIONS TELEPHONIQUES A GRANDE DISTANCE.

Plenary Session, Como, 5th–12th September, 1927.

English Edition,
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PREFACE TO THE ENGLISH EDITION.

This volume contains an unofficial translation of the official French text of the proceedings of the COMITE CONSULTATIF INTERNATIONAL DES COMMUNICATIONS TELEPHONIQUES A GRANDE DISTANCE (C.C.I.) at its Plenary Session in Como, 5th–12th September, 1927—with the exception of Section VI; *Questions concerning the protection of telephone cables against corrosion due to electrolysis or to chemical action*—which has been printed as a separate volume.

INTERNATIONAL STANDARD ELECTRIC CORPORATION.

COMITE CONSULTATIF INTERNATIONAL DES COMMUNICATIONS TELEPHONIQUES A GRANDE DISTANCE.

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* Printed as a separate volume.

GENERAL SUBJECT INDEX.

COMITE CONSULTATIF INTERNATIONAL DES COMMUNICATIONS TELEPHONIQUES A GRANDE DISTANCE.

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I.—LIST OF DELEGATES FROM ADMINISTRATIONS REPRESENTED.

GERMANY	Professor Dr. Breisig, Ministerial Councillor. Mr. Stegmann, Ministerial Councillor. Mr. Höpfner, Ministerial Councillor. Mr. Wiehl, Councillor, Higher Grade of Posts.
AUSTRIA	Mr. R. Heider, Ministerial Councillor. Mr. R. Oestreicher, Ministerial Councillor.
BELGIUM	Mr. J. Dethioux, Chief Engineer, Director-General of the Telegraph and Telephone Administration, Belgium. Mr. H. Fossion, Head of Department.
DENMARK	Mr. Gredsted, Chief of Division for International Development. Mr. K. Christiansen, Chief Engineer, Chief of the Technical Department.
SPAIN	Mr. A. Nieto y Gil, Inspector of Telegraphs, Chief of the Telegraph Department. Mr. G. Hombre y Chalbaud, Deputy Chief of Section, Chief of Telegraphic Development.
ESTHONIA	Not represented.
FINLAND	Not represented.
FRANCE	Mr. Milon, Chief Engineer, Director of Telephones, Ministry of Posts and Telegraphs. Mr. Drouet, Inspector-General, Director of "École Supérieure" and of the Investigation and Technical Research Service for Posts and Telegraphs. Mr. Rochas, Inspector-General of Posts and Telegraphs. Mr. Barillau, Deputy Director of Telephone Service. Mr. Lange, Chief Engineer, Director of Long-Distance Underground Line Service. Mr. Chavasse, Telegraph Engineer.
GREAT BRITAIN	Mr. H. Townshend, Principal, Secretary's Office, British Post Office. Mr. F. Strong, Principal, Accountant-General's Office, British Post Office. Mr. H. G. Trayfoot, Inspector of Traffic, British Post Office.

GREAT BRITAIN—*cont.*	Captain B. S. Cohen, Engineer, British Post Office. Mr. A. B. Hart, Engineer, British Post Office. Mr. C. Robinson, Engineer, British Post Office. Mr. S. C. Bartholomew, Engineer, British Post Office. Mr. B. J. Stevenson, Engineer, British Post Office. Mr. R. V. Hansford, Engineer, British Post Office.
HUNGARY	Mr. F. Kol, Under-Secretary of State, Head of Telegraph and Telephone Division. Dr. I. Tomits, Technical Adviser, Head of Electrical Section in the Experimental Department.
ITALY	Professor di Pirro, Director of the Experimental Institute for Communication, Telegraphic and Telephonic Sections. Mr. Magagnini, Engineer, Director of the State Telephone Services. Mr. Gorio, Engineer, Higher Grade Technical Inspector. Mr. Baldini, Technical Inspector for Communications.
LETTONIA	Not represented.
LITHUANIA	Not represented.
LUXEMBOURG	Mr. M. Klein, Engineer, Inspector of Telegraphs.
MOZAMBIQUE	Not represented.
NORWAY	Mr. S. Abild, Chief Engineer to the Telegraph Administration. Mr. M. Wahl, Secretary to the Telegraph Administration.
HOLLAND	Mr. S. J. J. H. Van Embden, Engineer-in-Chief of Telegraphs. Mr. H. J. Claasen, Chief of the Telephone Division. Mr. de Brauw, Engineer-in-Chief of Telegraphs. Mr. E. F. Petritsch, Engineer-in-Chief of Telegraphs. Mr. R. Santing, Assistant Director for Telegraphs and Telephones, Rotterdam. Mr. G. C. Snijders, Director, Municipal Telephone Service, Amsterdam.
POLAND	Mr. S. Zuchmantowitcz, Engineer, Ministerial Councillor. Mr. E. Jachimski, Engineer, Ministerial Councillor.
PORTUGAL	Not represented.
ROUMANIA	Mr. Constantinesco, Director of Telegraphic and Telephonic Development.
SERBS, CROATS AND SLOVENES.	Not represented.
SWEDEN	Mr. P. J. W. Hallgren, Head of Lines Section, Swedish Telegraph Administration. Mr. A. Lignell, Director of Telephones, Stockholm. Mr. A. V. A. Holmgren, Head of Department, Telegraph Administration.

SWITZERLAND	Mr. A. Muri, Head of Technical Section, General Administration of Telegraphs, Switzerland. Mr. J. Forrer, Head of Electro-technical Experimental Section and of Control of Material. Mr. Moeckli, Head of Telephone Department.
CZECHO-SLOVAKIA ..	Mr. S. Chocholin, Ministerial Councillor, Engineer. Mr. R. Prochazka, Ministerial Councillor, Engineer. Mr. F. Schneider, Technical Adviser, Engineer.
UNION OF SOVIET-SOCIALIST REPUBLICS.	Mr. Modenov, Member of the College of Posts, Telegraphs and Telephones. Mr. Chafranooski, Chief of the Telephone Service. Mr. Botcharov, Head of the Electrical Section in the Department of International Communications. Professor L. Kampe, Engineer-in-Chief of the Telephone System in Leningrad.

DELEGATES FROM ELECTRO-TECHNICAL COMMISSIONS.

1. International Electro-technical Commission.

Professor G. di Pirro, Member of the Italian Electro-technical Committee.
Professor E. Soleri, Member of the Italian Electro-technical Committee.

2. International Union of Railways.

Mr. Th. Muller, Assistant to the Principal Permanent Way Engineer of the Swiss Federal Railways.
Mr. Bachellery, Chief Engineer, in charge of Material and Traction in the Midi Railway Company, Paris.
Mr. Billing, Chief Engineer of the Swedish State Railway Telegraph and Telephone Service, Stockholm (Sweden).
Mr. Laigle, Chief Engineer of the Midi Railway Company, Paris, France.
Mr. A. Micarelli, Inspector (Higher Grade) in the Permanent Way Service of the Italian State Railways, Rome (Italy).
Mr. R. Regnoni, Chief Engineer of the Permanent Way Service of the Italian State Railways, Rome (Italy).
Mr. Schlemmer, Chief Councillor, Member of the Central Administration of the German Railways, Berlin (Germany).
Mr. Schulze, Chief Councillor, Member of the Central Administration of the German Railways, Berlin (Germany).
Mr. Thonet, Chief Engineer of the National Railway Company, Belgium.

3. International Union of Tramways, Local Railways and Public Motor Transport.

Observer.

Mr. J. Peridier, Director of Studies and Technical Control to the Joint Transport Company for the Paris Area.

4. International Union of Manufacturers and Suppliers of Electrical Energy.

Mr. Zangger, Head of the Technical Department of the Central Swiss Electrical Union.

5. Electrical Engineering Societies.

Mr. Heider, Electro-technical Society, Vienna (Austria).
Mr. R. Ettenreich, Electro-technical Society, Vienna (Austria).
Mr. Parodi, Consulting Engineer to the Orleans Railway Company, Paris (France).
Mr. Peridier, Director of Studies and Technical Control of the Transport Company jointly for the Paris area (France).
Mr. de Podoski, Engineer, Polish Electrical Society, Poland.
Mr. E. Velander, Secretary of the Electro-technical Department of the Swedish Electro-technical Society (Sweden).
Mr. Zangger, Swiss Society of Electricians (Switzerland).

Experts from the Private Industry engaged in the construction of telephone material, attending the Meetings of the 3rd and 4th Commissions of Assessors.

Mr. Krauskopf, Chief Councillor of Posts, German Long-Distance Cable Company (Germany).
Dr. Lüschen, Messrs. Pohlmann, Zastrow and Küpfmüller, Chief Engineers, Messrs. Siemens & Halske (Germany).
Doctors Schürer and Meyer, Messrs. Felten and Guilleaume, Carlswerk (Germany).
Doctors Jordan and Gehrts, The General Electricity Company (Germany).
Mr. Cahen, General Director of the Société d'Études pour Liaisons Téléphoniques et Télégraphiques à longue distance (France).
Messrs. Gill, Erikson, Catterson, Kaempf, The International Standard Electric Corporation (Great Britain).
Messrs. Hannam-Clark, Marris, Werren, Cobden-Turner, The General Electric Company, Ltd. (Great Britain).
Mr. Street, Messrs. Johnson and Philipps (Great Britain).
Mr. Harrison, The Automatic Telephone Manufacturing Company, Ltd. (Great Britain).

COMITE CONSULTATIF INTERNATIONAL DES COMMUNICATIONS TELEPHONIQUES A GRANDE DISTANCE.

Plenary Session, Como, 5th–12th September, 1927.

II.—MINUTES OF THE OPENING MEETING.

(5th September, 1927.)

The meeting opened at 10 o'clock.

Mr. di Pirro.—Mr. Valensi has just read to me a certain clause of the Regulations, which obliges me to be President for a few seconds. I take the opportunity to express my great pleasure in welcoming you in the name of my Minister, and to thank you again for agreeing to hold our annual conference here in the country of Alexander Volta, to whom we owe an instrument of our profession—the battery. You will not have the delights of Paris here; you must content yourselves with the lake, mountains and scenery, all of which will be excellent for your health.

During your visit here you will participate at the inauguration of the International Telegraph and Telephone Conference, which will take place at Como on Saturday, 10th September. On this occasion the Under-Secretary of State for Posts, Telegraphs and Telephones will have the pleasure of welcoming you.

On Sunday, 11th September, the solemn commemoration of the Centenary of Alexander Volta will take place, to which Members of the International Electro-technical Commission and of the International Telegraph and Telephone Conference will attend. In this way you will be in touch with men of high culture whom we wish to have as neighbours.

I must apologise for any inconveniences in your accommodation. We have had much anxiety on this subject. I have myself made a very great effort to have everyone well accommodated here, but there has been an overlapping of conferences, and the search has been difficult. I have endeavoured to arrange for you the best possible, not only because it was my duty to do so, but also for sentimental reasons, in view of the fact that I have known you for some time and that there are between us numerous bonds of friendship and sympathy.

Now, I must add that I do not see the smiling face of Colonel Purves, who has had to attend the Washington Conference. This is a kind of treason, but we will bear him no grudge, for we shall see him next year. Also, we miss our colleague, Mr. Santa Barbara, representing the Portuguese Colony, Mozambique, who died recently; we express our condolences to his family and his Government.

I hope all will go well with us here, and desire to express my wishes for the success of our Conference.

Gentlemen, the few seconds have elapsed, and I ask you to elect your President.

Mr. Milon.—I believe that I am expressing the wishes of all the Delegates in thanking Mr. di Pirro for the welcome given us at Como—a welcome worthy of the great Italian nation. Mr. di Pirro has just said that he regretted that he had not the delights of Paris to offer us, but, as he himself added, we have many others: a beautiful district and a splendid

situation; and we ought to thank Volta, not only for giving us our first working instrument, but also for having lived and died in such a beautiful country.

We have now to elect our President. You all know Mr. di Pirro, you have all been able to appreciate his competence and energy, and he is one of the members the most in touch with our Committee. I propose that we elect him unanimously as President of this Assembly.

The Assembly agreed to this resolution with applause, and Mr. di Pirro was unanimously elected.

Mr. di Pirro.—I think Mr. Milon should have been able to continue in office as President as he has so long held it with much competence and authority; but after this welcome I submit, and I will endeavour to do my best. Nevertheless, I wish to remind you of one of the fundamental rules of this Assembly, which provides for the possibility of nominating Vice-Presidents, and I ask you to nominate as Vice-President, specially for questions on corrosion, Doctor Breisig, and as Vice-President for questions relating to traffic and operating, Mr. Van Embden.

The Assembly approved by applause.

Dr. Breisig.—I thank you for your kindness and I accept this honour. I will do my best to lead the work on corrosion when this comes under discussion.

Mr. Van Embden.—I thank you for the confidence which you show in me and I hope that the discussions will always take place in the same cordial atmosphere.

Mr. di Pirro.—Finally, I will propose and nominate an Honorary Vice-President. This place is due to our President of the preceding year, Mr. Milon, who will thus occupy a place of honour and of rest.

This proposal was received with acclamation.

Mr. Milon.—I thank you for the honorary position that you offer me, and I am flattered to be your Honorary Vice-President, but I am sure that Messrs. di Pirro, Breisig and Van Embden will acquit themselves much better than I in the tasks in which thay have collaborated up to the present.

Mr. di Pirro.—It is still necessary to nominate Assistant Secretaries, who will assist our General Secretary. I propose **Messrs. di Pace** for traffic and operating questions, **Mocquart** for transmission questions, **Collet** for corrosion, and **Hubert** for the vocabulary and experiments relating to simultaneous and superimposed telegraphy and telephony.

The Assembly confirmed this proposal.

Mr. di Pirro.—I must call your attention to the fundamental clause of our regulations which says that the duty of the Plenary Assembly is to approve, reject or modify reports presented. By this new procedure the reports presented at the Plenary Assembly by Commissions of Assessors (*Rapporteurs*) (C.R.) will no longer be radically modified at the plenary meeting, but they will be sent to the competent Commission for a fresh examination. This procedure differs from that which was in force last year which enabled reports presented to be modified at the plenary meeting.

I have also another communication to make: my Minister has arranged for railway tickets with a 50 per cent. reduction for travelling throughout Italy to be put at the disposal of the Members of the Committee. There are also a certain number of free tickets for attending ceremonies in honour of Volta, which will take place in Rome. I shall request the different delegations to appoint representatives for these ceremonies, as the Administration, unfortunately, has not tickets available for all the Members.

Finally, it is desirable that our General Secretary should acquaint us with the provisional time-table that he has drawn up. Perhaps I shall modify it a little, but we will now listen to Mr. Valensi and I will speak later.

Mr. Valensi.—Before putting before you the provisional time-table which has been prepared, allow me to express in the name of the Secretariat the pleasure we feel in seeing you here. Allow me also to express to the Minister of Communications in the Italian Kingdom, to the General Director of Posts, Telegraphs and Telephones, to Mr. di Pirro and to all the officials of the Italian Administration, who have kindly helped in the preparation for this Conference, the respectful thanks from the Secretariat of the C.C.I. who found on arrival in Como large and well-equipped premises, not only for the Conference rooms, but also for the offices of the Secretariat. I also request Mr. di Pirro to express to the Italian Administration of the P.T.T. our gratitude for its generous contribution concerning the expenses of the C.C.I. officials for travelling and their stay at Como. I also wish to express our thanks to the executive Reception Committee who have very kindly prepared our accommodation.

Finally, I wish to propose to the Plenary Assembly that they send to-day telegrams of thanks to the Minister of Communications in the Italian Kingdom, to the General Director of Italian Posts and Telegraphs, to the Mayor of Como and Mr. E. Musa, Engineer, General Secretary of the Volta Committee.

The Assembly unanimously approved.

Mr. di Pirro.—In accordance with this suggestion, here is the text of the telegrams which are to be sent :—

"**His Excellency Admiral Costanzo Ciano, Minister of Communications, Rome.**

"The International Consultative Committee for Long Distance Communication inaugurating the Conference sends your Excellency respectful greetings and thanks for the support given in order that the annual Conference may take place in Italy, the native land of A. Volta.

"The President,
"Di Pirro."

"**Professor Commandant Pession, Director-General Posts and Telegraphs, Rome.**

"The International Consultative Committee for Long Distance Communication inaugurating its work sends your Excellency greetings, thanking the Administration of Posts and Telegraphs for organising the Conference at Como.

"The President,
"Di Pirro."

"**To the Honourable Baragiola, the Mayor of Como.**

"The International Consultative Committee for Long Distance Communication initiating its work sends sincere thanks to your Excellency for cordial hospitality offered in this city where A. Volta was born, and to whom the Committee gathered at Como desire to pay grateful homage.

"The President,
"Di Pirro."

"Volta Committee, General Secretary Engineer Musa.

"The International Consultative Committee for Long Distance Communication thanks your Committee for having rendered possible its Conference at Como, thus honouring the memory of A. Volta, whose achievements will inspire the deliberations.

"The President,

"DI PIRRO."

The assembly applauded at length.

Mr. Valensi.—A folder containing certain documents will be distributed to the chiefs of the delegations.

The first of these sheets is a provisional time-table of the Plenary Assembly. There are no sub-commissions this year, but more meetings of the Plenary Assembly, during which various questions of the programme will be discussed.

These questions can be grouped in three categories :

1. Questions of traffic and operating.
2. Questions of protection of cables against corrosion.
3. Transmission questions (concerning aerial lines and their cable sections, or reference systems for telephone transmission).

The provisional time-table provides three kinds of meetings for the Plenary Assembly : meetings reserved for traffic and operating questions, meetings relating to protection of cables, and meetings reserved for transmission questions.

In addition, a conference of the delegation chiefs has been arranged for Saturday, 10th September, to examine the management report and the budget report; but, as Mr. di Pirro has announced, the inaugural meeting of the Conference of Telegraph and Telephone technical experts being arranged for this day, it will be necessary to make a modification in the provisional time-table. Perhaps the questions on corrosion could be discussed by the Plenary Assembly in four meetings only; in this case the conference of the delegation chiefs could take place on Friday, 9th September, at 4 p.m. (in place of the fifth meeting on cable protection which had been planned).

However, this provisional time-table is a suggestion; it is for the Plenary Assembly to allocate the use of its own time.

The second sheet in the folder given to the delegation chiefs refers to the meetings of the Commissions of Assessors. The sub-commissions having been cancelled, as the President remarked just now, the Commissions of Assessors have replaced them and are at the disposal of the Plenary Assembly in order to modify any of the text which may not be approved by the Plenary Assembly.

The meetings of the Plenary Assembly will be of an explanatory nature, where the principal assessors will submit to all the Administrations the work of the Commissions of Assessors. As there are many Administrations who do not take part in these Commissions, it is possible that their delegates may present some new objections or observations. In this case, those not having the same point of view as the Assessors will be invited to be present at some additional meetings of the Commissions of Assessors, in the course of which, agreement being reached, it will be necessary to have a new text which will be referred to at the next meeting of the Plenary Assembly.

In addition to the Commissions of Assessors, formed in 1926, the meeting of a Mixed Commission (*Commission Mixte*) has been planned which is for experiments relating to simultaneous or superimposed telephony and telegraphy. This Mixed Telegraph and Telephone Commission will undertake to examine and, if convenient, prepare, a programme of

experiments to enable the numerical data to be verified which is contained in the recommendation relating to superimposed or simultaneous telegraphy and telephony in the same cable. This recommendation was issued both at the C.C.I. for Telephony and at the C.C.I. for Telegraphy.

Finally, on Friday, 9th September, from 3 p.m. to 5 p.m., a Commission will meet for the Telephone Vocabulary. This Commission will specify the method of work which will enable the final text of the Vocabulary of Telephone Expressions to be drawn up on the basis of the draft vocabulary recently sent by the Secretariat to all the Administrations of the C.C.I.

The third item of the file handed to the delegation chiefs is the list of questions to be discussed which was sent to all the Administrations last July.

The fourth item is a notice requesting the delegation chiefs to send to the Secretariat the official list of names and titles of members of their respective delegations, so that the correct list of the delegates may be made out in the final report of the Plenary Assembly.

Next, the folder also contains a note requesting each delegation chief to indicate the names of delegates in his delegation most particularly interested in questions relating to traffic and operating, protection of cables, transmission questions, or questions relating to the Vocabulary. Further, the delegation chiefs for Austria, Denmark, Italy and Czecho-Slovakia are requested to appoint some telephone experts who will meet with the telegraph experts already appointed by the Telegraph Administrations of Germany, Great Britain, Holland, Sweden and Switzerland, relative to the previous decisions of the Telephone and Telegraph Committees.

Finally, the file handed to the delegation chiefs contains the Administration Report of 1927, which gives the official account of the activity of the International Consultative Committee since the last Plenary Assembly of Paris, 1926, as well as a report on the budget. These two reports should form the subject of a discussion between the delegation chiefs during the meeting which will take place on Friday, 9th September, at 4 p.m.

On the suggestion of Dr. Breisig, chief of the German Delegation, the Assembly started a discussion on the subject of experts from private industrial companies attending the meetings of the Plenary Assembly, particularly meetings devoted to transmission questions.

At the end of this discussion it was decided by thirteen votes to four that the ruling of the C.C.I. (White Book, page 41, English translation, page 6), should be strictly adhered to, that is, that experts from private industrial companies for construction of telephone material may not attend meetings of the Plenary Assembly.

Nevertheless, as an exceptional case, each delegation at the 1927 Plenary Assembly at Como would be able to co-opt one expert only from the private industry.

Concerning the organisations that are grouped together as a State Administration and the industrial firms who manufacture telephone material, the Plenary Assembly considers that it is the duty of such a State Administration to decide, if it is desirable, that one representative of such an organisation may be a member of the delegation of this Administration to the C.C.I. as an official delegate.

The meeting closed at 11.30 a.m.

COMITE CONSULTATIF INTERNATIONAL DES COMMUNICATIONS TELEPHONIQUES A GRANDE DISTANCE.

Plenary Session, Como, 5th–12th September, 1927.

III.—QUESTIONS OF GENERAL ORGANISATION.

Distribution of Expenses incurred in the Operations of the Permanent Secretariat.*

The expenses incurred by the work of the Secretariat will be divided between the participating countries in accordance with the following table, in conformity with that adopted by the Universal Telegraph Union in 1925 :—

First Class	Germany, France, Great Britain, Italy and Union of Soviet-Socialist Republics.
Second Class	Spain and Poland.
Third Class	Belgium, Finland, Norway, Holland, Roumania, Kingdom of Serbs, Croats and Slovenes, Sweden and Czecho-Slovakia.
Fourth Class	Austria, Denmark, Hungary and Switzerland.
Fifth Class	Esthonia, Latvia, Lithuania and Portugal.
Sixth Class	Luxembourg and Mozambique.

The nations in the first class shall each pay 25 units; those of the second class 20 units; those of the third class 15 units; those of the fourth class 10 units; those of the fifth class 5 units, and those of the sixth class 3 units.

The contributing shares will be paid in advance on the 1st of January of each year by cheque or warrant (*virement de compte*) in gold francs.

The total annual expenditure shall not exceed 100,000 gold francs.

Vocabulary of Expressions used in Telephony.

The International Consultative Committee—

Considering :—

That the publication of the Official Vocabulary of expressions used in Telephony should be undertaken in the shortest time possible.

That it is convenient in the first place to have the draft Vocabulary already drawn up revised by the Administration interested.

That this work of revision will not be able to be completed and classified before the next Plenary Assembly.

That only at this time can the form and conditions which the publication of the final text is to take be decided.

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* This text replaces that appearing under the same title on page 43 of the White Book (C.C.I., 1926), page 8, English translation.

Unanimously advises :—

That the method to be followed for the revision of the draft Vocabulary may be fixed as follows :—

The draft Vocabulary of Expressions used in Telephony which has been sent by the Secretariat to all Administrations attending the International Consultative Committee will undergo detailed revision in each country.

For this revision each Administration will be assured of the collaboration of organisations or experts whom they may consider necessary to consult. Whatever the particular method adopted, this revision, when in the form sent to the Secretariat, will be considered as the final form in their own language from the countries interested.

The draft Vocabulary thus revised will be returned to the General Secretary. In their reply each Administration will state in particular :—

(*a*) The expressions appearing in the present draft which it proposes to cancel, either because these expressions do not belong exclusively to the subject of telephony or because they have no particular telephonic meaning in their own language.

(*b*) Expressions about which a doubt arises in making the exact French term correspond with the language under consideration and when this French term should have a more complete or more explicit definition. The Administration will suggest at the same time (and subject to later explanations), if necessary by drawing or diagram, the term which appears to them to correspond best with the French term.

(*c*) Expressions not appearing in the present draft and which, on the advice of the Administration interested, ought to be incorporated in this draft.

These expressions will be accompanied by a definition as accurate as possible.

This work of revision will be undertaken—

(*a*) by the German, French, British and Swedish Administrations, whose languages already appear in the draft Vocabulary;

(*b*) by the Spanish, Italian and Union of Soviet-Socialist Republics, who will complete this draft in their respective languages.

The other Administrations are invited to study the draft Vocabulary which has been submitted to them, and will be able, if they so desire, to include in it the corresponding terms of their own language.

The draft Vocabulary thus revised should reach the Secretariat before 1st March, 1928, in order that the latter may collate the replies and prepare in good time a revised draft Vocabulary for the next Plenary Assembly. Replies received after this date cannot be taken into consideration during this Assembly.

This Plenary Assembly will have to determine the method according to which the final text of the official Vocabulary will be prepared, also the form in which it will be presented and the organisation or company entrusted with the work of editing it.

It will specially decide if this text can be incorporated, partially or wholly, with the Electro-technical Vocabulary of the International Electro-technical Commission, or if, on the contrary, it shall form the subject of a separate publication.

Permanent Staff Regulations for the Secretariat of the International Consultative Committee for Long Distance Communication.

The International Consultative Committee is examining this question, which will form the subject of a discussion during the Plenary Assembly of 1928.

COMITE CONSULTATIF INTERNATIONAL DES COMMUNICATIONS TELEPHONIQUES A GRANDE DISTANCE.

Plenary Session, Como, September 5th–12th, 1927.

IV.—QUESTIONS CONCERNING TRANSMISSION, MAINTENANCE AND SUPERVISION OF LINES AND INSTALLATIONS.

A.a.2.

Practical limits of Transmission Equivalents.

The International Consultative Committee—

Unanimously advises* :—

(1) That it is desirable the transmission equivalent between two subscribers involved in an international communication shall not exceed 3·3 népers or 29 decibels.

(2) That transmission equivalent of the international circuit, including the line transformers, shall not exceed 1·3 néper or 11·3 decibels.

(3) That the total losses occurring between the subscriber and the terminals of the input transformer of the international circuit shall not ordinarily exceed 1 néper or 8·6 decibels, in order that any subscriber in one country may be connected to any subscriber in another country.

The losses due to secondary long distance lines, intermediate offices, auxiliary apparatus connected in series or in shunt and the subscriber's loop shall be included in the total losses occurring between the subscriber and the terminals of the input transformer of the international line.

The above losses do not include battery supply losses.

NOTE.—When the Standard Reference System which has been adopted is available, it will be necessary to define the transmission equivalent of the entire circuit between the subscriber and the terminals of the input transformer of the international line.

(4) That the maximum value allowable for transmission loss at a junction point on an international line caused by signalling or control apparatus (electro-magnets, resistances, condensers, keys, monitoring receivers and office cabling in the toll exchange) shall not exceed 0·2 néper or 1·7 decibel in the frequency range 300–2,500 p.p.s., estimating the losses due to signalling apparatus at approximately 0·05 néper or 0·43 decibel, those due to control apparatus at approximately 0·09 néper or 0·77 decibel, and to office cabling in the toll exchange at approximately 0·06 néper or 0·51 decibel.

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* These recommendations replace those appearing under the same heading on page 68 of the White Book (C.C.I., 1926), English Translation, page 29.

GENERAL CONDITIONS TO BE FULFILLED BY OPEN-WIRE LINES USED FOR INTERNATIONAL COMMUNICATIONS.

A.d.1.

Setting up of Open-wire Lines*.

The C.C.I.—

Considering :—

That the setting up of international telephone communications over long distance necessitates at present in certain countries the use of open-wire lines.

That the greatest efficiency of these lines will be obtained if phantom circuits are used and, in addition, repeaters and also carrier systems.

That in order to ensure satisfactory operation of these various arrangements as well as to avoid the introduction of losses due to reflection, it is essential that the circuits should be balanced and that the electrical constants should be uniformly distributed over the whole length of the lines between two repeater stations.

That it is very important to construct the open-wire lines in such a way as to ensure continuity of service and satisfactory operation.

That it is not possible to give general and permanent definitions of the geometric or mechanical constants of the lines, since the choice of these constants depends not only on the electrical characteristics but also on economic factors which may vary from time to time and from country to country.

Unanimously recommends :—

(*a*) Concerning the mechanical qualities of the open-wire lines :

(1) That for the construction of long open-wire lines for international service conductors of at least 3 mm. diameter and having a sufficiently high mechanical resistance to reduce the chances of breaking to a minimum shall be employed.

(2) That the strength of the pole line shall be great enough to withstand with as great a margin of safety as possible the greatest load caused by wind, frost or snow.

(*b*) Concerning the electrical qualities of the open-wire lines :

(1) That the conductors shall be of copper or of an alloy of copper the conductivity of which shall not differ from that of high conductivity copper by more than 10 per cent., or of a metal or alloy which has the same advantages and satisfies the conditions mentioned above.

(2) That in a section of line between two successive repeaters or between a repeater station and the neighbouring terminal station, the metal, the diameter of, and the distance between, the conductors of a long distance telephone circuit shall remain the same in order to assure a satisfactory degree of regularity (*see* Appendices 1*a*, 1*b*, 1*c* and 1*d*). In order to ensure satisfactory regularity, the deviation of the impedance (as a function of the frequency) from the mean curve shall not exceed 5 per cent. This deviation shall be calculated in accordance with the definition in the White Book, page 151, English Translation, page 99.

(3) That all joints on an open-wire line shall be made in such a way as not to introduce variable resistance.

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* These recommendations replace those concerning the establishment of open-wire lines on pages 93–94 of the White Book, English Translation, page 45.

(4) That in any section of line between repeater stations or between a repeater station and the neighbouring terminal station, the resistance unbalance of the two wires of any pair measured with direct current shall not be greater than 2 ohms.

(5) That in order to avoid trouble due to cross-talk or interference from heavy current or high-tension power lines or from telegraph circuits, long distance international telephone circuits shall have transpositions or rotations so made that the length over which neutralisation between any two of these circuits is complete shall be less than 100 km. In the case of carrier systems or interference from heavy current or high-tension power lines or parallels with telegraph circuits it may be advisable to reduce the length of the "barrel."

(6) That so far as concerns dangers and operating troubles due to heavy current or high-tension power lines, the telephone circuits shall satisfy the conditions indicated in the "Guiding Principles concerning measures to be taken in order to protect telephone lines against the disturbing influences of heavy current or high-tension power lines," published by the C.C.I. (Paris, 1926).

(7) That the insulation resistance of each wire from earth shall not fall below the value of 1 megohm per km., which experience in several countries has shown to be a practicable value for normal conditions of humidity, the maintenance of this insulation resistance being possible by the use of double-groove insulators of suitable design. This value may be decreased in exceptionally damp districts.

(8) That the transmission equivalent of the line between two successive repeater stations or between a repeater station and the neighbouring terminal station shall not exceed 1·6 néper or 13·9 decibels.

(9) The circuits shall be brought out to testing points in accordance with the recommendations of the C.C.I. in the White Book, page 100 ("Testing points on international circuits"), English Translation, page 53.

A.d.3.

General conditions to be fulfilled by sections of cable inserted in open-wire lines so far as loss of efficiency and impedance irregularities are concerned.*

The International Consultative Committee—

Considering:—

That on mixed lines—that is to say, those comprising both open-wire lines and cable sections—it is difficult to obtain stable and efficient operation of the repeaters;

That there are always reflection losses at the junction of lines having different characteristics which reduce the total efficiency of the circuit; that the insertion of heterogeneous sections, even of very short length (through tunnels, passing through large towns, etc.) in telephone lines is, according to experience gained by certain countries represented on the International Consultative Committee, of such a nature as seriously to interfere with the development of long distance telephony owing to disturbances affecting the operation of the repeaters and high-frequency telephone systems; that it is, therefore, advisable to avoid this procedure except where it is impossible to do otherwise;

That, nevertheless, certain cases of this kind may involve the necessity for such practices, but that it would then be best to take special precautions;

* This replaces the recommendation entitled "General recommendations concerning mixed lines" (White Book, C.C.I., 1926, page 97), English Translation, page 49.

Unanimously advises :—

(1) That, so far as possible, it is desirable to avoid the use of mixed lines for international long-distance telephony.

(2) That if it is impossible to avoid mixed lines, efforts should be made to reduce reflection effects as much as possible by using, for example, Krarup loaded cable or cable loaded according to the rules set out below for the construction and loading of cable inserted in open-wire lines.

Rules for the Construction and Loading of Cables inserted in Open-wire Lines.

The C.C.I.—

Unanimously advises :—

(1) That any section of cable longer than 100 metres which is inserted in an open-wire line should be constructed specially to satisfy the following conditions :—

(2) That the difference $2\,\frac{Z_1 - Z_2}{Z_1 + Z_2}$ between the impedance Z_1 of a section of mixed line between repeater stations or between a repeater station and the adjacent terminal station, and the impedance of a homogeneous open-wire section or of the balancing network, shall not exceed 5 per cent. (measured from the ends of the section) for any frequency between 300 and 2,500 p.p.s.

This condition can be satisfied, according to the length and number of intermediate cables, by the use of Krarup cables or light loaded cables (*see* (4) below) or by medium loaded cables terminated by networks designed to adapt the impedances of cable and open-wire line (*see* (5) below).

(3) That the electrical characteristics of a cable inserted in an open-wire line should be such that—

$\frac{R_1}{R} = \frac{L_1}{L} = \frac{C_1}{C}$ where R_1, L_1 and C_1 represent the resistance, inductance and capacity of the cable, and R, L and C the corresponding values for the open-wire line. The leakance is not considered as its effect is very small and variable.

(4) That for sections of cable there should be used—

Either Krarup loaded cables—notably for one or more short sections of cable in the same circuit—whose electrical characteristics R, L and C conform to the conditions given in Section 3;

Or cables loaded so that the electrical characteristics R, L and C conform to the conditions given in Section 3, and having a cut-off frequency such that the conditions given in Section 2 are met.

If there are several sections of cable in the same open-wire circuit, the limiting frequency of the different cable sections shall be increased in order to fulfil the conditions given in Section 2.

(5) That where very long cables are inserted in the line, economic consideration may be given to the use of medium loaded cable terminated at each end by a "Supplementary Balancing Network," designed to adapt the impedance of the cable to that of the open-wire line within the limits of the frequencies to be transmitted, with lower balance limits than allowed in paragraph (2) above.

This proceeding will avoid difficulties in certain cases.

(6) In the Appendices 2 and 3 details are given of two methods of calculating the data of Krarup loaded cables (or lump loaded cables) which may or may not be fitted with supplementary balancing networks designed to adapt the cable and open-wire impedances in order to ensure that the conditions outlined above are met.

(7) The foregoing notes do not apply to circuits for use with carrier currents. Underground sections should be avoided as far as possible on such circuits, but when inevitable they should be specially designed.

(8) Appendices 2 and 3 are applicable also to sections of cable inserted in existing open-wire lines.

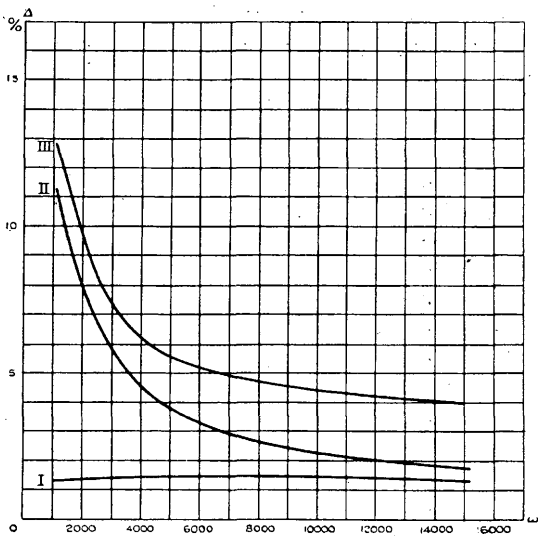
Appendix 1a

VARIATION IN THE IMPEDANCE OF A CIRCUIT MADE UP OF OPEN-WIRE LINES OF DIFFERENT CONSTRUCTION.

DISTANCE OF JUNCTION POINT EQUIVALENT TO $\beta l = 0.6$ NÉPER.

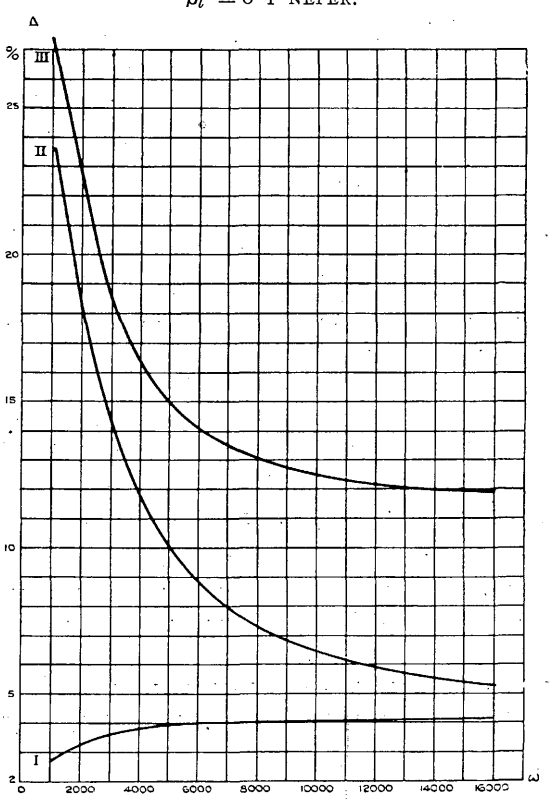
Diameter of Conductors : d_1, d_2.
Distance of Conductors : a_1, a_2.

I.—$d_1 = d_2 = 3$mm.....$a_1 = 30$cm.....$a_2 = 40$cm.
II.—$d_1 = 3$mm.....$d_2 = 4$mm.....$a_1 = a_2 = 30$cm.
III.—$d_1 = 3$mm.....$d_2 = 4$mm....$a_1 = 50$cm.....$a_2 = 30$cm.



Appendix 1b.

DISTANCE OF JUNCTION POINT EQUIVALENT TO $\beta l = 0.1$ NÉPER.

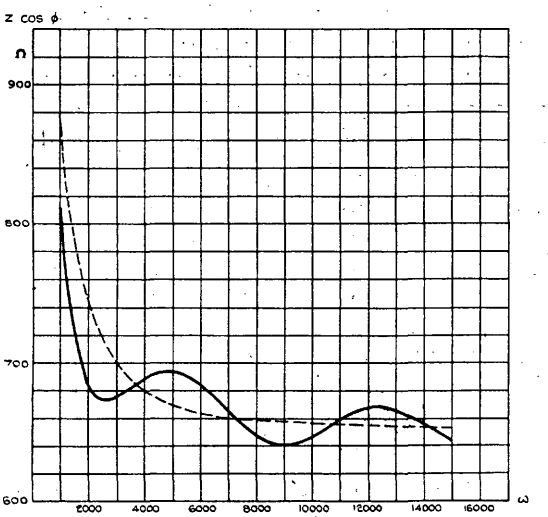


Appendix 1c

IMPEDANCE OF A CIRCUIT MADE UP OF TWO OPEN WIRE LINES OF 3 AND 4 mm. RESPECTIVELY.

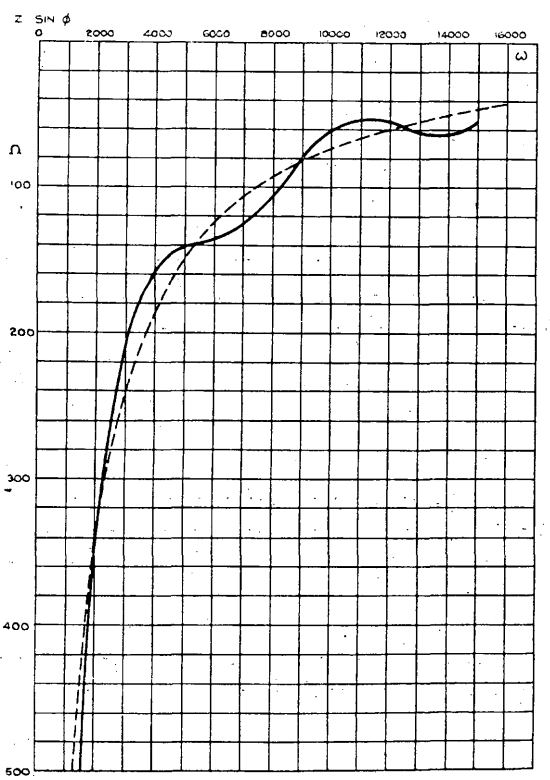
DISTANCE OF JUNCTION POINT EQUIVALENT TO $\beta l = 0.6$ NÉPER.

REAL COMPONENT.



Appendix 1d.
(continuation of Appendix 1c).

IMAGINARY COMPONENT.



APPENDIX 2.

NOTES BY MESSRS. SIEMENS AND HALSKE (CENTRAL LABORATORIES) ON THE INSERTION OF A SECTION OF CABLE IN AN OPEN-WIRE LINE.

In the following notes is described an investigation which has been made as to the methods to be adopted for connecting open-wire lines to cable circuits with a minimum reflection effect at the junction.

Fig. 1 shows the theoretical impedance curves for an open-wire line (Curve 1) and a loaded cable (Curve 2), both the real ($Z \cos \phi$) and imaginary ($Z \sin \phi$) components being shown. The calculations are made as described below.

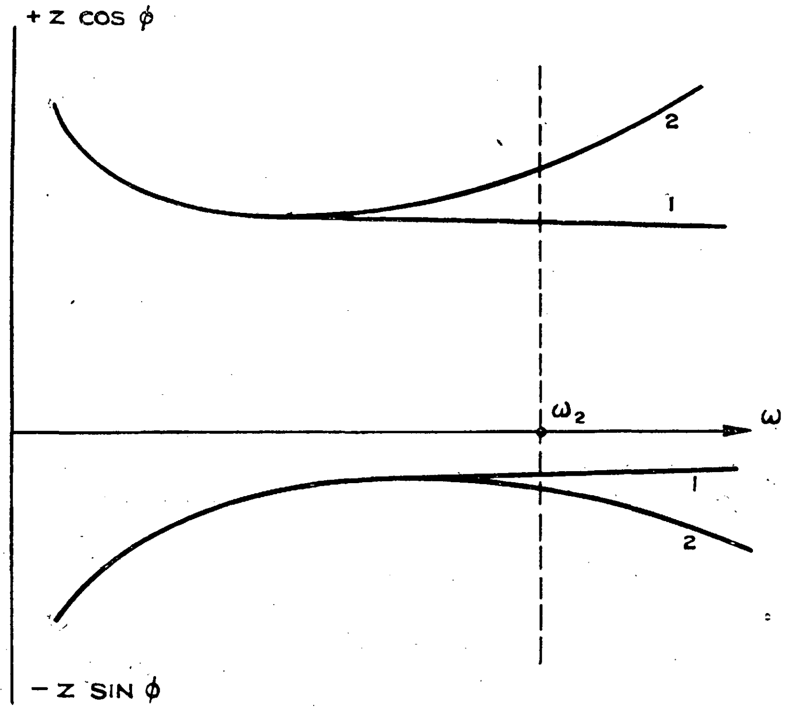


FIG. 1.

I.—CALCULATION OF KILOMETRIC CONSTANTS.

Let R, L, K and G be the constants of the aerial line (Curve 1) or of the cable (Curve 2); at the low and middle frequencies the impedances will agree if

$$\frac{R_1}{L_1} - \frac{G_1}{K_1} = \frac{R_2}{L_2} - \frac{G_2}{K_2} \quad \ldots\ldots (1)$$

$$\frac{L_1}{K_1} = \frac{L_2}{K_2} \quad \ldots\ldots (2)$$

If equation (1) is satisfied the two impedance frequency curves will have the same shape, and if equation (2) is satisfied the absolute values of the impedance will be the same.

Although perfect agreement can be obtained at the low frequencies, increasing discrepancies appear at the higher frequencies due to the fact that the cable is lump-loaded (*see* Figs. 1 and 2).

The smallest discrepancies are obtained if the error made in reproducing the impedance of the open-wire line be known and if the constants of the cable are so chosen that this

error is equal to $+\Delta$ for the highest frequencies to be transmitted, and to $-\Delta$ for the lowest frequencies.

This is equivalent to saying that the inductance of the cable should be 2Δ below that indicated by equation (2).

Equation (2) would thus become—

$$\frac{L_2}{K_2} = \frac{L_1}{K_1}(1 - 2\Delta) \quad \ldots\ldots (3)$$

In practice the capacity K_2 and the leakance G_2 of the cable are known. Equations (1) and (3) thus allow the resistance R_2 and the inductance per kilometre of the cable to be calculated from the known constants of the open-wire line.

Solving equations (1) and (3) we obtain—

$$R_2 = L_1\left(\frac{R_1}{L_1} - \frac{G_1}{K_1} + \frac{G_2}{K_2}\right)\frac{K_2}{K_1}(1 - 2\Delta) \quad \ldots\ldots (4)$$

$$L_2 = L_1\frac{K_2}{K_1}(1 - 2\Delta) \quad \ldots\ldots (5)$$

The constants of usual types of open-wire line (3 mm. bronze) and cable are as follows :—

Open Wire.	*Cable.*
$R_1 = 5{\cdot}4$ ohms per km.	R_2 } to be calculated from equations (4)
$L_1 = 2{\cdot}0$ mh. per km.	L_2 } and (5).
$K_1 = 0{\cdot}006\ \mu$F. per km.	$K_2 = 0{\cdot}036\ \mu$F. per km.
$G_1 = 1{\cdot}0$ micromh. per km.	$G_2 = 0{\cdot}6$ micromh. per km.

Given that the maximum permissible value for the error in impedance is $\Delta = 0{\cdot}05$, it will be seen from equations (4) and (5) that :

$$R_2 = 27{\cdot}4 \text{ ohms per km.}$$
$$L_2 = 10{\cdot}8 \text{ mh. per km.}$$

In order to find the inductance per km. to be added by means of loading coils, and the conductor resistance, it is necessary to subtract from the above values the inductance of the conductors (0·8 mh.) and the effective resistance of the loading coils. In view of the low inductance in this case the time constant T is of the order of 0·01. Thus, in calculating R_2, it is necessary to subtract $\frac{L_2}{T} = 1{\cdot}1$ ohms, thereby obtaining—

Resistance per km. of cable conductors .. .. 26·3 ohms.
Inductance per km. of loading coil .. .. 10·0 mh.

The table given below shows the relation between the resistance per km. and the diameter of cable conductors.

Diameter of Conductors.	Resistance in ohms per km.
0·9 mm.	55·6
1·0 mm.	45·0
1·1 mm.	36·2
1·2 mm.	31·3
1·3 mm.	26·6
1·4 mm.	23·0
1·5 mm.	20·0

II.—CALCULATION OF THE ERROR Δ MADE IN THE MATCHING OF THE IMPEDANCE OF THE LINE.

In addition to the different impedances of different types of open-wire lines there are other causes of the errors made in matching. These are :—

(1) That the cable is lump-loaded and that, consequently, its impedance increases at the higher frequencies.

(2) That the loading coil spacing departs in practice from the nominal theoretical value.

(3) That the actual cable conductor resistance does not correspond exactly with the theoretical.

1. Imperfections in Matching due to Errors in Resistance and Inductance.

An error Δ_R in the resistance R_2 from the theoretical value of resistance and an error Δ_L in the inductance L_2 from the theoretical value of inductance cause an error in impedance matching which is given by the formula :—

$$\Delta_Z = \tfrac{1}{2}\left(\Delta_L + \frac{R}{j\omega L}\Delta_R\right) \quad \ldots\ldots(6)$$

It is seen that Δ_L determines the real part of the impedance and Δ_R the imaginary part.

For R and L the constants of either cable or open-wire line may be taken, for equation (1) shows that for both cases the ratio $\frac{R}{L}$ is approximately the same. In order that the impedance error at the lower limit ($\omega_1 = 2000$) of frequencies transmitted should not be greater than 5 per cent., Δ_R must not be greater than 7·4 per cent.

2. Errors in matching due to the Cable being Lump-Loaded.

Let S represent the loading spacing.

The error in matching for the higher limit ω_2 of the range in which distortion is compensated is given approximately by :—

$$\Delta = L_2 K_2 \left(\frac{S\omega_2}{4}\right)^2 \quad \ldots\ldots(7)$$

from which may be derived the spacing corresponding to a given error in impedance matching.

$$S = \frac{4}{\omega_2}\sqrt{\frac{\Delta}{L_2 K_2}} \quad \ldots\ldots(8)$$

If $L_2 = 10{\cdot}8$ mh., $K_2 = 0{\cdot}036$ μF, and $\omega_2 = 15{,}000$, the following table of loading coil spacings may be drawn up :—

Δ	0·01	0·02	0·03	0·05	0·10	0·15
S (Km.)	1·36	1·93	2·35	3·04	4·30	5·27
ω_0 (Cut-off Frequency)	75,000	53,000	44,000	34,000	24,000	19,000

An error in matching of the order of 5 per cent. appearing allowable, a suitable loading would consist of 30 mh. coils at intervals of 3 km.

3. Errors in Matching due to Inaccuracies in Loading Spacing from Theoretical Value.

If no loading coils other than 30 mh. were used it would only be possible to load cables having lengths of 3, 6, 9, etc., km.

For intermediate lengths (*e.g.*, $7\frac{1}{2}$ km.) a 15 mh. coil must be used as well; in such a case the coils would be spaced as shown in Fig. 2.

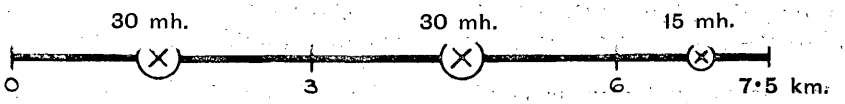


FIG. 2.

In general, the following method is followed :—

Let l be the lengths of the cable in km. and L (10 mh.) the calculated coil inductance. The coil having the lowest inductance being a 15 mh. coil, the number n of such coils for this cable would be $n = l\frac{L}{15}$.

Since n can only be a whole number, the nearest whole number n_0 will be taken. Then all the loading coil spacings will be made equal: instead of two coils of 15 mh. it is more convenient to use a 30 mh. coil at double the spacing.

If n is not a whole number the actual spacing will differ from the theoretical spacing, and there will be an error in reproduction—

$$\Delta_s = \left|\frac{n - n_0}{n + n_0}\right| \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

Under the most unfavourable conditions $n - n_0 = \frac{1}{2}$, thus Δ_s decreases as the number of coils increases.

Fig. 3 shows the value Δ_s plotted against cable length for the cable being considered. (Diameter of cable conductor 1·4 mm. $L_2 = 10$ mh. per km.)

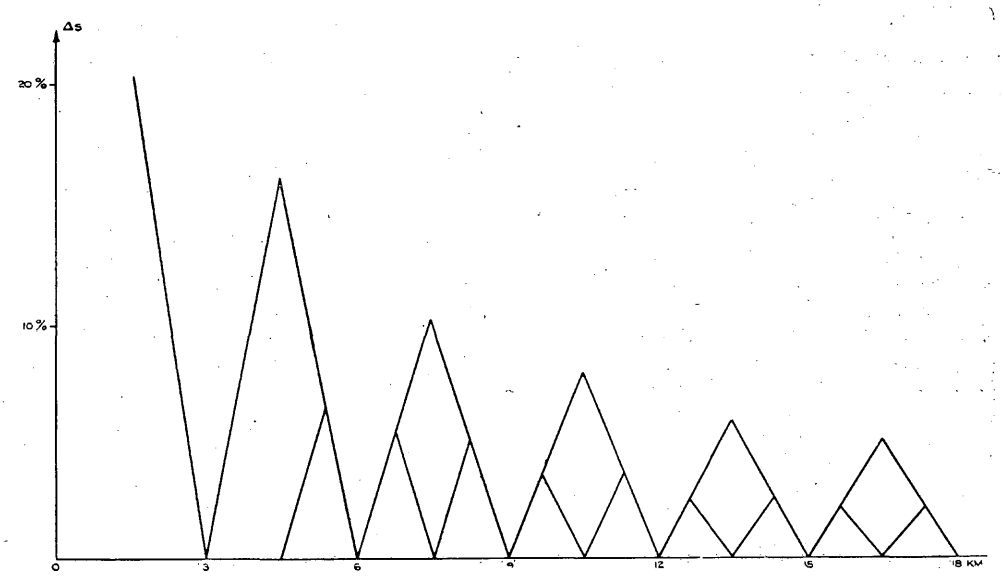


FIG. 3.

The error Δ_s becomes zero for all lengths which are multiples of 1·5 km.; for small lengths it becomes quite large.

Since the errors in matching Δ_z (equation 6 for the inductance and the resistance), Δ (equation 7 for the lump-loading effect) and Δ_s (equation 9 for the loading spacing) are additive, Δ_s should not exceed 2 per cent. Fig. 2 shows that if 30 and 15 mh. coils are used it will only be on cables longer than 18 km. For shorter lengths condensers must be used in order to bring the electrical length of the cable to a multiple of 1·5 km.

Further, the necessity for using condensers depends on the attenuation b between the junction point of cable and open wire and the repeater station, for the reflected current (echoes) are attenuated by an amount e^{-2b} before reaching the repeater station, and it is only these currents which have effect on the possibility of balancing the line exactly.

Let A and B represent two successive repeater stations, and CB the length of line to be carried through a cable.

FIG. 4.

From equation (9) the error in matching which is effective at B is—

$$\Delta_s = \left| \frac{n - n_0}{n + n_0} \right| e^{-2b} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10)$$

Condensers must be used if Δ_s thus calculated comes out to more than 0·02. Consequently condensers will have to be applied where the cable lengths are $l = (4{\cdot}8 + 5{\cdot}7)$ and $(6{\cdot}5 + 6{\cdot}9)$ km.

If between the cable and the repeater station there is an open-wire line of attenuation b, condensers will be necessary for the following lengths (expressed in km.) :—

b between 0 and 0·2.	b between 0·2 and 0·4.	b between 0·4 and 0·6.	b between 0·6 and 0·8.
4·7– 5·8	4·8– 5·7	4·9–5·5	5·1–5·3
6·2– 7·2	6·4– 7·1	6·5–6·9	
7·8– 8·6	8·0– 8·5	8·2–8·3	
9·4–10·1	9·5– 9·9		
10·9–11·5	11·1–11·3		
12·5–13·0			
14·0–14·4			
15·6–15·8			
17·2–17·3			

The cable would be loaded in accordance with the following scheme :—

(*a*) Up to 4·5 km. use a Krarup loaded cable (*see* curve of characteristic impedance on page 32).

(*b*) For lengths from 4·5—18 km. 15 mh. coils should be used, spaced evenly. Two successive 15 mh. coils may be replaced by a single 30 mh. coil at double the spacing. According to the attenuation of the line from the junction point of cable and open wire and the repeater station, condensers must be used for different lengths of cable (*see* table above).

(*c*) For lengths between 18 and 36 km. the loading will be as for (*b*) but without condensers.

(*d*) For lengths above 36 km. 30 mh. coils will be used regularly spaced.

III.—CABLE INSERTED IN OPEN-WIRE LINES AND PROVIDED WITH IMPEDANCE-TRANSFORMING NETWORKS.

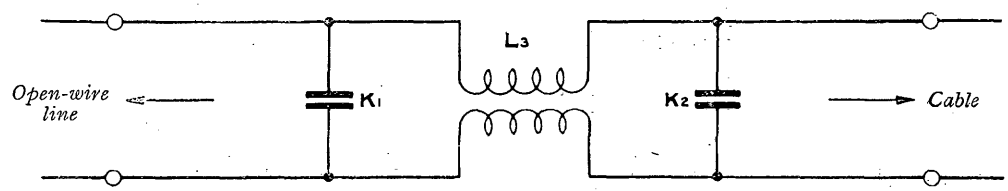


FIG. 1.

If between the loaded cable and the open-wire line a transformation network (*see* Fig. 1) is used the cable may, for an allowable error in matching, have a lower cut-off frequency than is used normally. The construction of the cable is thus more economical. The network (Fig. 1) allows the increase in impedance of the loaded cable to be neutralised over a wide frequency range in such a manner that the impedance of the cable approximates to that of the open-wire line. If it is desired, for example, that the two impedances be equal to within 2 per cent., it is possible to reduce the cut-off frequency of the cable to a value which is 25 per cent. above the highest frequency to be transmitted. Taking this latter frequency as $\omega = 15{,}000$, a cut-off frequency for the cable of $\omega_0 = 18{,}800$ is arrived at.

If S represents the loading spacing, C_2 the cable capacity per unit length and L_2 the effective inductance per km., then K_1, K_2 and L_3 of the network are—

$$L_3 = 0{\cdot}775\ L_2 \cdot S.$$
$$K_1 = 0{\cdot}340\ C_2 \cdot S.$$
$$K_2 = 0{\cdot}423\ C_2 \cdot S.$$

K_1 and K_2 are represented, within the limits of possibility, by lengths of the cable to be loaded. The values of loading spacing, coil inductance and cable conductor resistance are determined (calculating from the constants C_1, L_1, R_1 and G_1 of the open-wire line), by—

$$\frac{L_1}{C_1} = \frac{L_2}{C_2}$$

$$\frac{R_1}{L_1} - \frac{G_1}{C_1} = \frac{R_2}{L_2} - \frac{G_2}{C_2}.$$

For a bronze open-wire line, for example, we have—

$R_1 = 5{\cdot}4$ ohms per km.
$L_1 = 2{\cdot}6$ mh. per km.
$C_1 = 0{\cdot}006\ \mu$F. per km.
$G_1 = 1$ micromh. per km.

With these values there is obtained $R_2 = 29{\cdot}0$ ohms per km. for the cable conductor resistance (1·25 mm. copper); $L_2 = 11{\cdot}8$ mh. per km. for the inductance and $C_2 = 0{\cdot}036\ \mu$F per km. for the capacity. Subtracting the line inductance of 0·8 mh. per km., a loading of 11·0 mh. per km. is arrived at.

A suitable loading would have a cut-off of $\omega_0 = 21{,}200$, thus—

Loading coil inductance = 50 mh.
Loading coil spacing S = 4·55 km.
$L_3 = 40$ mh.
$\frac{K_1}{C_2} = 1{\cdot}55$ km.
$\frac{K_2}{C_2} = 1{\cdot}92$ km.

The use of the transformation network proposed allows the following rules for loading to be drawn up :—

1. Cables shorter than 3·1 km.

Continuously loaded cable will be used.

2. Cables 3·1–6·94 km.

The loading will be provided by the inductances of two networks.

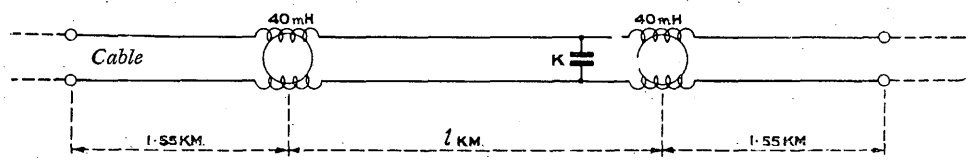


FIG. 2.

Spaced at 1·55 km. from each end of the section of cable, a 40 mh. coil is inserted. The remaining l km. of cable is built out by means of a condenser K, in order to obtain $6{\cdot}94 - 3{\cdot}10 = 3{\cdot}84$ km.

Thus the capacity required $K = (3{\cdot}84 - l)C_2$

or $K = (0{\cdot}138 - 0{\cdot}036l)\ \mu$F.

3. Cables longer than 6·94 km.

In addition to the two networks, 50 mh. coils are used, spaced every 4·55 km. At a distance of 1·55 km. from each end of the cable will be placed the two 40 mh. coils belonging

to the networks; the first 50 mh. coil is placed at 4·20 km. from the 40 mh. coil. The distance between successive 50 mh. coils is 4·55 km.

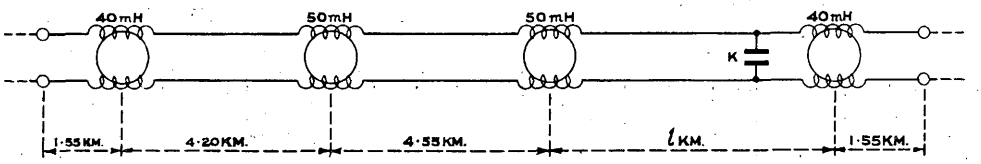


FIG. 3.

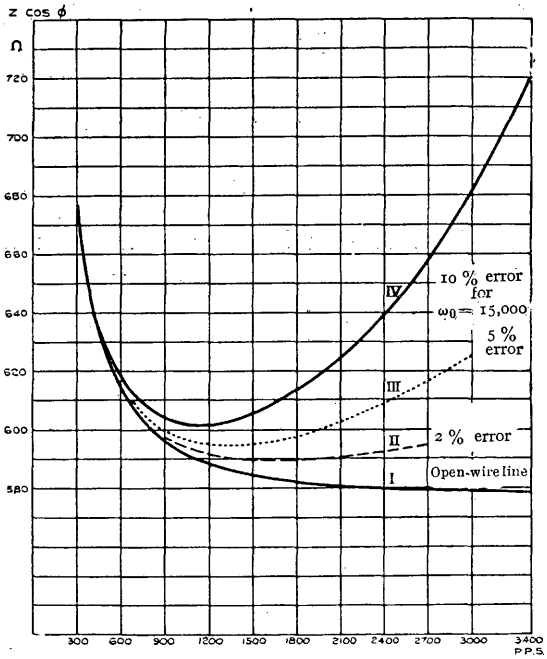
In order to make the length of cable between the last 50 mh. coil and the 40 mh. network coil equal to 4·2 km. a condenser will be necessary, of such a value that—

$$K = (0{\cdot}15 - 0{\cdot}036\, l)\ \mu\text{F},$$

where l is the length of this section of cable.

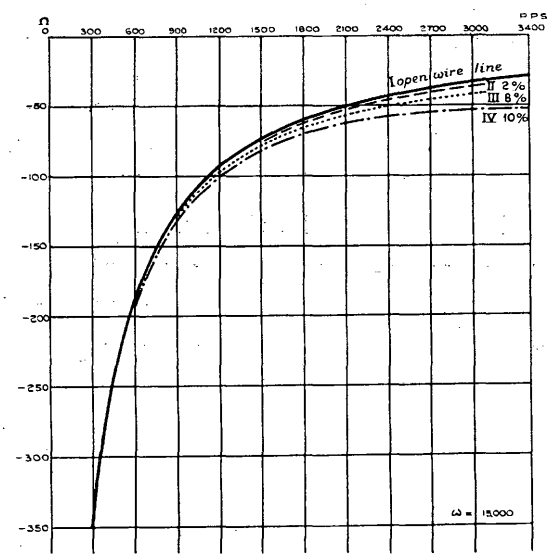
CURVES OF REAL COMPONENTS OF THE IMPEDANCE.

I.—For open-wire line d = 3 mm bronze.
II.—For loaded cable $\omega_0 = 75{,}000$.
III.— ,, ,, $\omega_0 = 47{,}000$.
IV.— ,, ,, $\omega_0 = 34{,}000$.



CURVES OF IMAGINARY COMPONENTS OF THE IMPEDANCE.

I.—For open-wire line d = 3 mm bronze.
II.—For leaded cable $\omega_0 = 75{,}000$.
III.— ,, ,, ,, $\omega_0 = 47{,}000$.
IV.— ,, ,, ,, $\omega_0 = 34{,}000$.

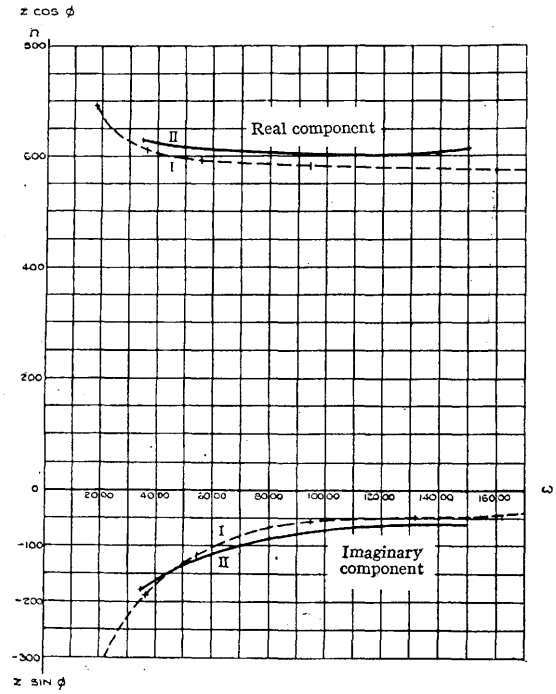


CHARACTERISTIC IMPEDANCE OF KRARUP LOADED CABLE.

(Measured Valves.)

Cable Constants { $L_2 = 14{\cdot}5$ mh/Km.
$K_2 = 0{\cdot}039$ μF/Km.
Diameter of copper conductors 1·2 mm.

I.—Open-wire line.
II.—Krarup loaded cable.



APPENDIX 3.

NOTES BY THE INTERNATIONAL STANDARD ELECTRIC CORPORATION REGARDING INTERMEDIATE SECTIONS OF CABLE INSERTED IN OPEN-WIRE LINES.

The electrical characteristics of cable circuits differ in a number of important respects from those of open-wire lines. The problems which arise when sections of cable are to be inserted in open-wire lines centre round the necessity for limiting the harmful effects of these differences on the satisfactory performance of the overall mixed circuit thus constituted.

The most important of the electrical characteristics just referred to are attenuation, impedance and natural frequency.

Attenuation.

The attenuation of the type of open-wire line suitable for long distance communication is considerably lower than that of cable. Consequently, the attenuation of the inserted length of cable may be very important in comparison with that of the open-wire lines and it is desirable to keep it as low as possible, due consideration being given to the economic aspects. The attenuation of the cable circuits may be controlled practically by the choice of conductor diameter and type of loading, which will depend also to some extent upon the other requirements discussed here.

Impedance.

The majority of open-wire lines used for international traffic will be repeatered, and even where this is not the case it seems desirable that they should be made suitable for repeater operation so that the system may be as flexible as possible.

It is desirable, therefore, that the impedance of the " mixed " lines, as viewed from the terminal or repeater station, should be smooth enough to allow satisfactory repeater operation, and in order to bring this about the impedance of the inserted cable must be matched as nearly as possible (at all frequencies within the transmitted range) with that of the open-wire line by the choice of a suitable type of loading and suitable conductor diameter.

Natural Frequency.

When the length of cable to be inserted is considerable, some attention must be given to its filter effect. The attenuation frequency curve for the open-wire line may be taken as practically flat compared with that of non-loaded cable or cable loaded to a low cut-off, and care must therefore be taken that the attenuation introduced by the cable at the higher frequencies is not sufficient to cause the attenuation-frequency curve of the mixed line to be undesirably steep. This can be prevented by loading the cable to a high cut-off.

Summarising the above requirements, it will be seen that in any given case the most satisfactory conductor diameter and type of loading will be those which most nearly satisfy all the conditions just outlined. There would therefore be ideally a very large number of solutions, but for purposes of standardisation these may be reduced to one only for the type of loading and to a very small number for the conductor diameter.

The loading which has been standardised is known as H–28–16, the letter " H " referring to a " heavy " spacing of 1,830 metres and the figures referring to the inductance in mh of the side and phantom circuit coils respectively.

It will be noted that the spacing of the loading coils is the same as for Method No. 1 of the Long Distance Loading Systems, as described in " Essential Clauses for a typical Specification for Repeater Sections of Loaded International Cable " (*see* White Book, p. 152; English Translation, p. 100). This fact is of advantage in those countries where Method No. 1 is generally adopted, as the toll entrance cable route sometimes parallels a main long distance cable and in some cases long distance circuits and toll entrance circuits are accommodated in the same cable.

Figs. 1, 2 and 3 (pages 36–38) show the impedance and attenuation characteristics of side and phantom cable circuits loaded as just described.

Figs. 4, 5 and 6 (pages 39–41) show corresponding characteristics for various types of open-wire lines constructed with the normal flat transposition system and with a spacing of approximately 30 cm.

Figs. 7 to 12 inclusive (pages 42–47) show that by selection of the appropriate cable conductor diameter, each type of open-wire line may be matched with considerable accuracy. Both by inspection of these curves and by consideration of the ratios of the primary constants of the cable and open-wire circuits $\left(\frac{R}{R_1} = \frac{L}{L_1} = \frac{C}{C_1} = \frac{G}{G_1}\right)$ it is found that the lines which should be associated are—

2·5 mm.	open-wire line		0·9 mm.	cable loaded	H–28–16.
3·0 mm.	,,	,,	1·3 mm.	,,	,, ,,
3·5 mm.	,,	,,	1·3 mm.	,,	,, ,,
4·0 mm.	,,	,,	1·8 mm.	,,	,, ,,

The above assumes that standard conductor gauges of 0·9, 1·3 and 1·8 mm. are employed. If intermediate sizes are used a closer matching is possible, but for most purposes the three gauges stated are satisfactory.

The location of the point of junction between the loaded cable and the open-wire line is of great importance. The best impedance matching is usually obtained when this point of junction occurs either at mid-loading section or at a terminal loading coil of half normal inductance value. These methods are referred to as " half-section " and " half-coil " terminations respectively.

When the point of junction occurs at intermediate points in the loading section, that is, when the distance to the first loading coil is more or less than a half-loading section, the impedance matching becomes worse.

Fig. 13 (page 48) shows, for a particular case, the effect of varying the distance between the first loading point on the cable and the junction of cable and open-wire line, and also the effect of half-coil termination.

Calculations of impedance ratios, expressed as percentages, and singing point, expressed in decibels, at the junction point have been made from this series of curves at frequencies of 300 and 2,500 p.p.s., and the results are shown in the following tables :—

Singing Point at Junction of 2·5 mm. Open-Wire Line Side Circuit with 0·9 mm. H–28–16 Cable Side Circuit.

Distance of First Loading Point from Junction.	Viewed from Cable.				Viewed from Open-wire Line.			
	300 p.p.s.		2,500 p.p.s.		300 p.p.s.		2,500 p.p.s.	
	Decibels.	%.	Decibels.	%.	Decibels.	%.	Decibels.	%.
Half-Coil	31	5·5	25·5	10	31	5·5	25·5	10
Half-Section ..	31	5·5	37	3	31	5·5	37	3
0·2 Section ..	31	5·5	21	21	31	5·5	20	24
0·8 Section ..	31	5·5	20	24	31	5·5	21	21

NOTE.—Columns headed % refer to the radius of the circle as defined by the C.C.I. for impedance regularity. (White Book, p. 151; English Translation, p. 99.)

It should be noted that the singing point (expressed in decibels) of the mixed line at a repeater located on the open-wire line or on the cable will be greater than the singing point at the junction (assuming that there are no irregularities on the lines themselves) by an amount equal to twice the attenuation of the portion of line between the repeater and junction point.

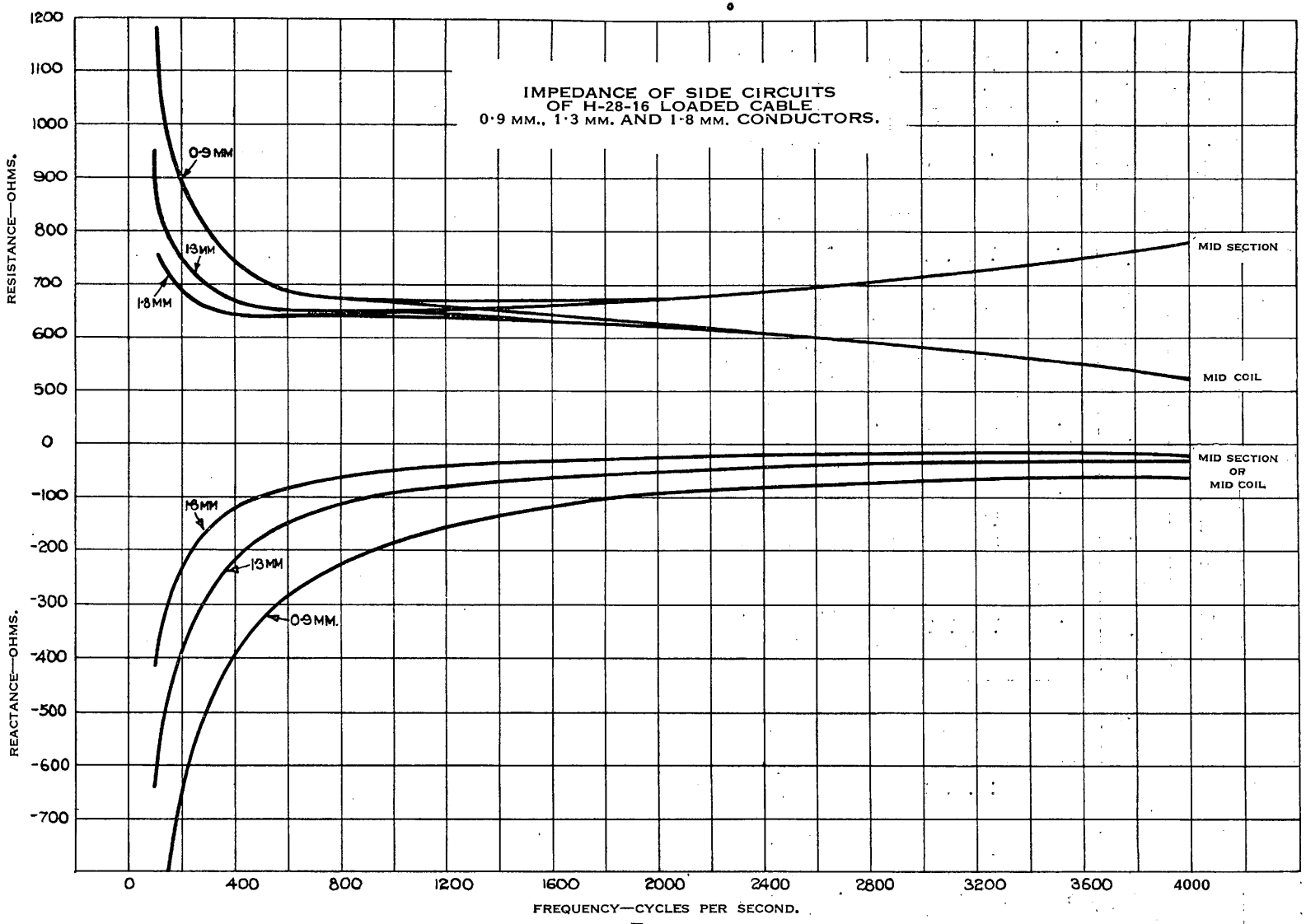

IMPEDANCE OF SIDE CIRCUITS
OF H-28-16 LOADED CABLE
0·9 MM., 1·3 MM. AND 1·8 MM. CONDUCTORS.
RESISTANCE—OHMS.
REACTANCE—OHMS.
FREQUENCY—CYCLES PER SECOND.
0·9 MM
1·3 MM
1·8 MM
MID SECTION
MID COIL
MID SECTION OR MID COIL
1200
1100
1000
900
800
700
600
500
0
-100
-200
-300
-400
-500
-600
-700
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000

FIG. 1.

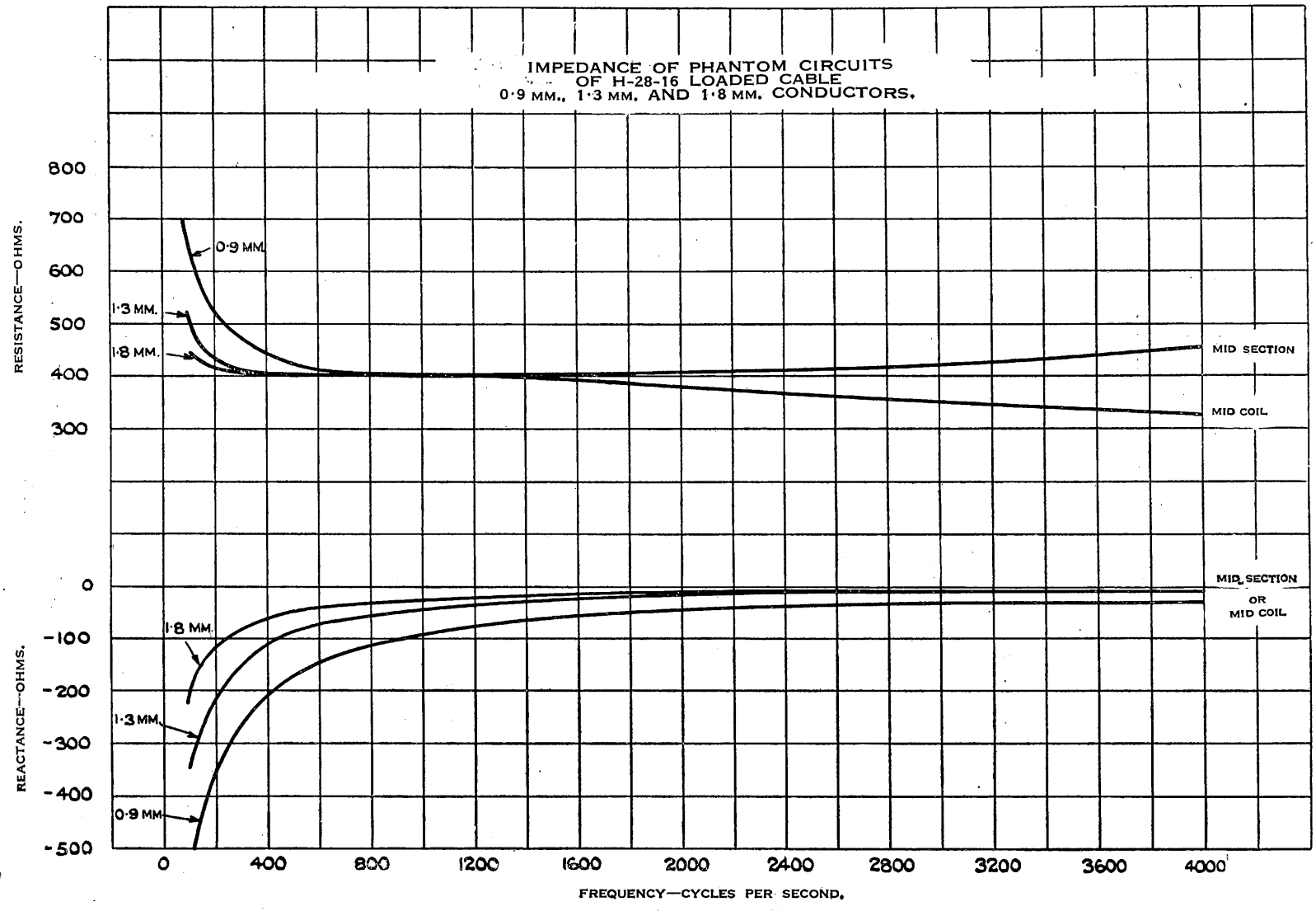

IMPEDANCE OF PHANTOM CIRCUITS
OF H-28-16 LOADED CABLE
0·9 MM., 1·3 MM. AND 1·8 MM. CONDUCTORS.
RESISTANCE—OHMS.
800
700
600
500
400
300
0·9 MM.
1·3 MM.
1·8 MM.
MID SECTION
MID COIL
REACTANCE—OHMS.
0
-100
-200
-300
-400
-500
1·8 MM.
1·3 MM.
0·9 MM.
MID SECTION
OR
MID COIL
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
FREQUENCY—CYCLES PER SECOND.

FIG. 2.

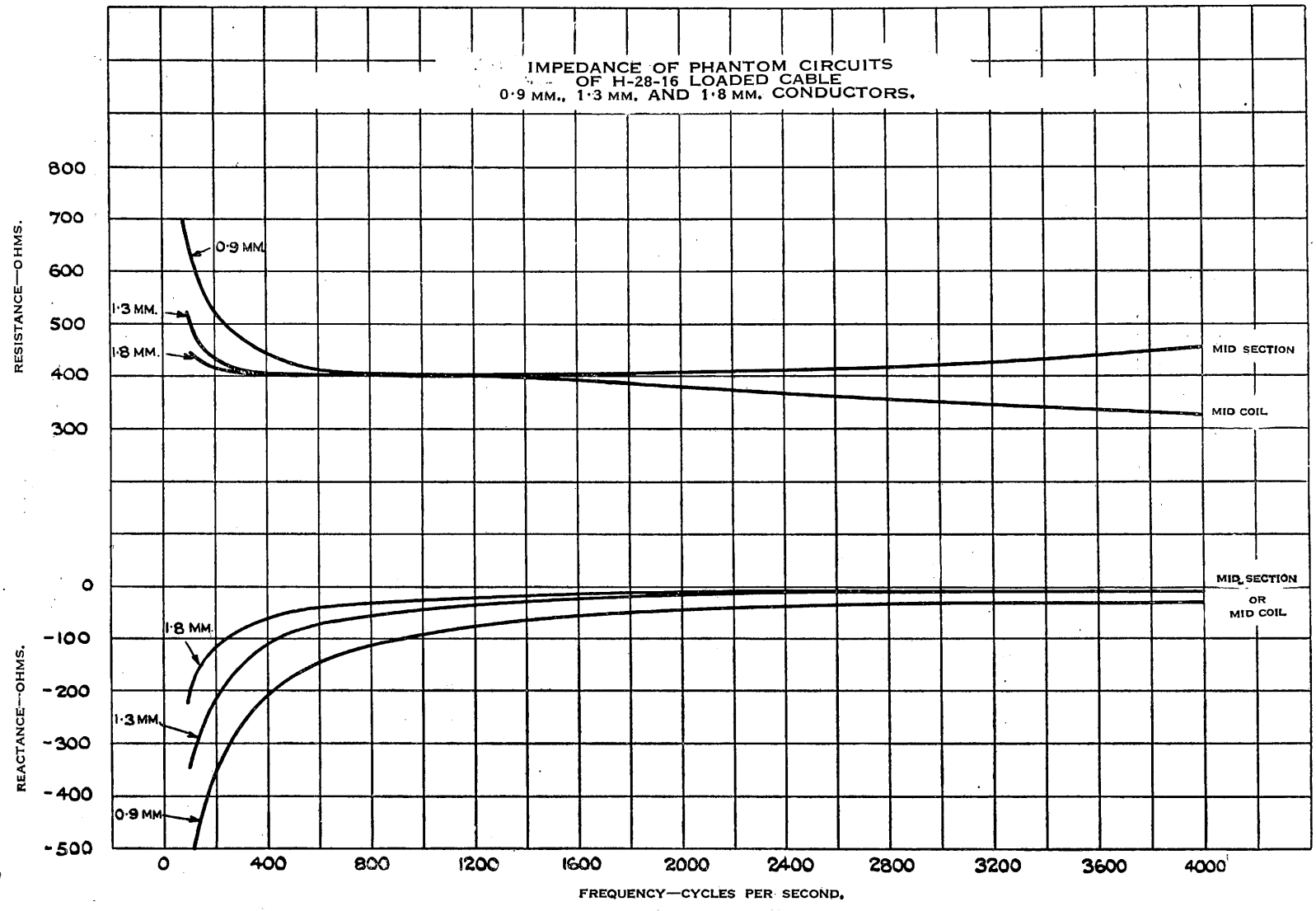

IMPEDANCE OF PHANTOM CIRCUITS
OF H-28-16 LOADED CABLE
0·9 MM., 1·3 MM. AND 1·8 MM. CONDUCTORS.
RESISTANCE—OHMS.
800
700
600
500
400
300
0·9 MM.
1·3 MM.
1·8 MM.
MID SECTION
MID COIL
REACTANCE—OHMS.
0
-100
-200
-300
-400
-500
1·8 MM.
1·3 MM.
0·9 MM.
MID SECTION
OR
MID COIL
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
FREQUENCY—CYCLES PER SECOND.

FIG. 2.

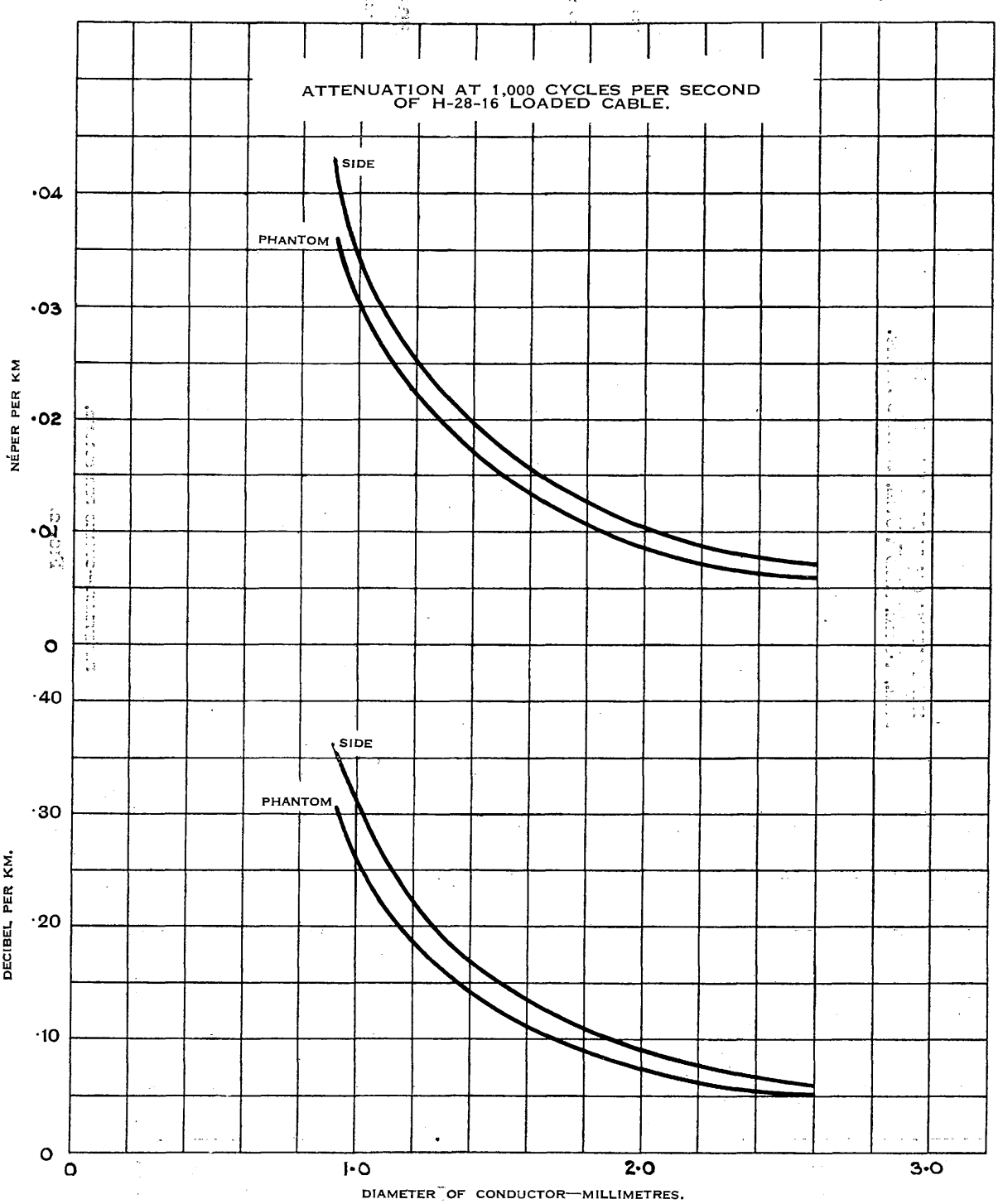

ATTENUATION AT 1,000 CYCLES PER SECOND
OF H-28-16 LOADED CABLE.
SIDE
PHANTOM
SIDE
PHANTOM
·04
·03
·02
·01
0
·40
·30
·20
·10
0
NÉPER PER KM
DECIBEL PER KM.
0
1·0
2·0
3·0
DIAMETER OF CONDUCTOR—MILLIMETRES.

FIG. 3.

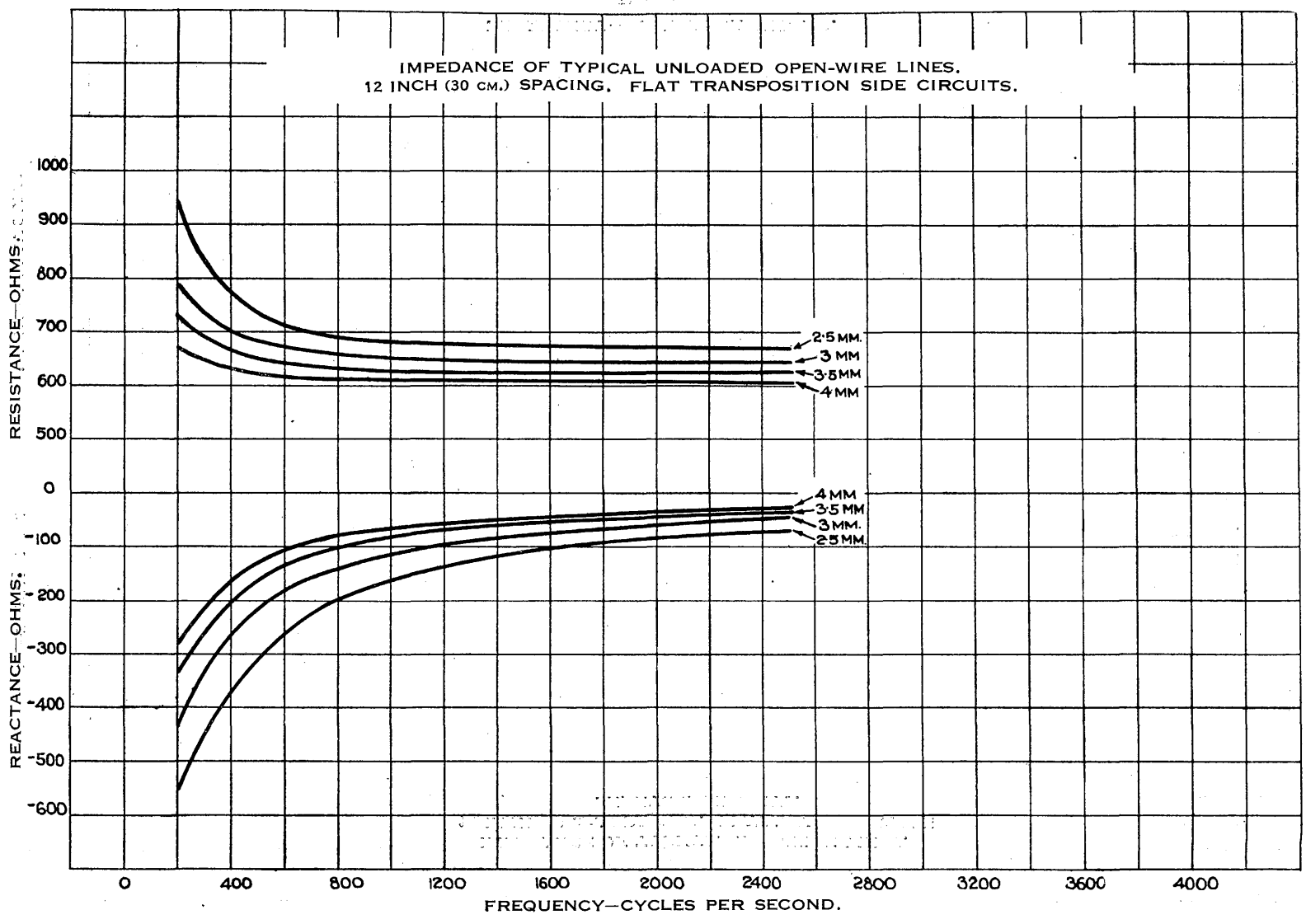

IMPEDANCE OF TYPICAL UNLOADED OPEN-WIRE LINES.
12 INCH (30 CM.) SPACING. FLAT TRANSPOSITION SIDE CIRCUITS.
RESISTANCE—OHMS.
REACTANCE—OHMS.
1000
900
800
700
600
500
0
-100
-200
-300
-400
-500
-600
2·5 MM.
3 MM
3·5 MM
4 MM
4 MM
3·5 MM
3 MM.
2·5 MM
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
FREQUENCY—CYCLES PER SECOND.

FIG. 4.

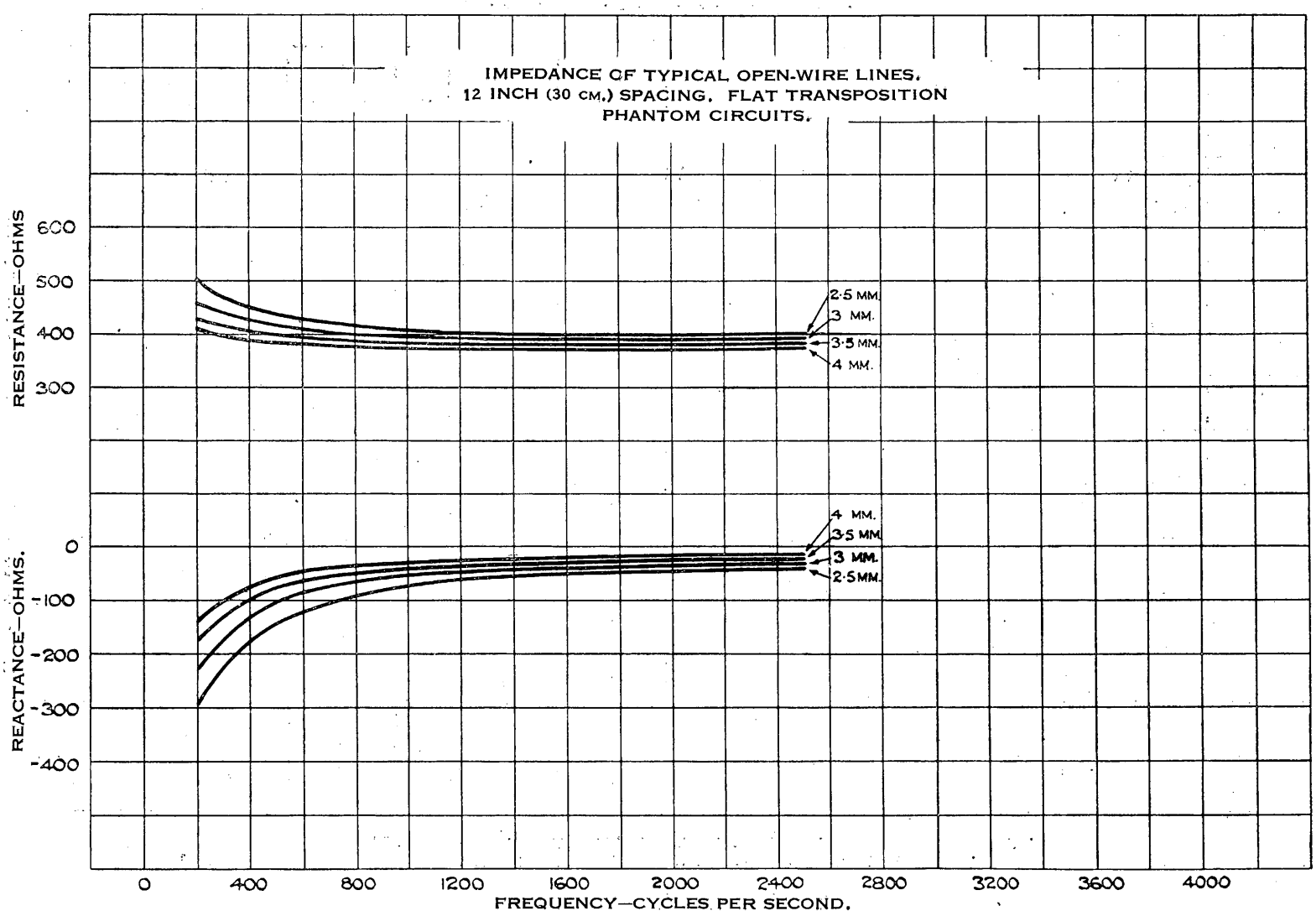

IMPEDANCE OF TYPICAL OPEN-WIRE LINES.
12 INCH (30 CM.) SPACING. FLAT TRANSPOSITION
PHANTOM CIRCUITS.
RESISTANCE—OHMS
600
500
400
300
2·5 MM.
3 MM.
3·5 MM.
4 MM.
REACTANCE—OHMS.
0
-100
-200
-300
-400
4 MM.
3·5 MM.
3 MM.
2·5 MM.
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
FREQUENCY—CYCLES PER SECOND.

FIG. 5.

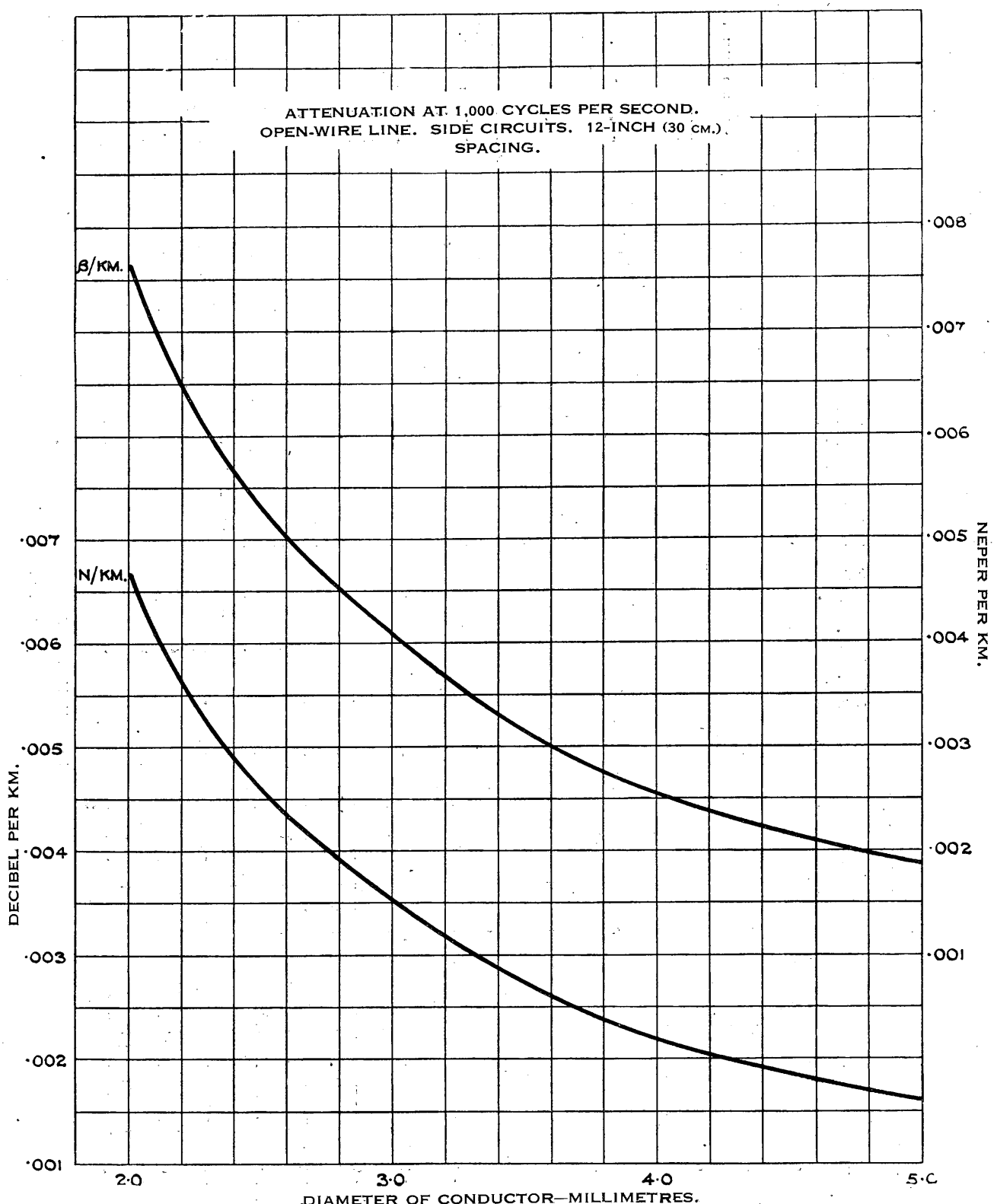

ATTENUATION AT 1,000 CYCLES PER SECOND.
OPEN-WIRE LINE. SIDE CIRCUITS. 12-INCH (30 CM.) SPACING.
β/KM.
N/KM.
·008
·007
·006
·005
·004
·003
·002
·001
·007
·006
·005
·004
·003
·002
·001
DECIBEL PER KM.
NEPER PER KM.
2·0
3·0
4·0
5·0
DIAMETER OF CONDUCTOR—MILLIMETRES.

FIG. 6.

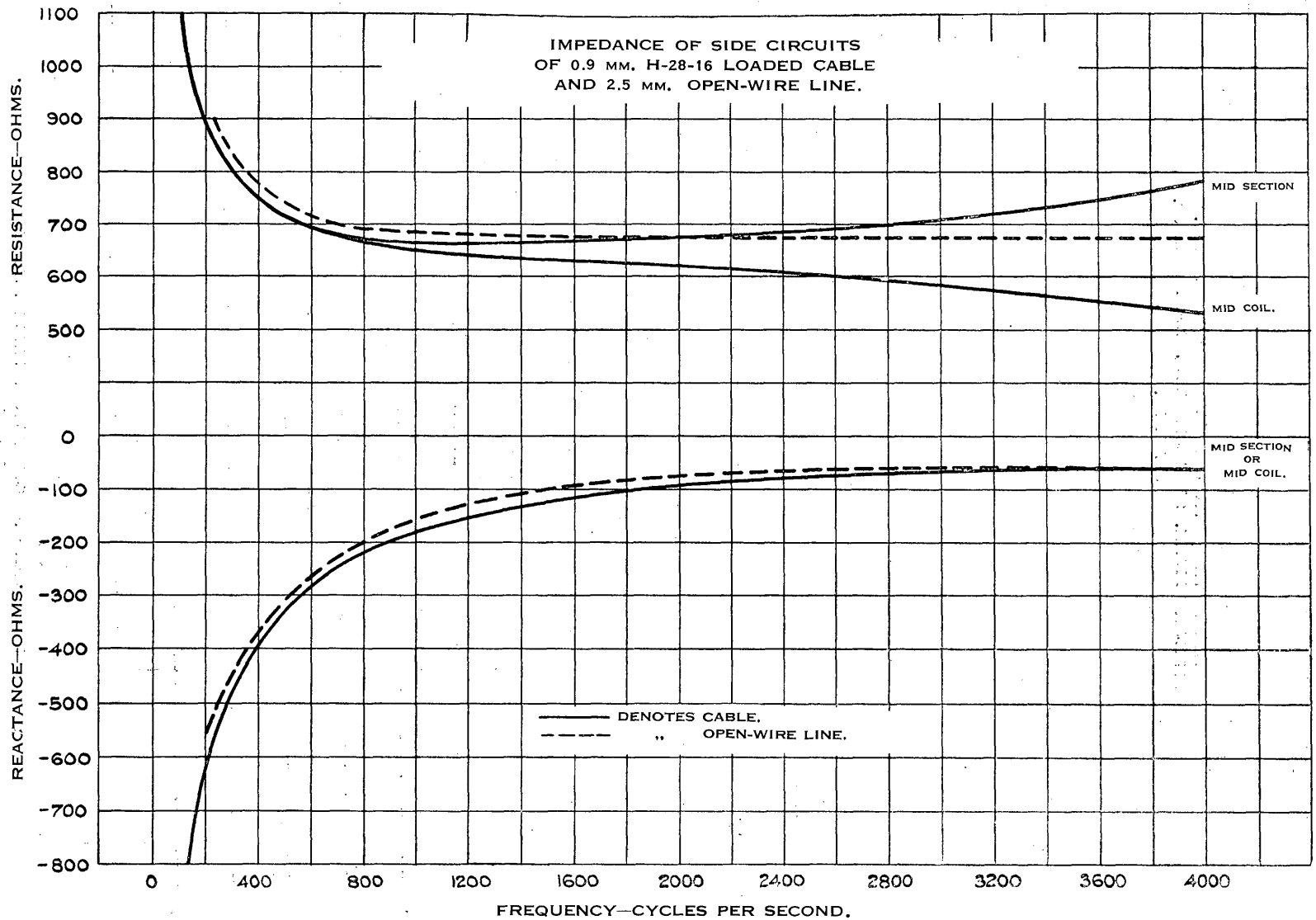

IMPEDANCE OF SIDE CIRCUITS
OF 0.9 MM. H-28-16 LOADED CABLE
AND 2.5 MM. OPEN-WIRE LINE.
RESISTANCE—OHMS.
REACTANCE—OHMS.
1100
1000
900
800
700
600
500
0
-100
-200
-300
-400
-500
-600
-700
-800
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
FREQUENCY—CYCLES PER SECOND.
MID SECTION
MID COIL.
MID SECTION
OR
MID COIL.
DENOTES CABLE.
" OPEN-WIRE LINE.

FIG. 7.

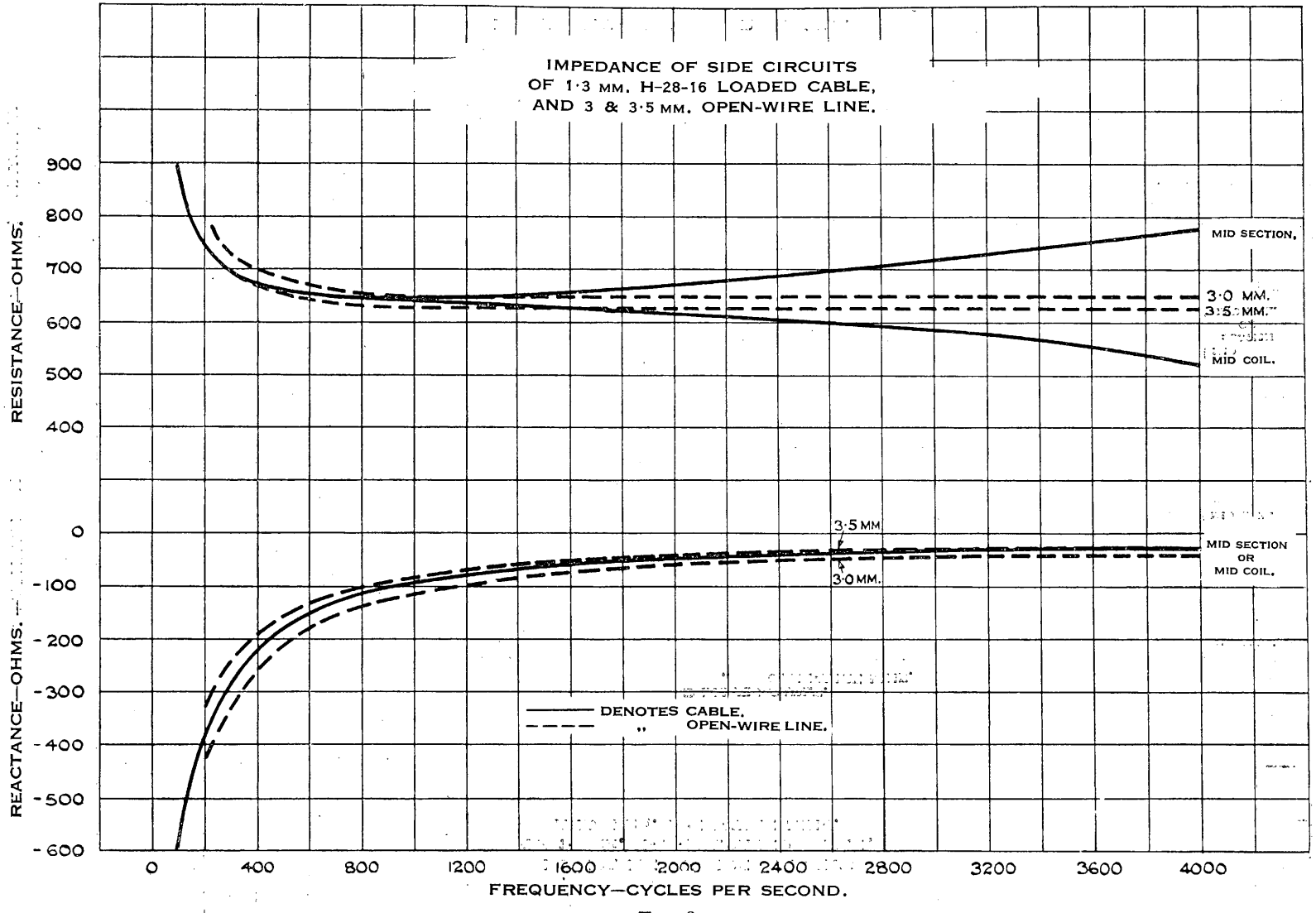

IMPEDANCE OF SIDE CIRCUITS
OF 1·3 MM. H-28-16 LOADED CABLE,
AND 3 & 3·5 MM. OPEN-WIRE LINE.
RESISTANCE—OHMS.
REACTANCE—OHMS.
900
800
700
600
500
400
0
-100
-200
-300
-400
-500
-600
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
FREQUENCY—CYCLES PER SECOND.
MID SECTION.
3·0 MM.
3·5 MM.
MID COIL.
3·5 MM
3·0 MM.
MID SECTION
OR
MID COIL.
DENOTES CABLE.
" OPEN-WIRE LINE.

FIG. 8.

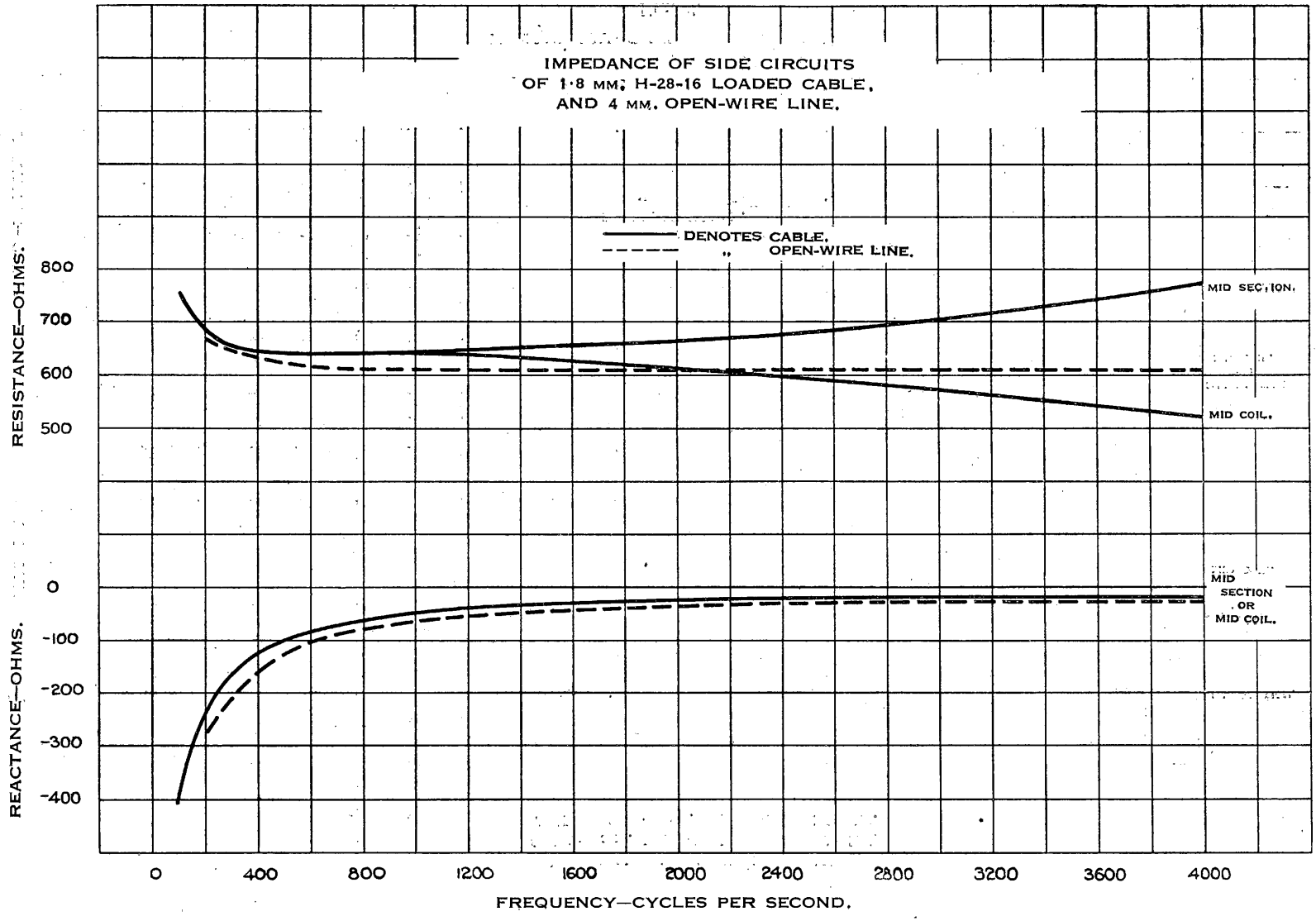

IMPEDANCE OF SIDE CIRCUITS
OF 1·8 MM; H-28-16 LOADED CABLE,
AND 4 MM. OPEN-WIRE LINE.
DENOTES CABLE.
" OPEN-WIRE LINE.
RESISTANCE—OHMS.
800
700
600
500
MID SECTION.
MID COIL.
REACTANCE—OHMS.
0
-100
-200
-300
-400
MID SECTION OR MID COIL.
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
FREQUENCY—CYCLES PER SECOND.

FIG. 9.

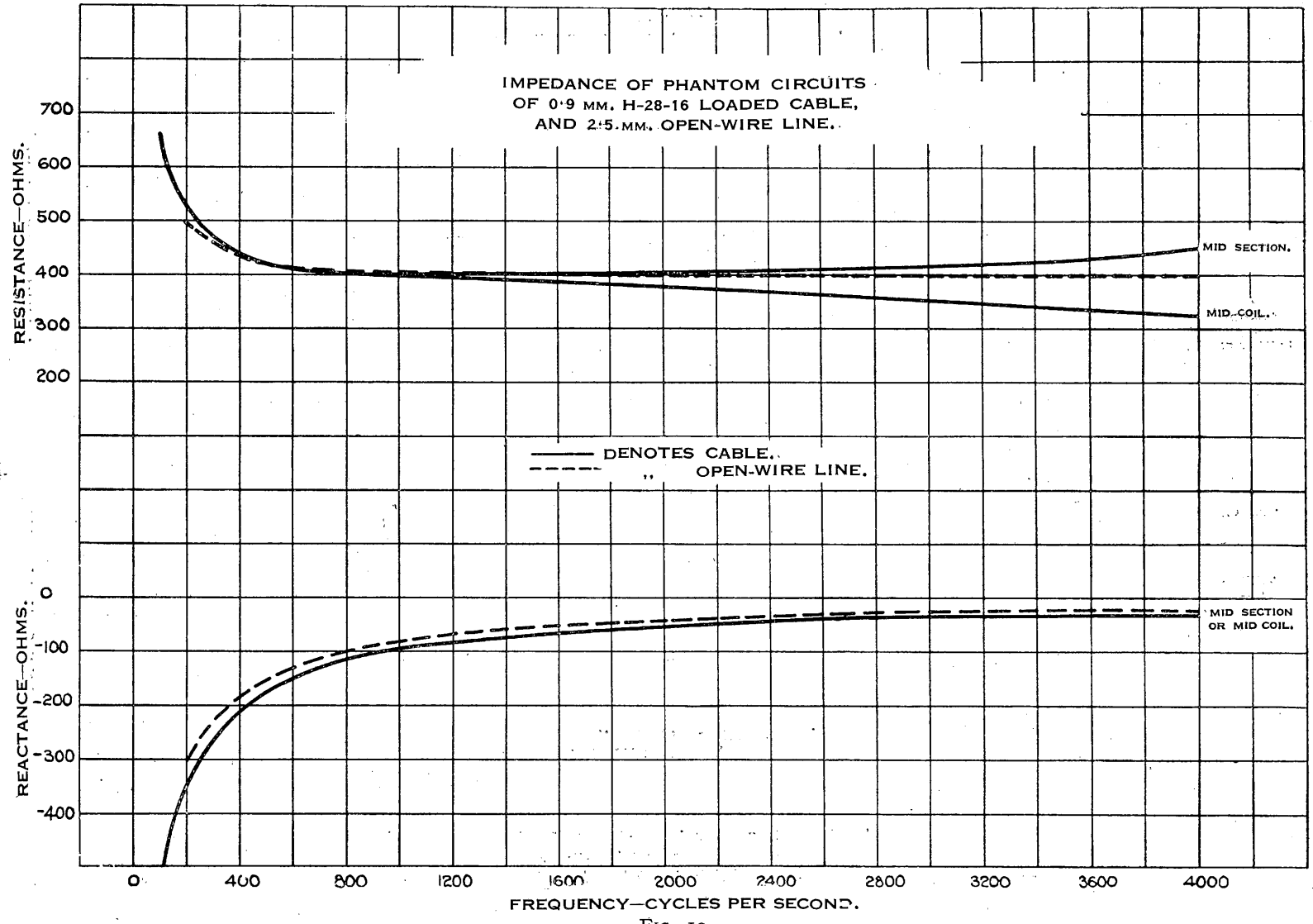

IMPEDANCE OF PHANTOM CIRCUITS
OF 0·9 MM. H-28-16 LOADED CABLE,
AND 2·5 MM. OPEN-WIRE LINE.
RESISTANCE—OHMS.
700
600
500
400
300
200
MID SECTION.
MID COIL.
DENOTES CABLE.
,, OPEN-WIRE LINE.
REACTANCE—OHMS.
0
-100
-200
-300
-400
MID SECTION
OR MID COIL.
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
FREQUENCY—CYCLES PER SECOND.

FIG. 10.

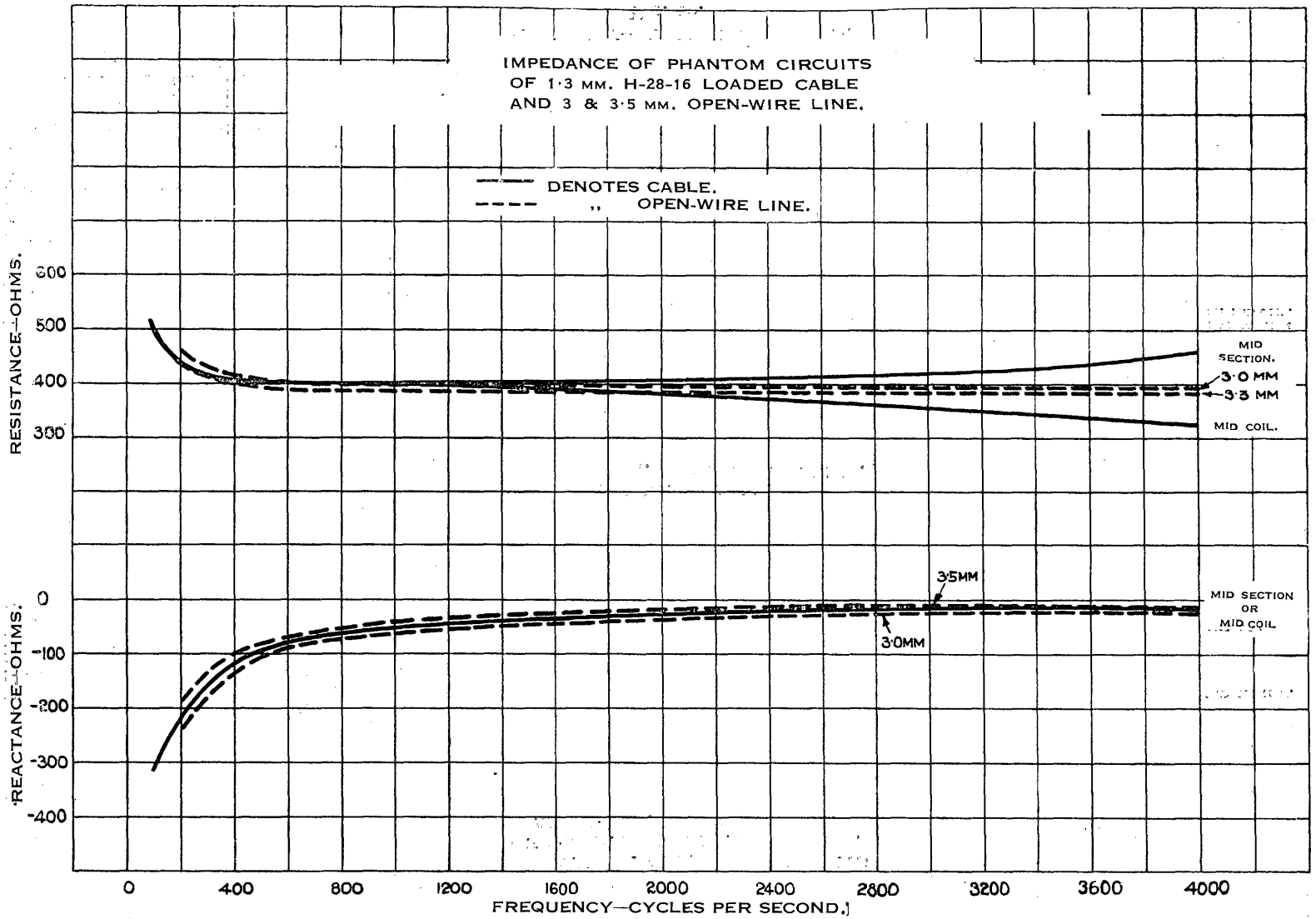

IMPEDANCE OF PHANTOM CIRCUITS
OF 1·3 MM. H-28-16 LOADED CABLE
AND 3 & 3·5 MM. OPEN-WIRE LINE.
DENOTES CABLE.
,, OPEN-WIRE LINE.
RESISTANCE—OHMS.
600
500
400
300
MID SECTION.
3·0 MM
3·5 MM
MID COIL.
REACTANCE—OHMS.
0
-100
-200
-300
-400
3·5MM
3·0MM
MID SECTION OR MID COIL
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
FREQUENCY—CYCLES PER SECOND.

FIG. 11.

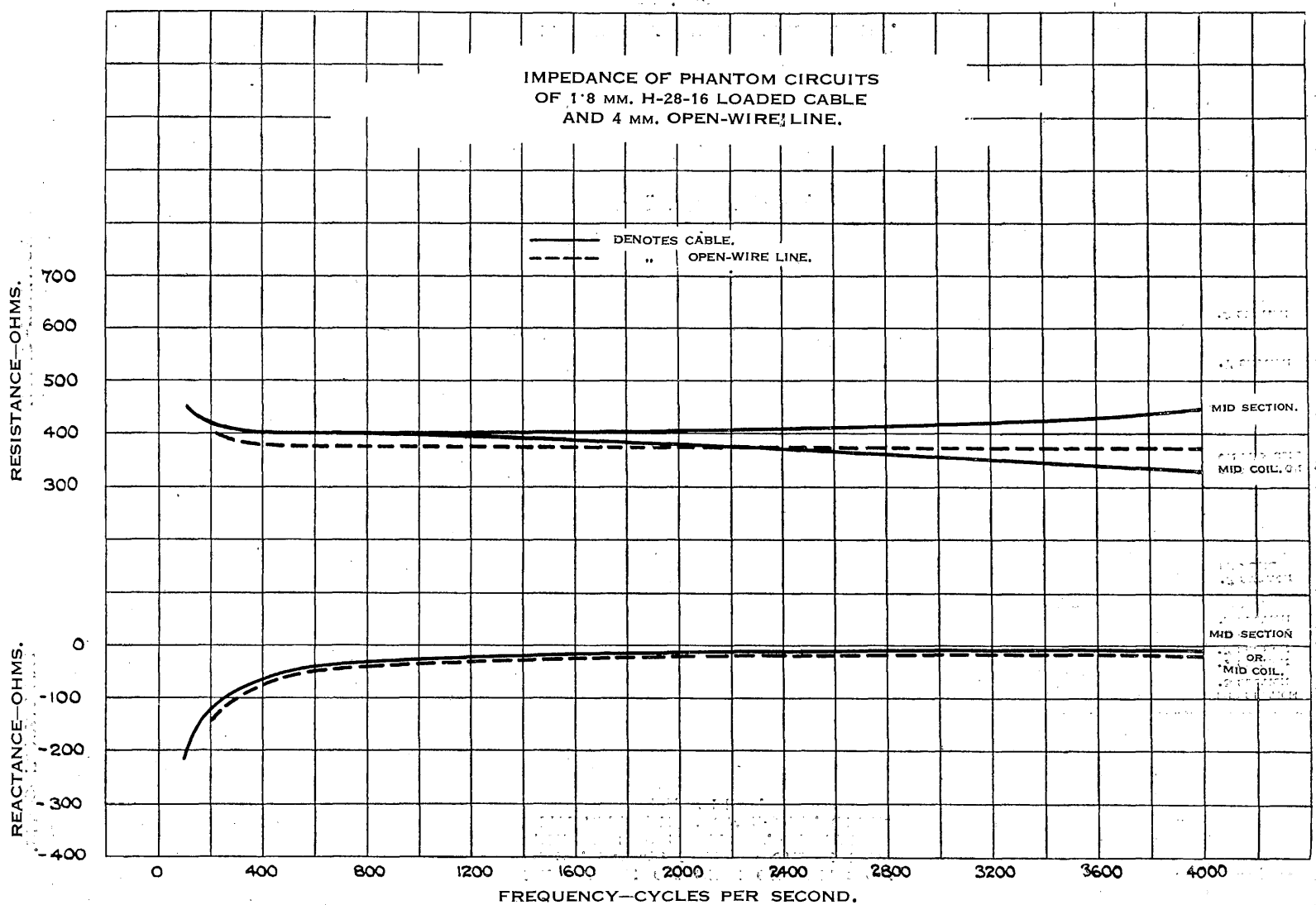

IMPEDANCE OF PHANTOM CIRCUITS
OF 1·8 MM. H-28-16 LOADED CABLE
AND 4 MM. OPEN-WIRE LINE.
DENOTES CABLE.
" OPEN-WIRE LINE.
RESISTANCE—OHMS.
700
600
500
400
300
MID SECTION.
MID COIL.
REACTANCE—OHMS.
0
-100
-200
-300
-400
MID SECTION
OR
MID COIL.
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
FREQUENCY—CYCLES PER SECOND.

FIG. 12.

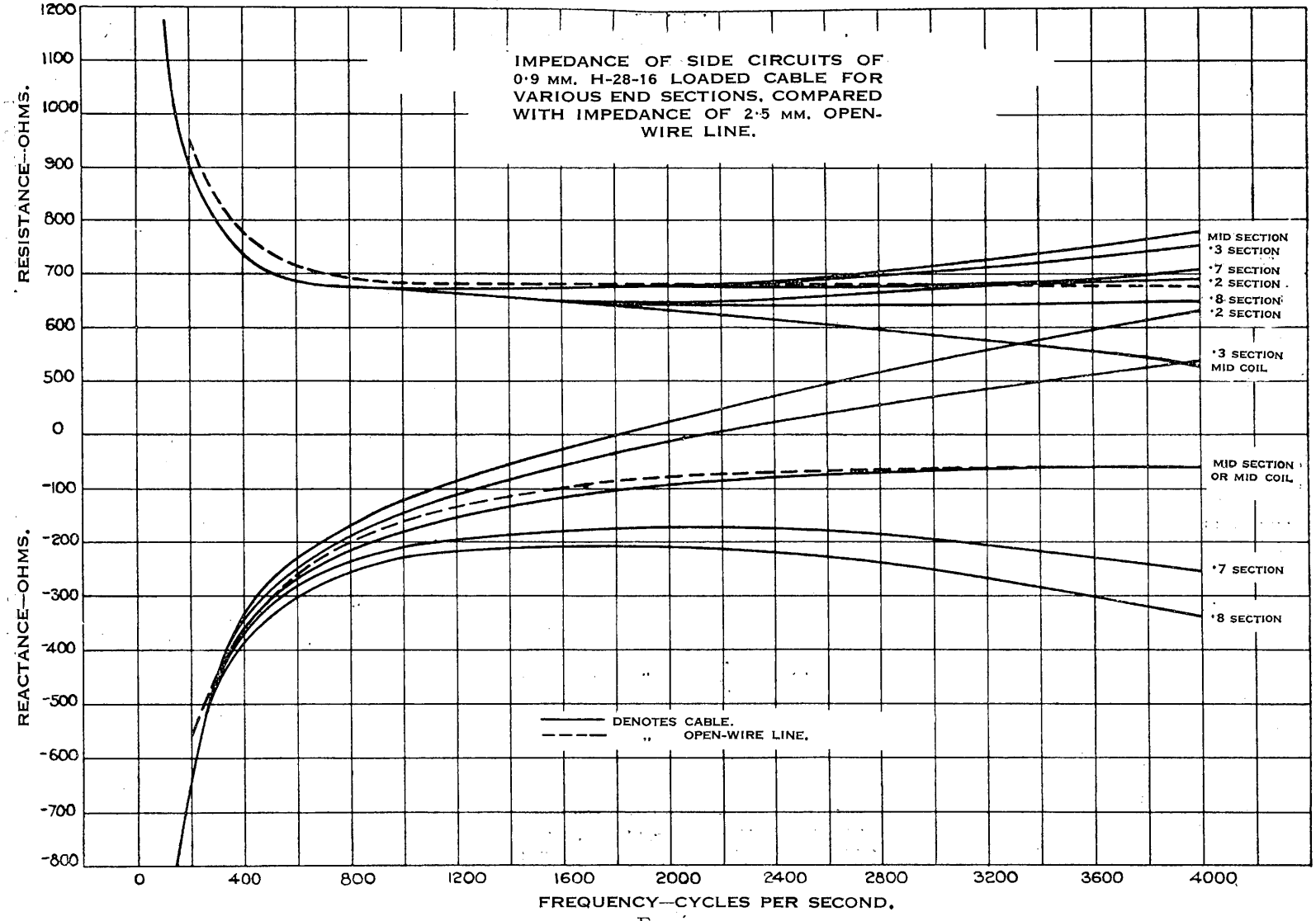

IMPEDANCE OF SIDE CIRCUITS OF 0·9 MM. H-28-16 LOADED CABLE FOR VARIOUS END SECTIONS, COMPARED WITH IMPEDANCE OF 2·5 MM. OPEN-WIRE LINE.
RESISTANCE—OHMS.
REACTANCE—OHMS.
1200
1100
1000
900
800
700
600
500
0
-100
-200
-300
-400
-500
-600
-700
-800
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
FREQUENCY—CYCLES PER SECOND.
MID SECTION
·3 SECTION
·7 SECTION
·2 SECTION
·8 SECTION
·2 SECTION
·3 SECTION MID COIL
MID SECTION OR MID COIL
·7 SECTION
·8 SECTION
DENOTES CABLE.
" OPEN-WIRE LINE.

FIG. 13.

NOMENCLATURE OF INTERNATIONAL CIRCUITS.

The International Consultative Committee :—

Unanimously advises* :—

That, in future, the nomenclature of international circuits and the map of the existing and projected international telephone cables, kept up to date by the General Secretariat of the International Consultative Committee, should be arranged in accordance with the following indications :—

I.—Nomenclature of the Circuits.

The nomenclature of the international telephone circuits, which will form the subject-matter of a new edition of January 1st, 1929, should be presented in the form of the following table, comprising eleven columns.

This nomenclature should be arranged in such a manner that a complete idea of the composition of each international circuit may be obtained without having to consult different pages of the nomenclature for the same circuit.

Designation of the Circuits.	Country.	Length in each country (km.).	Type of construction.	Nature of Circuits.	Diameter of the conductors (mm).	Coil Loading or Continuous Loading.	Cut-off Frequency (p.p.s.).	Total Attenuation. Népers.	Total Attenuation. Decibels.	Names of Intermediate Repeater Stations.	Remarks.
1	2	3	4	5	6	7	8	9		10	11
										Berlin–Friesack.	Rept. s.c. $\frac{2f}{2f}\frac{2f}{4f}\frac{4f}{4f}$
Berlin–London 3	Germany	4	a	2f	2	Non-loaded	—			Perleberg. Vellahn, Hamburg.	
	,,	582	a	4f	0·9	Method 2	5,400			Rotenburg–Bassum.	
	,,	193	a	4f	0·9	103 mh/km. D=1·66 km.	3,300			Bohmte, Munster.	
	Holland	20	a	4f	0·9					Wesel	
	,,	184	a	4f	1·29	30 mh./km. D=1·66 km.	5,740			Arnheim	
										Rotterdam	
	,,	93	a	4f	1·8	100 mh./km. D=1·761km.	2,790	1·0	8·686	Domburg	
	,,	153	d	2f	2·0	13 mh./km. Krarup	—				
	Gt.Britain										
	,,	73	a	4f	0·9	50 mh./km. D=1·83 km.	3,920			Aldeburgh	
	,,	82	a	4f	1·27	65 mh./km. D=2·72 km.	2,340			Marks Tey	Rept. s.c. $\frac{2f}{2f}\frac{2f}{4f}\frac{4f}{4f}$
		1,384									

* This completes the recommendations, on the same subject, on page 45 of the White Book (English Translation, page 9).

Column 1.—" DESIGNATION OF THE CIRCUITS."

Each international circuit should be designated by the name of the two localities which it connects, followed by the number of the circuit, the names of the localities included in the designation of the circuit being those which figure on the official plans of their countries, the two names being placed in alphabetical order, *e.g.*, Berlin—London 3.

Column 2.—" COUNTRY."

Column 2 should include the names of the countries on whose territory the different sections of the circuit lie, in the order which the circuit crosses them going from one terminal exchange to the other terminal exchange, in alphabetical order, *e.g.*, Berlin—London 3 : Germany, Holland, Great Britain.

Column 3.—" LENGTH IN EACH COUNTRY (KM.)."

Column 3 should include the length of each circuit expressed in kilometres.

Column 4.—" TYPE OF CONSTRUCTION."

The type of construction of each section of the circuit should be shown as follows :—

Open-wire line	*a*
Underground cable	*b*
Aerial cable	*c*
Submarine cable	*d*

Column 5.—" NATURE OF CIRCUITS."

The nature of the different sections of the circuit should be shown as follows :—

Two-wire side (or physical) circuit	2 f
Two-wire phantom circuit	2 f comb.
Four-wire side (or physical) circuit	4 f
Four-wire phantom circuit	4 f comb.

Column 6.—" DIAMETER OF THE CONDUCTORS (MM.)."

The diameter of the conductors should be expressed in millimetres for each section of the circuit.

Column 7.—" COIL LOADING OR CONTINUOUS LOADING."

This column should include concise information on the type of coil loading or continuous loading of each section of the circuit. If the coil loading conforms to the recommendation of the International Consultative Committee it is sufficient to show the method chosen in the following way : " Method 1 " or " Method 2." If the methods of coil loading differ from the International Consultative Committee's recommendations the inductance per kilometre and the coil spacing should be shown—

$$e.g.\begin{cases} 103 \text{ mh./km.} \\ D = 1{\cdot}66 \text{ km.} \end{cases}$$

In the case of continuously loaded cables the inductance per kilometre followed by the word Krarup should be included, *e.g.*, 13 mh./km. Krarup. If a section of the circuit is neither coil loaded nor continuously loaded this should be indicated in column 7 by " non-loaded."

Column 8.—" CUT-OFF FREQUENCY (P.P.S.)."

In this column the critical cut-off frequency (or frequency limit) should be expressed in periods per second for each loading section of the circuit.

Column 9.—" TOTAL ATTENUATION."

This column is divided into two parts. On the left the total attenuation at 800 cycles per second (or the resultant attenuation at 800 cycles per second between the line terminals in the exchanges at the head of the line) should be shown in nepers and on the right in decibels.

Column 10.—" NAMES OF INTERMEDIATE REPEATER STATIONS."

The names of the intermediate repeater stations shown in this column should be grouped together by countries.

Column 11.—" REMARKS."

It is desirable to include in this column for each of the terminal exchanges reference to the use of cord circuit repeaters for connecting two-wire—two-wire, two-wire—four-wire and four-wire—four-wire, as follows :—

$$\text{Cord circuit repeater } \frac{2f}{2f}\ \frac{2f}{4f}\ \frac{4f}{4f}.$$

The nomenclature of the international telephone circuits should be set up in future in accordance with this table.

Under this form the nomenclature will be used everywhere by engineers of the operating services who wish to know : up to what distance circuits can be connected; if the lines considered are adapted to carry conversations of short, long or very long distances, etc.

II. Schematic Plan of the Cables.

With reference to the schematic plan of the international telephone cables of Europe, published by the International Consultative Committee in 1925, this plan shows numerous projected cables which it is definitely known will not be carried out in the near future. Owing to this the plan loses a certain value. In future only those cables should be included which it is known with certainty will be put into service before a new publication of this plan. In view of the rapid development of the European network of telephone cables, a plan should be re-edited at least every two years.

The distinction between a central exchange with a repeater station and a repeater station only is of little interest.

On the other hand, on each line representing a cable should be written a reference number followed by an indication, in brackets, of the number of metallic pairs.

The reference number of a cable should correspond to a similar number on a list attached to the plan and on which the following indications should be given :—

1. The number of metallic pairs.
2. The number of pairs coil loaded.
3. The number of two-wire circuits.
4. The number of four-wire circuits.

A.e.

INSTRUCTIONS FOR PUTTING INTO SERVICE AND MAINTAINING INTERNATIONAL TELEPHONE CIRCUITS.

The International Consultative Committee—

Unanimously advises :—*

That the different Administrations should agree to give a trial to the following proposed instructions, and that they should advise the Secretariat of the C.C.I. of any modifications which they wish to suggest.

A.—Setting up and Putting into Service of International Circuits.

When the Administrations have decided to bring new telephone circuits into service, the Administration of one of the countries in which the circuits terminate shall, after agreement with the other country in which the circuits terminate, undertake the correspondence with the transit countries on the make-up of the circuits in these countries with a view to preparing the circuit charts, collecting detailed information on the circuits in accordance with the recommendations of the C.C.I. and to drawing up diagrams of the type shown in Appendix No. 1, after as much information as possible has been collected.

At the same time the Administrations in which the circuits terminate shall come to an agreement as to appointing for each of the circuits of a control station and, in collaboration with the Administrations of the transit countries, of sub-control stations. All proposals (or information) on this point of view shall be submitted with as little delay as possible.

The Administration which has under its orders the control station (appointed as explained above) shall prepare the transmission level diagrams, based on an impedance of 600 ohms at the output of the repeaters in conformity with the recommendations of the C.C.I., and they shall forward copies to all the Administrations concerned.

Each Administration shall interpret these levels in terms of the actual line impedance measured at the output of the repeaters. Both the corrected and the uncorrected levels shall be marked on the diagrams which are to be kept at the terminal station, but the former only shall be kept at the intermediate repeater stations.

The Administrations concerned shall, in so far as each is concerned, give the necessary instructions to ensure that the gains of the repeaters are maintained at the correct values.

Finally, the terminal stations shall proceed with the definite lining-up of the circuits. When a sufficient degree of stability has been obtained (if necessary by adjusting the repeater gains) they shall measure the overall transmission at frequencies of 300, 400, 500, 600, 800, 1,000, 1,200, 1,400, 1,600, 1,800, 2,000 and 2,200 p.p.s. and also at 2,400 and 2,500 on extra-light loaded circuits. The repeater stations concerned shall take part in these tests by measuring and, if necessary, adjusting the levels until the terminal stations have obtained the most satisfactory attenuation values and until the repeater stations have announced that they have the correct levels.

The terminal stations shall plot the overall attenuation as a function of the frequency, and shall make the necessary corrections on the transmission level diagrams, basing the curves and the corrections to the level diagrams on actual measured values.

As soon as possible the Administration to whom the control station belongs shall send to the other Administration concerned copies of a table drawn up as recommended by the

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* This recommendation completes that concerning the maintenance and supervision of the lines and installations given on page 99 and following pages of the White Book (English Translation, pages 51–74).

C.C.I. and indicating the transmission levels on the whole circuit, as well as instructions for the work to be undertaken to maintain the new circuits; for this purpose a form of the type indicated in Appendix No. 2 shall be used.

B.—Routine Tests to be made in order to ensure Satisfactory Operation of the Circuits.

1. Daily Tests.

(*a*) Each morning the operators at terminal stations shall make talking tests on all circuits in order to satisfy themselves that they are in every way suitable for commercial speech. If a fault is observed, the tests described in Section 3a (Monthly Tests) shall be made.

(*b*) The voltage and current of *all* repeaters on the circuits shall be checked.

(*c*) *Ringing Tests.*—In order to check the signalling apparatus the operators shall exchange rings whilst making the talking tests. If the ringing signals are not received correctly, the procedure described in Section 9 (Localisation of faults) shall be applied.

2. Weekly Tests.—The gains of all repeaters *in service* at a frequency of 800 p.p.s. ($\omega = 5{,}000$) shall be measured in both directions and the results noted. The time of day for these tests shall be so chosen that the telephone traffic is not interfered with.

3. Monthly Tests.

(*a*) *Overall Attenuation Test.*—This test shall be made on all circuits at a frequency of 800 p.p.s. ($\omega = 5{,}000$), and the results noted. It shall be considered that a fault exists if the results vary by more than 0·2 néper or 1·7 decibel from the normal value. The normal values of overall attenuation are given in Appendix No. 2, together with the control stations, the sub-control stations and the date of the tests. For localisation of faults *see* Section 9.

(*b*) *Determination of Singing Point on 2-wire Circuits.*—In order to check the stability of the 2-wire circuits their singing point shall be measured and noted. This test shall be carried out as follows: With all other repeaters giving a *normal* gain the gain given by the repeater under test shall be increased in both directions until singing sets in. The gain shall then be decreased until singing ceases. One-half of the sum of the increases of gain in the two directions over the normal gains shall be taken as a measure of the stability of the circuits. This value should not be less than 0·4 néper or 3·4 decibels.

This value is provisional and may be modified later as a result of the experience obtained. If it is impossible to reach the singing point even when the gains of a given repeater are increased to a maximum, the gains of one or two neighbouring repeaters shall be increased until singing takes place. As explained above, note shall be taken of one-half of the sum of the increases of gain for each of the repeaters.

(*c*) *Determination of Singing Point of 2-wire Telephone Repeaters.*—This test shall be made by one of the methods described by the C.C.I. (*see* White Book, pages 108–110; English Translation, pages 58–60).

(*d*) *Determination of Singing Point of 4-wire Circuits.*—It is proposed to try certain methods as soon as the opportunity presents itself. Until then it is not possible to recommend any method applicable in all cases.

(*e*) *Line Insulation Resistance.*

(*f*) *Conductor Resistance.*—These tests shall be carried out as recommended by the C.C.I., but the results need not be communicated to the control or sub-control stations. The results shall be noted and kept at the repeater station at which the tests are made.

(*g*) *Ringing Apparatus.*—The ringing apparatus shall be tested every month, the repeater station concerned measuring and noting the voltage necessary to operate them.

4. Quarterly Tests.—Measurements of transmission level at 800 p.p.s. ($\omega = 5{,}000$) shall be made at all stations shown in Appendix No. 2 at the same time as the monthly overall transmission tests are being made. Note shall be made of the normal and measured values of transmission level.

During these tests the overall attenuation on all circuits shall be measured at the frequencies given in Appendix No. 2. The normal values are shown in this Appendix.

5. Half-yearly Tests.

(*a*) *Measurement of Gain* given by the repeaters over a certain frequency band.

(*b*) *Calibration of Repeaters.*—These tests shall be carried out as recommended by the C.C.I., but the results need not be communicated to the control or sub-control stations. The results shall be noted and be kept at the repeater station at which the tests are made.

6. Yearly Tests.

(*a*) *Impedance Tests.*

(*b*) *Transmission Tests* on the section of line between successive repeater stations.

These tests shall be carried out as recommended by the C.C.I., but the results need not be communicated to the control or sub-control stations. The results shall be noted and kept at the repeater station at which the tests are made.

7. Sundry Tests.

(*a*) *Cross-talk Tests.*—The method of making these tests will be described after the experiments mentioned in Appendix No. 3 have been made.

(*b*) *Measurement of Line Noises.*—If "frying" noises are noticed on the line, the fault shall be localised as described in Section 9.

8. Circulation of Information.—Every three months (in March, June, September and December) all stations shall send to their sub-control stations a report of all trouble or changes on the lines during the preceding quarter. This report shall mention in detail all changes made to the circuits or to the repeaters (changes of type or repeaters, change of conductors, replacing of repeating coils, indication of faults or unsatisfactory operation, including mention of the period of the trouble). The report shall also contain particulars of the results of the weekly gain tests made on the repeaters at 800 p.p.s. ($\omega = 5{,}000$), as well as the results of any transmission level measurements which the stations have made.

Every three months (in January, April, July and October) the sub-control stations shall exchange the information mentioned above, and shall decide if they are to change any entries made on the permanent circuit record card, drawn up as advised by the C.C.I. Mention shall also be made of the results, if known, of the overall attenuation tests appearing in the report of the control station.

It is recommended that the form illustrated in Appendix No. 4 should be used for the exchange of information between repeater stations and sub-control stations.

9. Localisation of Faults.

(*a*) *Defective Transmission.*—If a fault is noticed when the monthly tests of overall transmission are being made, the transmission level shall be measured at the repeater station which is nearest to the frontier, in order to determine in which country the fault has developed. The normal values of transmission level are set down in Appendix No. 2 by the Administrations concerned. The control station or the sub-control stations are responsible for the clearing of the fault; they shall inform the terminal stations of the nature of the fault and shall advise them when it has been cleared.

The terminal stations shall, if requested, take part in the location and clearing of the fault by assisting in the tests made in either country.

If a fault is noticed when the quarterly tests of attenuation at various frequencies are being made, the stations mentioned above shall make transmission level measurements at these same frequencies. The results shall be sent to the central technical department by the control and sub-control stations.

(*b*) *Bad Transmission of Ringing Signals.*—If the ringing signals are not received satisfactorily, the local apparatus shall be verified first; if it appears to be normal, tests of transmission level shall be made in the same way as for a case of defective transmission, except that the frequency shall be 500 p.p.s.

(*c*) *"Frying" Circuit.*—If "frying" noises are heard on the circuit the fault shall be localised by starting from the terminal stations and putting out of circuit one repeater after the other. The defective section of the circuit will be found by noting at which terminal station the noise is heard whilst successive repeaters are put out of circuit.

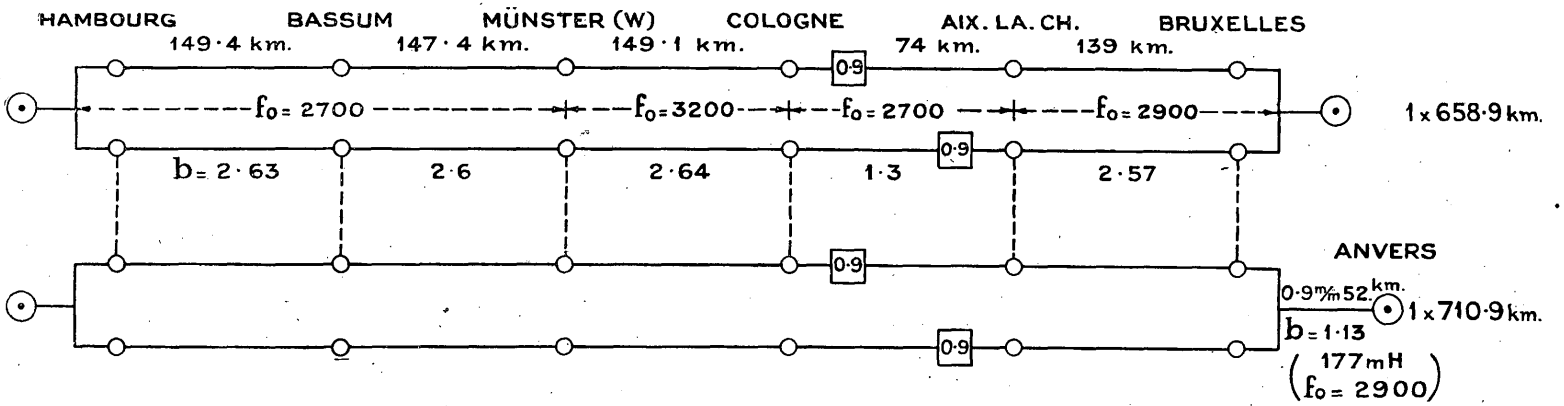
To determine the country in which the fault exists the repeaters which are nearest to the frontier shall be put out of circuit one after the other; the echo suppressors shall be out of circuit during the whole period of these tests.

(*d*) *Cross-talk.*—If service is interfered with by cross-talk, the tests described in Appendix No. 2 shall be made, first of all between terminal stations. In order to find in which country the fault exists, the tests shall be repeated with the repeater stations nearest to the frontier, taking them one after the other and making the tests in both directions from the terminal stations.

The tests described above in (*a*) to (*d*) shall be made every time a fault occurs, even if they have already been made on the same day.

CABLE CIRCUITS—"GERMANY—BELGIUM."

a. 4-WIRE CONNECTION : CONDUCTOR DIAMETER 0·9mm. HEAVY LOADING.



Telephone Exchange.

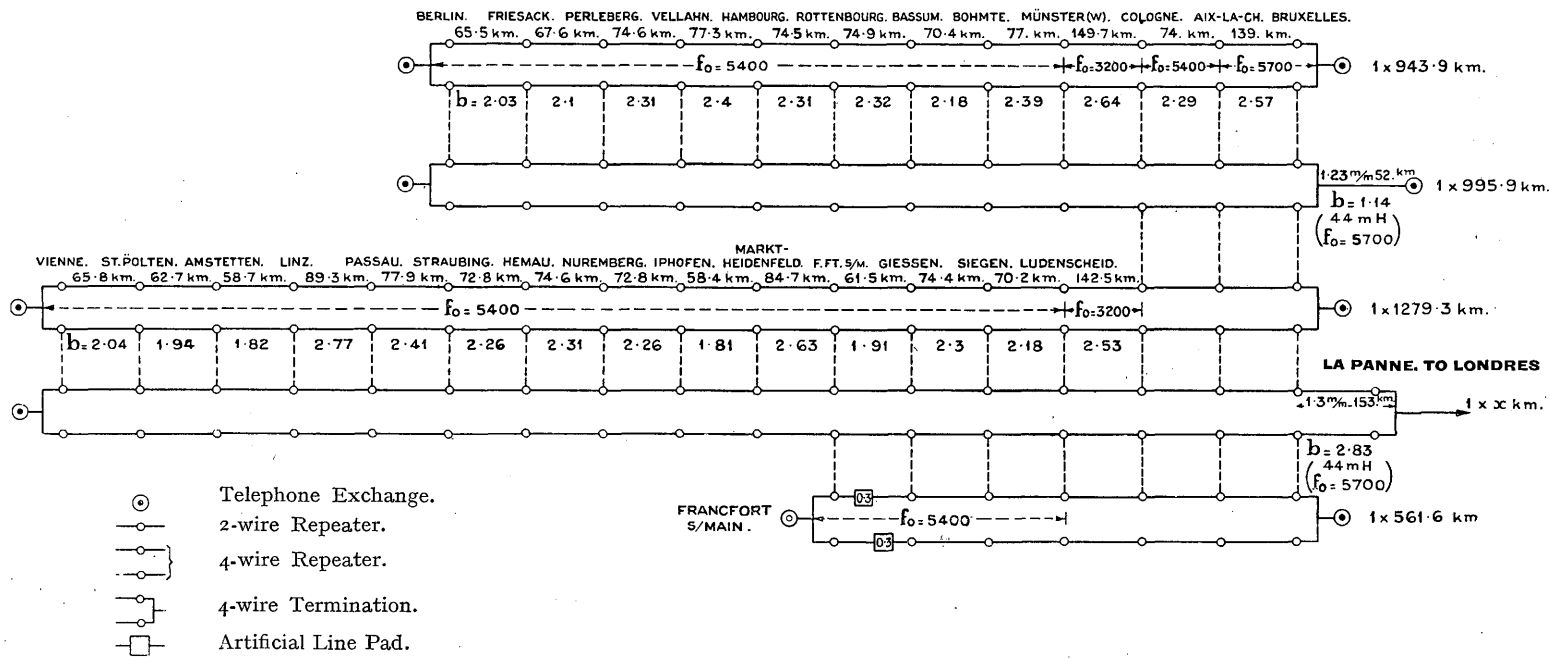
2-wire Repeater.

4-wire Repeater.

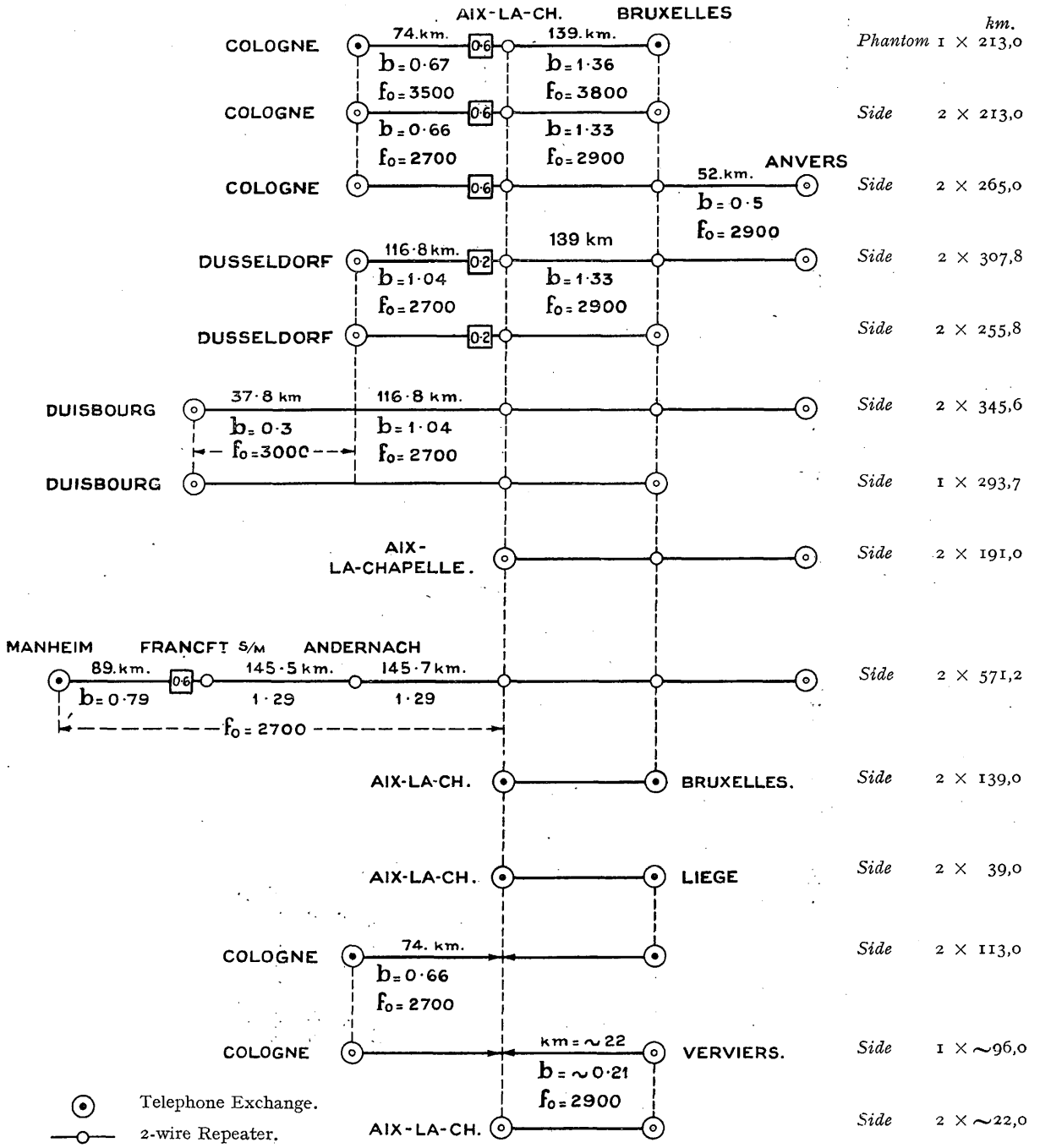
4-wire Termination.

Artificial Line Pad.

b. 4-WIRE CONNECTION : CONDUCTOR DIAMETER 0·9mm. LIGHT LOADING.



c. 2-WIRE CONNECTION : CONDUCTOR DIAMETER { GERMANY—AIX-LA-CH. : 1.4 mm.
AIX-LA-CH.—BRUSSELLS—ANTWERP : 1.5 mm.



ORDER NO.	CIRCUIT.		No. OF CIRCUIT.		CONTROL STATION.	SUB-CONTROL STATION.	MONTH, DAY, HOUR OF ROUTINE TESTS.			NORMAL VALUES.					
	from (A)	to (B)	at (A)	at (B)			Overall Attenuation at 800 p.p.s.	Overall Attenuation at 500, 800, 1,400 and 2,000 p.p.s.	Singing Point on Overall Circuit.	Overall Attenuation at 800 p.p.s.	Overall Attenuation at 500, 800, 1,400 and 2,000 p.p.s.	Transmission Level at output of repeater at ..... Néper. A–B	B–A		Singing Point on Overall Circuit.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

APPENDIX 3.

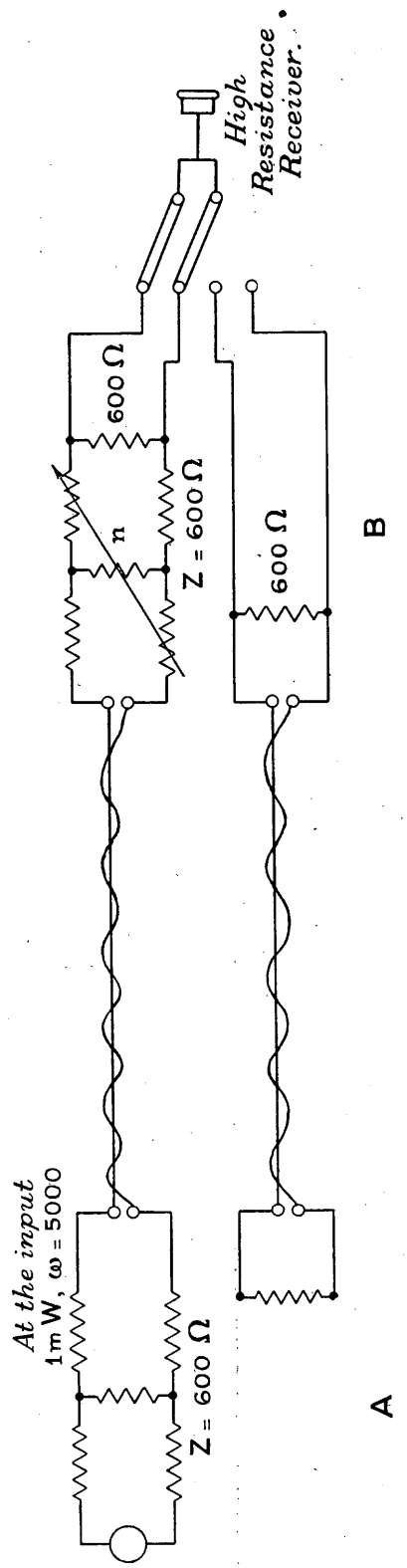
Cross-talk Tests.

It is proposed to make some experimental tests on the London–Berlin and London–Amsterdam circuits in order to collect information on actual values of cross-talk obtained in practice and on variations likely to be met with.

The method of measuring crosstalk is as follows :—

The cross-talk at the receiving end is considered to be equal to $n + n'$, where n' is the total attenuation of the line, and n is the attenuation of the variable artificial line, when the volume of sound in the telephone receiver is the same for the two positions of the switch.

The cross-talk at the transmitting end is measured in the same way, the receiver, artificial line and switch being at the same end of the circuit.



APPENDIX 4.

QUARTERLY REPORT OF THE ..... REPEATER STATION CONTROLLED BY .....

(Sub-control Station.)

Quarter ending.....

Circuit No. .....

	WEEKS IN NUMERICAL ORDER.														HOUR OF TEST.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Routine Tests :															
Gain at 800 p. p. s. .. direction A–B															
Gain at 800 p. p. s. .. direction B–A															
Transmission Level Measurements .. direction A–B															
Transmission Level Measurements .. direction B–A															
Repeater Singing Point Tests .. .. .. direction A–B															
Repeater Singing Point Tests .. .. .. direction B–A															
Circuit Singing Point Tests															

Faults :

Reported.		Cleared.		Nature and Position of Fault : Method used to clear it, etc.
Date.	Time.	Date.	Time.	

Changes to Circuits :

Under any of the headings on the form " Special Instructions for the maintenance of Telephone circuits between ..... and ..... "

A.a.1.

DEFINITION OF SOME EXPRESSIONS USED IN QUESTIONS OF TELEPHONE TRANSMISSION.*

The International Consultative Committee proposes unanimously the following definitions :—

(*a*) **General Definition.**

The transmission unit serves to express the power ratios, apparent or real, of voltages or currents in transmission systems.

In practice the number of transmission units for a given case is determined by a logarithmic expression.

1. If two powers P_1 and P_2 are concerned, the number of units is :

In the Naperian system :

$$\tfrac{1}{2} \log_E \frac{P_1}{P_2};$$

In the decimal system :

$$\log_{10} \frac{P_1}{P_2}.$$

2. If two voltages V_1 and V_2 or two currents J_1 and J_2 are concerned, the number of units is :

In the Naperian system :

$$\log_E \frac{V_1}{V_2} \text{ or } \log_E \frac{J_1}{J_2}.$$

In the decimal system :

$$2 \log_{10} \frac{V_1}{V_2} \text{ or } 2 \log_{10} \frac{J_1}{J_2}.$$

The Naperian unit is called the "néper," the decimal unit is called the "bel." It will be possible to use a decimal sub-multiple of these units : decinéper and decibel.

In the official text of the C.C.I. the names of the units will always be written in full and equivalents, transmission losses or gains, cross-talk, etc., will be expressed in both népers and decibels; as, for example :

A transmission equivalent of 3 népers or 26 decibels.

A.a. 1.

CONDITIONS WHICH THE TRANSMISSION REFERENCE SYSTEMS SHOULD FULFIL.†

The C.C.I., after having studied a certain number of questions relating to telephone transmission systems, is unanimously of opinion that the following arrangements should be observed :

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* This replaces the text under the same title on page 50 of the White Book (English Translation, page 15).

† This chapter replaces that published under the same title on pp. 53–58 of the White Book (English Translation, pp. 19–21).

I.—TRANSMITTING SYSTEM.

Definition of the Acoustic Input to the Transmitter.

In order to simplify the definition of the reference system, it is useful to start with the sound pressure rather than with the acoustic power. For the transmitter the ratio of the voltage delivered to the input of the reference artificial line to the uniform sound pressure on the diaphragm of the reference transmitter is chosen as the measure of efficiency. Hence it is necessary to fix the essential external mechanical dimensions of the reference transmitter and the manner in which it is to be used.

Method of measuring the Acoustic Input to the Transmitter.

For the measurement of sound pressure any reliable method may be used (*e.g.*, Thermophone, Rayleigh Disc, or compensation methods).

Maximum permissible Acoustic Power for which the Transmitter is to be constructed.

The maximum acoustic pressure depends upon the permissible non-linear distortion. It has been found that when the types of transmitters and receivers mentioned below, together with suitable amplifiers, are used, no appreciable non-linear distortion is produced over the range of sound pressures normally occurring.

The value of the Output Impedance of the Transmitting System.

In order to have all required corrections in a positive direction it is convenient to select 600 ohms (zero angle) as the output impedance of the transmitting system. A tolerance of $\pm$ 5 per cent. and an angle not greater than $\pm$ 10° may be permitted over the frequency range 100 to 5,000 p.p.s.

Adjustment of the efficiency of the Transmitting System.

The efficiency of the transmitting system must be adjustable in steps of 0·1 néper or 0·87 decibel between the limits of — 1 néper or — 8·7 decibels to + 1 néper or + 8·7 decibels.

Ratio between the Acoustic and Electric Power (taken respectively at the Input and Output of the Transmitting System) defining the Zero Point of the Transmitting System.

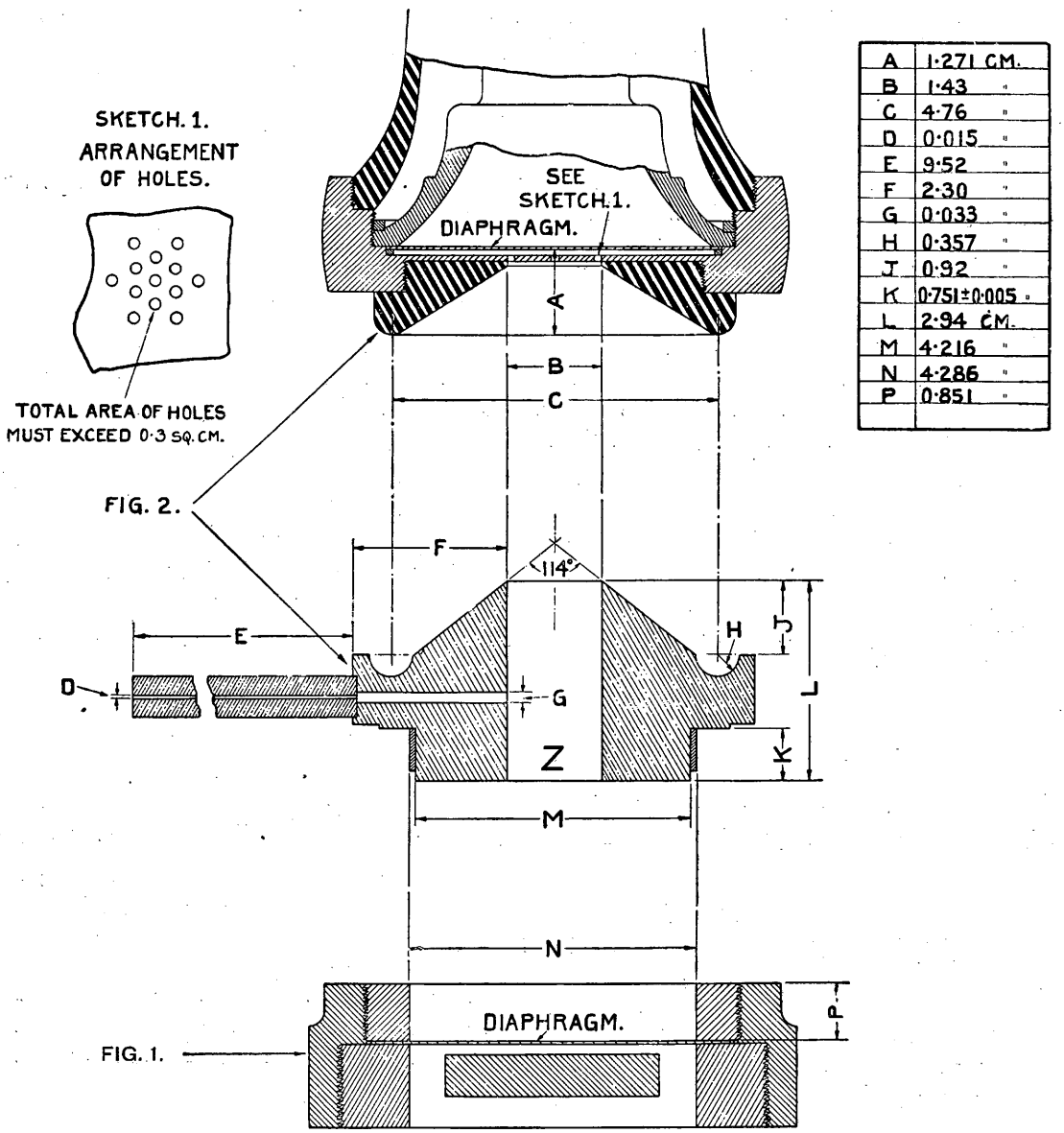
The zero point of the transmitting system should approximate to that of the standards for commercial transmitting systems in general use and is therefore designed provisionally by the value of 0·05 volt per bar (dyne per cm.^{2}) taken as the arithmetical mean of this ratio over the frequency range from 500 to 2,500 p.p.s.

Frequency Range in which this Ratio must remain Constant. Tolerable Variations of this Ratio within this Frequency Range.

The variations of this ratio must not exceed $\pm$ 0·2 néper or $\pm$ 1·74 decibel in the frequency range between 100 and 5,000 p.p.s.

Maximum permissible Non-linear Distortion (*a*) for the Maximum Power, (*b*) for a given Fraction of this Power.

The maximum acoustic pressure on the transmitter depends on the permissible non-linear distortion. Experience has shown that for normal intensity the use of the types of transmitter and of receiver specified below and associated with suitable amplifiers, does not give rise to any appreciable non-linear distortion.



FIGS. 1 AND 2.

Method of construction of Transmitting System satisfying the required Conditions.

A transmitting system composed of a condenser transmitter with stretched metallic diaphragm connected to a suitable amplifier is recommended. The essential dimensions of

the condenser transmitter are indicated in Fig. 1. To compensate the variations which may occur a regulating device should be included in the transmitting system.

II.—REFERENCE ARTIFICIAL LINE.

Characteristic impedance of the Reference Artificial Line.

The Reference Artificial Line must have a characteristic impedance of 600 ohms (zero angle). A tolerance of $\pm$ 1 per cent. in the value of the modulus and of $\pm$ 2° in the value of the angle may be permitted over the frequency range 100 to 5,000 p.p.s.

Adjustment of the attenuation of the Reference Artificial Line.

The attenuation of the Reference Artificial Line must be adjustable in steps of 0·02 néper or 0·174 decibel between the limits 0 and 12 népers or 104 decibels.

III.—REFERENCE RECEIVING SYSTEM.

Definition of the Acoustic Output of the Receiver.

The sound pressure delivered at the end (marked Z in Fig. 2) of a metallic acoustic coupler (artificial ear passage) should be regarded as a measure of an acoustic output. The essential dimensions of the coupler are shown in Fig. 2. It is necesssary to fix the essential dimensions of the receiver in the same way as for the transmitter, and these are given also in Fig. 2.

Method of measuring the Acoustic Output of the Receiver.

The measurement of the sound pressure, as in the case of the transmitter, may be carried out by means of any practicable method (calibration by means of a condenser transmitter and the sound pressure compensation method are in practical use).

The value of the Electrical Impedance at the Input of the Receiving System.

The impedance of the receiving system must be 600 ohms (zero angle). A tolerance of $\pm$ 5 per cent. in the value of the modulus and $\pm$ 10° in the value of the angle over the frequency range 100 to 5,000 p.p.s. may be permitted.

Adjustment of the efficiency of the Receiving System.

The efficiency of the receiving system must be adjustable by steps of 0·1 néper or 0·87 decibels between the limits of $-$ 1 néper or $-$ 8·7 decibels to $+$ 1 néper or $+$ 8·7 decibels.

Ratio between the Electrical and Acoustic Powers (taken respectively at the Input and Output of the Receiving System) defining the Zero Point of the Receiving System.

The efficiency of the reference receiving system is determined by the ratio of the sound pressure at the end marked Z in Fig. 2 of the acoustic coupler (artificial ear passage) to the input voltage across the receiving system. The zero point of the receiving system should approximate to that of the standard commercial receiving systems in general use and is defined provisionally by the value of 50 bars (dynes per cm.^{2}) per volt, taken as the arithmetical mean of this ratio over the frequency range 500 to 2,500 p.p.s.

Frequency range over which this Ratio must remain Constant. Tolerable variations of the Ratio in this frequency Range.

The variations of this ratio must not exceed $\pm$ 0·4 néper or $\pm$ 3·5 decibels for frequencies lying between 300 and 3,000 p.p.s. and $\pm$ 1 néper or $\pm$ 8·7 decibels for frequencies lying between 100 and 5,000 p.p.s.

Maximum non-linear distortion permissible in the Receiving System (*a*) for Maximum Power, (*b*) for a given Fraction of this Power.

The maximum acoustic pressure on the transmitter depends on the permissible non-linear distortion. It has been found that for sounds of normal intensity the use of types of transmitter and receiver specified below when associated with suitable amplifiers does not give rise to any appreciable non-linear distortion.

Method of construction of Receiving System satisfying the required Conditions.

A receiving system composed of a receiver of the bell type, with a diaphragm additionally damped, connected to a suitable amplifier, is recommended.

The essential dimensions of the ear cap of this receiver are shown in Fig. 2.

Receivers of the moving coil type have also been found satisfactory in performance and may prove to be preferable if their constancy is found to be adequate.

To compensate the variations which may occur a regulating device should be included in the receiving system.

Comparison of Primary Reference Systems with Master Reference System, and the Intervals of Time at which such Comparison should be made.

Since the Primary Reference System is defined as an exact copy of the Master Reference System, it may be assumed that the performance of the amplifiers, attenuators, etc., is practically identical in the two systems, and is in any case easily capable of measurement without being related to the Master Reference System. Under such conditions it appears that it is sufficient to compare transmitters and receivers of the Primary Systems with those of the Master Reference System in the laboratory of this system (*i.e.*, the Master System). Comparable frequency characteristics can then be obtained by using the equipment of the Master Reference System and its thermophones. Measurements of comparison by voice and ear and measurements of articulation are equally necessary and must be carried out under distortionless conditions. As differences of tone can be neglected in this case, precise results can be obtained with three observers by carrying out only a relatively small number of measurements, the exact number to be determined experimentally.

Until considerable experience has been gained on this subject it is preferable to repeat the calibrations every nine months, in order that these calibrations may be carried out under variable atmospheric conditions.

The necessity of making complete voice and ear tests in addition to taking frequency characteristics results from the presence of the tolerances permitted in the transmitting and receiving systems.

The tolerance which may be permitted for the transmitting system considered in relation to an ideal system may either increase the maximum tolerance permitted for the receiving system, or may reduce it; so that two assemblies of apparatus conforming to the given specification may have very different characteristics and, in consequence, their performance may be very different.

Comparison of Secondary Systems with Primary Systems and with the Master System, and the Intervals of Time at which this Comparison must be repeated.

Since a Secondary System may differ considerably from the Master Reference System, the first calibration would have to be made in the laboratory of the Master System employing the complete Secondary System, but using the procedure adopted for the calibration of the Primary Reference System. After the first calibration it would probably suffice to recalibrate the transmitters and receivers of the Secondary System.

Realisation of Working Standards corresponding to the different Types of Commercial Telephone Connections existing in different Countries.

Calibration of these Working Standards by relation to the Master, Primary and Secondary Systems, and the Intervals of Time at which these Calibrations must be Repeated.

It will, without doubt, be most convenient to obtain Working Standards by choosing certain pieces of apparatus of commercial type. These pieces of apparatus will be compared with the Master Reference System or with the Primary System by volume tests and by articulation measurements made by voice and ear.

The Administrations will have to make some preliminary tests (on a certain number of transmitters and receivers) which will be used as Working Standards (before calibrating them by comparison with the Master System); these tests will be made to ensure that the instruments are sufficiently stable. This will avoid loss of time during calibration.

The calibration of Working Standards by comparison with the Master System furnished with added distortion is a fairly complicated operation. If it is desired to know the total efficiency of a Working Standard circuit there will be no difficulty, each circuit being complete in itself and measured in its entirety.

If it is desired to know only the transmission efficiency of such a circuit two methods are possible :—

The transmitter of the Working Standard can be substituted for the transmitter of the Master Reference System in the circuit of the Master System, or the transmitter of the Master System may be substituted for the transmitter of the Working Standard in the circuit of the Working Standard.

Since the transmission efficiency of a transmitter possessing resonance depends to a certain extent on the accord between this transmitter and the receiver used for listening, it is probable that these two methods will give different results. In practice, a transmitter (having resonance) of a Working Standard will normally be used with a receiver having resonance. Usually these pieces of apparatus are more or less in accord, so that the efficiency from the point of view of sound volume will be found better than if one or the other of the pieces of apparatus were not resonant. It is always possible that in international service it will happen that pieces of apparatus of different model are used at the two ends of the line; for this reason a more correct value of transmission efficiency will be obtained for the Working Standard if the first method outlined above has been used, and preference should be given to this method.

When the Working Standard is used to check the efficiency of commercial apparatus, errors will always occur because of the difference in accord referred to above; it appears that this is in any case inevitable, but that the errors can be reduced to a minimum by associating successively several receivers with one transmitter.

The difficulty would not be removed by using receivers without resonance on the circuit of the Working Standard, since what is required to be determined is the efficiency of a commercial piece of apparatus operating with a commercial receiver; further, the measurement of articulation must be made with a receiver of commercial type.

Evidently the foregoing considerations do not reduce at all the value of the Reference System either as a basis of comparison of transmission or as a means of verifying that the Working Standards have not varied. It is possible that transmitters used as Working Standards by different Administrations may have appreciably different efficiencies, and that, however, the total efficiencies of transmission in the limits of territory served by the different Administrations may be the same, because of the correlation between the respective resonances of the transmitters and receivers. That is why it seems convenient to measure the total

efficiency of each Working Standard circuit as well as the elements constituting this circuit. The paragraphs above apply equally to the calibration of receivers.

Volume Level of Sound and Temperature.

Because the mechanical construction of the Master System and the Primary Reference Systems, on the one hand, differ entirely from those of the Working Standards on the other, it is necessary to fix a volume level of sound for comparison measurements, as well as a normal temperature at which these measurements must be made.

The International Consultative Committee has already mentioned the apparatus which may be used to measure the volume level of sound (*see* White Book, pages 203–209; English Translation, pages 147–155). By means of this apparatus it is possible to maintain this level at a constant value corresponding to a normal conversation. As regards temperature, it is considered that it will be sufficient to maintain a normal room temperature.

Definition and Determination of the "Experimental Practice Coefficient" of different Crews of Operators carrying out Voice and Ear Tests and working in the Phonometric Laboratories of the different Administrations.

In order to compare with one another the different crews of operators carrying out voice and ear tests, it will be best for each Administration to send its crew to the laboratory of the Master Reference System at the time of the calibration of the Working Standards which will be used ultimately by this Administration. The results of voice and ear measurements obtained by this crew in the calibration of these Working Standards by comparison with the fundamental system will thus be compared directly with the results obtained at the same time by the operators attached to the laboratory of the Master Reference System.

Tests (Physical and Physiological) to be carried out in engaging Operators for the Phonometric Laboratories in order to ensure that their Hearing and Voices are in good Condition.

The French Administration has adopted a series of physical and physiological tests to which it submits the personnel of the transmission testing department; these tests could very well be employed for the personnel of the laboratory of the Master Reference System.

Details can be found in the publications of the library of the C.C.I., and, when required, the Secretary will supply extracts on this subject to any Administrations who are interested.

Definition and Determination of the mean correcting Factors corresponding to the different Languages in order to allow comparisons of Results of Measurements on Articulation carried out in different Countries, taking account of the Language employed.

In order that results of articulation obtained in different countries may be compared, it will be necessary to attempt to determine and define the correction factor corresponding to different languages. This will be done in the laboratory of the Master System and it will be possible to establish at a later date a method of carrying out these researches.

Corrections to be applied to the Results of Measurements of Transmission Equivalents or Efficiency of Transmission to take account of the difference in impedance between the pieces of Apparatus measured and the Elements corresponding to the Reference System.

The mean impedance of international cable circuits only differs slightly from that established for the Master Reference System. The reflection losses produced in circuits will be approximately of the same order both in practice and in the Master Reference System. For this reason it does not seem necessary to apply any correction in practice.

A.f.

CO-EXISTENCE OF TELEPHONE AND TELEGRAPH CIRCUITS IN THE SAME CABLE.*

The International Consultative Committee—

Considering :—

That technical arrangements already exist which permit telephone and telegraph service in the same cable, either over separate conductors or even over common conductors; that with these arrangements, and by taking the precautions stated below, the telephone circuits, including phantoms, are practically not influenced by the telegraphs, either from an electrical or from a traffic standpoint;

That even when the cable is subject to influence by power systems (in particular, railroads using A.C.), it is possible to obtain a telephone and telegraph service free from interference troubles by using devices which have already proved satisfactory in practice;

That, furthermore, the simultaneous use of long-distance cables for telephony and telegraphy is recommended for economical reasons;

Unanimously advises :—

That the simultaneous exploitation of international telephone and telegraph circuits in the same cables be forthwith accepted in principle, either over separate conductors or common conductors, on condition that all measures be taken to ensure that the telegraph does not interfere with present and future telephone traffic;

The provisory conditions which, in the present state of the technique, shall be met by simultaneous or coexistent telegraph and telephone installations, are as follows :—

I.—SIMULTANEOUS TELEGRAPHY AND TELEPHONY (OVER THE SAME CONDUCTORS) OR INFRA-ACOUSTIC TELEGRAPHY.

In order not to prejudice the transmission quality of telephone circuits the following requirements must be met :—

1. The E.M.F. produced in the line circuit by the telegraph transmitter must not exceed 50 volts.

2. When the terminals of the telegraph transmitter are closed through a resistance of 30 ohms substituted for the line, the current through this resistance must not exceed 50 m.a.

3. The increase in the attenuation of the telephone line due to infra-acoustic telegraph installations must not exceed 0·06 néper or 0·52 decibel for a line section having the length of the section between two successive repeaters and over the frequency range of 300 p.p.s. and the maximum frequency transmitted.

4. Over 4-wire circuits the variation of line impedance produced by infra-acoustic telegraph installations must not exceed 10 per cent. in the frequency range indicated. As regards 2-wire circuits, infra-acoustic telegraph installations must not exceed the values prescribed by the Telephone C.C.I. for the exact simulation of the impedance of the line by balancing networks.

5. Interference noise produced in telephone circuits by telegraph apparatus must not exceed a value which corresponds to an interference voltage of 0·1 m.v. for a transmission level of — 1 néper or — 8·7 decibels and an impedance of 800 ohms.

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* This chapter replaces that published under the same title, pages 127–135 of the White Book (C.C.I., 1926) (English Translation, pages 75–82).

6. The increase in cross-talk produced by infra-acoustic telegraph installations shall be determined as follows :—

The cable quads are replaced by artificial lines free from cross-talk and reproducing within the closest possible limits, the impedances of the circuits (terminal apparatus for quads). Under these conditions the attenuation corresponding to the cross-talk measured from the telephone office side must not be inferior to the following values :—

(*a*) For 4-wire circuits : 7·5 népers or 65 decibels for the cross-talk between any two speech circuits in the same quad;

(*b*) For 2-wire circuits : 8·5 népers or 74 decibels for the cross-talk between any two speech circuits in the same quad;

(*c*) For 4-wire and 2-wire circuits : 10 népers or 87 decibels for the cross-talk between two speech circuits in different quads.

7. For International telephone communications the total length of circuit sections employed simultaneously for infra-acoustic telegraphy must not exceed 450 kilometres.

8. After infra-acoustic telegraph systems are connected into a circuit the unbalance to earth must not exceed the value prescribed by the C.C.I.

II.—CO-EXISTENT TELEGRAPHY AND TELEPHONY (OVER SEPARATE CONDUCTORS).

1. Where the telegraph uses loaded conductors which may later be used for telephony, the conditions stated under heading **1**, Nos. 1, 2 and 5 must be fulfilled.

2. Where the telegraph uses non-loaded conductors, paragraph 5 of heading **1** need only be fulfilled.

III.—VOICE FREQUENCY TELEGRAPHY.

The sum of the effective voltages corresponding to the frequencies used simultaneously over the same circuit should be less than 2 volts, and the sum of the effective currents corresponding to the frequencies used simultaneously over the same circuit shall be less than 2 m.a. When it is required to use currents or voltages greater than the above values, it is desirable, for preference, to choose the circuits allotted to telegraph purposes in outer layers of the cable and to balance them in separate groups.

The Committee has received and will study later the following proposal (Appendix) :—

" Proposal for the selection of carrier telegraph frequencies to be used in loaded telephone cables."

Selection of Carrier Frequencies.

The International Consultative Committee—

Considering :—

That in cables the use of carrier frequencies of harmonic multiple telegraphy instead of separate wires is to be strongly recommended;

That it would be very desirable to have standardised carrier frequencies for harmonic multiple telegraphy;

That on this subject a proposal has been formulated by the International Consultative Committee for telegraph communications which deals with these questions;

That, however, it has not yet been possible to estimate the influence of all the factors involved;

Unanimously advises :—

That provisionally the indications contained in the Appendix can be taken into consideration.

APPENDIX.

PROPOSAL FOR THE SELECTION OF CARRIER TELEGRAPH FREQUENCIES TO BE USED IN LOADED TELEPHONE CABLES.

It is desirable that the different nations should agree as to the exact frequency values to be employed in voice frequency carrier current telegraphy, particularly over loaded telephone circuits. With reference to telegraph apparatus, it is necessary to consider, first of all, Start-Stop apparatus, Siemens high-speed telegraphs and Multiplex systems.

Taking as a basis an output of 480 letters per minute for Start-Stop apparatus and 1,500 per minute for Multiplex apparatus, there results for the two cases a dot frequency of 56 and 125 cycles per second. To transmit this a filter frequency band of 65 and 150 cycles per second is required. Such a transmission band is also adequate for the operation of the Siemens high-speed telegraph system.

For medium-heavy loaded cables a frequency band is available between 300 and 1,800 cycles per second. When a distance of at least 50 cycles per second between the cut-off frequencies of adjacent filters is prescribed, it is possible to operate 12 Start-Stop systems or Siemens high-speed telegraph and 6 multiplex systems within this interval.

Regarding the distribution of carrier frequencies it is necessary to take care, on the one hand, that the carrier frequencies are odd multiples of a single fundamental frequency, so that interference oscillations which may occur shall not be included in any of the channel frequency bands and, on the other hand, that the carrier frequencies for simplex and multiplex apparatus coincide, thus allowing the same source of current to be used for both systems.

These requirements will best be made by starting from the fundamental frequency :

60 for single channel transmission apparatus (Start-Stop or Siemens high speed), and 113 for multiplex apparatus.

The following odd multiples are then obtained (Table 1).

Simplex Apparatus.	Multiplex Apparatus.	Percentage Frequency Difference.
p.p.s.	p.p.s.	%
420		
540	565	5
660		
780	791	1·3
900		
1020	1017	0·3
1140		
1260	1243	2
1380		
1500	1469	2
1620		
1740	1695	2·6

TABLE 1.

Applying in place of the carrier frequencies indicated in the second column those indicated in the first column, a maximum variation of 5 per cent. is obtained, the interference oscillations being in this case sufficiently removed from the carrier frequencies of the different filters. It is thus expedient to select the transmission bands given in Table 2.

Simplex Apparatus.			Multiplex Apparatus.		
Frequency No.	Carrier Frequencies.	Frequency Bands.	Frequency No.	Carrier Frequencies.	Frequency Bands.
	p.p.s.	p.p.s.		p.p.s.	p.p.s.
1	420	387.5– 452.5	1	540	465– 615
2	540	507.5– 572.5			
3	660	627.5– 692.5	2	780	705– 855
4	780	747.5– 812.5			
5	900	867.5– 932.5	3	1020	945–1095
6	1020	987.5–1052.5			
7	1140	1107.5–1172.5	4	1260	1185–1335
8	1260	1227.5–1292.5			
9	1380	1347.5–1412.5	5	1500	1425–1575
10	1500	1467.5–1532.5			
11	1620	1587.5–1652.5	6	1740	1665–1815
12	1740	1707.5–1772.5			

TABLE 2.—CARRIER FREQUENCY BANDS FOR SIMPLEX AND MULTIPLEX APPARATUS.

Simplex Apparatus.				Multiplex Apparatus.		
Frequency No.	Range.	No. of lines/ min. for the range indicated.	Siemens high-speed telegraph.	Frequency No.	Range.	No. of lines/min.
	Km.				Km.	
1–4	10,000	1,920	2,640	1	1,900	1,500
1–5	6,500	2,400	3,300	1–2	1,500	3,000
1–6	5,000	2,880	3,960	1–3	800	4,500
1–7	4,200	3,360	4,620	1–4	500	6,000
1–8	3,500	3,840	5,280	1–5	400	7,500
1–9	3,000	4,320	5,940	1–6	300	9,000
1–10	2,300	4,800	6,600			
1–11	1,900	5,280	7,260			
1–12	1,500	5,760	7,920			

TABLE 3.—RANGE FOR CIRCUITS IN MEDIUM-HEAVY LOADED CABLES.

The same method could be used for circuits with light loading.

For the reason that the duration of propagation of the frequencies appropriated to the transmission is more or less long, the transient period exceeds the duration imposed by the filter frequency band. The differences in duration of propagation of frequencies included in a band are increased in proportion as the carrier frequencies approximate to the cut-off frequencies of the circuits and as the filter bands are widened. The range of the different carrier frequencies is therefore limited. If an extension of 10 per cent. of the transient periods is allowed, the duration of which depends on the width of the filter band, the theoretical ranges given in Table 3 are obtained for cables with medium-heavy loading.

For distances exceeding 300 km. the best operation of the circuit is obtained if multiplex and simplex apparatus are used simultaneously. For different distances the most favourable conditions will be as indicated below:—

Length of line.	Multiplex Apparatus Frequencies No.	Simplex Start–Stop Apparatus Frequencies No.	Total No. of Letters transmitted per minute.	Multiplex Apparatus Frequencies No.	Siemens High-Speed Telegraph.	Total No. of Letters transmitted per minute.
Km.						
300	1–6	—	9,000	1–6	—	9,000
300– 400	1–5	12	7,980	1–5	12	8,160
400– 500	1–4	10–12	7,440	1–4	10–12	7,980
500– 800	1–3	8–12	6,900	—	1–12	7,920
800– 1,300	1 and 2	6–12	6,360	—	1–12	7,920
1,300– 1,900	1	4–11	5,340	—	1–11	7,260
1,900– 2,300	—	1–10	4,800	—	1–10	6,600
2,300– 3,000	—	1– 9	4,320	—	1– 9	5,940
3,000– 3,500	—	1– 8	3,840	—	1– 8	5,280
3,500– 4,200	—	1– 7	3,360	—	1– 7	4,620
4,200– 5,000	—	1– 6	2,880	—	1– 6	3,960
5,000– 6,500	—	1– 5	2,400	—	1– 5	3,300
6,500–10,000	—	1– 4	1,920	—	1– 4	2,640

For cables with extra light loading there is available the band between 300 cycles per second and 2,500 cycles per second. Within this band it is possible to operate with the fundamental frequency of 60 cycles per second:

9 multiplex transmissions and 18 single-channel transmissions.

Frequency No.	Frequency in p.p.s.	Range in Km.
1	540	2,200
2	780	5,000
3	1,020	5,900
4	1,260	5,300
5	1,500	4,400
6	1,740	3,400
7	1,980	2,500
8	2,220	2,000
9	2,460	1,800

TABLE 4.—RANGE OF MULTIPLEX APPARATUS OVER CIRCUITS IN EXTRA LIGHT LOADED CABLES.

For simplex systems, under the same conditions as indicated above, there will generally be theoretical ranges of more than 10,000 km. For multiplex apparatus, Table 4 indicates the range for circuits in extra light loaded cables.

As is known, it is possible to compensate to a certain extent the difference in the duration of propagation for different frequencies.

Using for this object the same networks as those used in telephony, it is possible to obtain the following ranges :—

Frequency No.	Simplex Apparatus.	Frequency No.	Multiplex Apparatus.
1	8,000	1	8,000
2–12	10,000	2	8,000
		3	5,000
		4	2,000
		5	3,000
		6	5,000

TABLE 5.—RANGE IN CABLE CIRCUITS WITH PHASE BALANCING.

The most favourable distribution resulting from this is indicated below :—

Length of line.	Simplex Apparatus Frequency No.	Multiplex Apparatus Frequency No.	Total Number of Letters transmitted per minute.	
			Start-Stop Apparatus.	Siemens High-Speed Telegraph and Multiplex Apparatus.
Km.				
2,000	—	1–6	9,000	9,000
2,000–3,000	8	1–3, 5·6	7,980	8,160
3,000–5,000	8–10	1–3, 6	7,440	7,980
5,000–8,000	6–12	1 and 2	6,360	7,920
8,000	2–12	—	5,280	7,260

Summary.—It is proposed to employ Voice-Frequency Carrier operation for international traffic on loaded cables and a study is being made to determine what output it is possible to obtain from the circuits with Start-Stop apparatus, Siemens high-speed telegraph and Multiplex apparatus. The frequencies proposed can be very well adapted to all practical requirements.

LIST OF TRANSMISSION QUESTIONS UNDER EXAMINATION.

A.—Various questions concerning Transmission and Maintenance.

1. Possibility of standardising long-distance telephone systems.
2. Limits imposed by transient effects and methods by which these limitations can be reduced (*see* White Book, page 73; English Translation, page 32).
3. Method of cross-talk measurement intended to replace voice tests.
4. New specifications and revision of existing specifications concerning repeater stations :—
   - (*a*) Terminal apparatus and protecting devices.
   - (*b*) 2-wire and 4-wire repeaters.
   - (*c*) Power Supply Equipment.
   - (*d*) Signalling Equipment.
   - (*e*) Balancing Equipment for 2-way repeaters.
   - (*f*) Echo Suppressors.
5. Revision of the standard specifications of the C.C.I., taking into consideration recent progress in cable manufacture, especially in relation to numerical data characterising regularity of manufacture.
6. List of usual phrases to be used by fault location and testing services and in repeater stations for the maintenance of international communications.
7. Co-ordination of wireless telephony and wire telephony from the point of view of technical questions concerning the international network.

B.—Questions concerning Reference Systems for Telephone Transmission.

1. What are the various acceptable methods of constructing Secondary Reference Systems?
2. Does the figure 0·05 volt per dyne per square centimetre (volts per bar), specified provisionally in the proposals of the London Conference for the zero level of the transmitting system, correspond with the efficiency of the commercial types of standard transmitting systems used by the various Administrations in their working standards for every-day measurements?
3. Does the figure 50 dynes per square centimetre per volt (bars per volt), specified for the zero level of the receiving system, actually correspond to the efficiency of the commercial types of standard receiving systems used by the various Administrations in their working standards for every-day measurements?
4. Method of transmission equivalent measurement of subscribers' apparatus and subscribers' lines enabling it to be determined rapidly whether a subscriber's station (including a subscriber's line, junction elements, etc.) meets the conditions required for international service.
5. What general method shall be used for articulation tests carried out on international circuits?
6. Relation between "syllable articulation" (*see* White Book, page 52; English Translation, page 16) and "word articulation" (intelligibility) principally in cases of very long telephone circuits.

C.—Questions and Proposals concerning the Organisation of the Laboratory of the European Fundamental System of Telephone Transmission.*

(*a*) *Questions.*

1. Programme of examinations for recruiting operators for the European Fundamental Systems Laboratory and programme of the Preliminary course to be followed by them.
2. Fixing the tariffs for the calibration of Primary or Secondary Systems or of working standards.
3. Scientific and technical research which the Fundamental Reference System makes possible in addition to regular calibrations. General rules to be followed in the execution of and the fixing of tariffs for these special investigations.

(*b*) *Proposals.*

The American Telephone and Telegraph Company will deliver and instal the apparatus of the European Fundamental System in the early part of 1928. It is proposed that during the installation an experienced engineer of the French P.T.T. Administration (who will later occupy a part of his time with the general supervision of the laboratory) and an assistant (who will later be in charge of the calibration work under the supervision of the Engineer and will devote all his time to this work) shall be placed at the disposal of the representatives of the A. T. & T. Co. to give them any assistance required, and to obtain from them as much information as possible during the period of installation and test. It is expected that the engineer-in-charge of the general supervision of the Fundamental System will devote at the most one-third of his time to this work. The International Consultative Committee will endeavour to secure the services of Mr. Chavasse, who is a member of the Reference System Commission.

When the calibration work commences, three operators will be necessary to carry out the comparative voice and ear tests as well as the articulation tests and the alternating-current measurements, including the calibration of the Fundamental System itself and the graph of the amplitude-frequency characteristics of Primary Systems apparatus or of Secondary Systems as a whole.

The senior of these three operators will be the afore-mentioned assistant, placed at the disposal of the C.C.I. by the French P.T.T. Administration; he should have the requisite technical abilities and, in addition, must comply with the physical and physiological conditions necessary to undertake the voice and ear tests and the articulation test. It is considered that such an operator (Chief of the Operating Staff) could be obtained for 6,000 gold francs per annum.

It is proposed that, in the first instance, the other two operators be recruited in Germany and Great Britain respectively. With regard to Great Britain, the Post Office could release a young man of the grade of "transmission assistant" for, say, one year; this assistant could be replaced by another at the end of this period so that ultimately a certain number of operators would obtain experience with the Reference System and at the same time improve their knowledge of the French language. It is estimated that, provisionally, a salary of about 5,000 gold francs per annum would be sufficient for each of the operator assistants. If it is considered desirable, the British Post Office is willing to receive the Engineer and the Chief

* The Committee of Assessors permanently in charge of the study of questions concerning Reference Systems will have full latitude to take any decisions necessary on these subjects before the Plenary Meeting of the C.C.I. in 1928.

of the operating staff at the Research Laboratories at Dollis Hill for one month's study of the technique of voice and ear tests or articulation tests.

According to these various propositions, the expenses which the C.C.I. would incur for staff would include :—

(1) An allowance for the engineer-in-charge of general supervision equal to one-third of the salary which would be granted to him if he were exclusively in the service of the C.C.I.

(2) The salary of the assistant, chief of the operating staff.

(3) The salary of the two other operators.

(4) The expenses for the stay in London of the engineer and assistant for a period not exceeding one month.

The other expenses would relate to maintenance of the laboratory, including the costs for light, electrical energy for charging accumulators, heating costs, etc.

The total expenses will be much less than what they would have been if the French Government had not generously provided rooms for the Fundamental System, free of charge, in the Conservatoire des Arts et Métiers.

The apparatus has also been offered free of charge to the C.C.I. by the American Telephone and Telegraph Company; in addition, the French Government has consented to exempt this apparatus from customs duties.

It is proposed to establish a tariff for calibrations, the fees demanded by the Laboratory varying necessarily with the nature of the work to be done.

The price of a working standard calibration involving only volume tests and articulation tests by voice and ear would be considerably less than the price of Primary or Secondary System calibrations which require, in addition, measurements with alternating current. It is not expected that the income resulting from these calibrations will cover all expenses, but it will enable a part of the expenses to be met. In addition, the application of charges for the various jobs executed will allow the activity of the laboratory to be controlled.

It is recommended that all the Administrations and manufacturers possessing Primary Systems shall only consent to calibrate working standards at the tariff agreed upon for the calibrations carried out in the laboratory of the Fundamental System, and the attention of the Administrations of countries conveniently situated to carry out calibrations in this laboratory shall be drawn to the interest they have in applying to this laboratory for calibrations. It is also desirable that all manufacturers supplying telephone apparatus shall be invited to use standards which have been calibrated by comparison with the Fundamental Reference System..

COMITE CONSULTATIF INTERNATIONAL DES COMMUNICATIONS TELEPHONIQUES A GRANDE DISTANCE.

Plenary Session, Como, 5th–12th September, 1927.

V.—QUESTIONS CONCERNING TRAFFIC AND OPERATING.

Agreement to be concluded between Exchanges and Subscribers for the Exchange of Calls by Subscription.

The International Consultative Committee—

Considering :—

That the legal or administrative clauses which accompany a subscription contract can differ according to the country, but that it is necessary to include in all contracts of this kind a certain amount of indispensable information to give the contract its corresponding legal status;

Unanimously advises :—

That the Administrations, in editing the subscription contracts, should be guided by the following typical form.

The International Consultative Committee—

Considering :—

That, in accordance with the Regulations of International Service, Revision of Paris, 1925, Section H, § 8 (2) the times and duration of subscription calls, after having been fixed by agreement between the offices interested, are confirmed in writing;

Unanimously advises :—

1. That the arrangements in connection with the reception of calls by subscription should be made by telephone during the hours of light loads between the terminal exchanges.

2. That the written confirmation should be drawn up in accordance with the following formula :—

Confirmation of the arrangement relating to the subscription call received the ..... 19 ....

A call of ..... minutes must be established every day, Sundays and Feast Days excluded,* at ..... o'clock (legal time of .....†) between subscriber No. ..... at ..... and subscriber No. ..... at ..... on and after ..... 19 .....

For confirmation

..... exchange ..... 19 .....

Signed.....

3. That this confirmation should be sent by the originating terminal exchange to the other interested terminal exchanges, the latter communicating, as the case may be, with the other exchanges in their country who are interested in the establishment of the communication.

Typical Form of Subscription Contract (Obverse).

The Telephone Administration of ..... (country of origin)
Subscription for International Telephone Service.

* The mention of " Sundays and Feast Days excluded " may be omitted if necessary.

† Name of country where subscription is made.

The undersigned ..... residing at ..... agrees to pay until further notice, according to the conditions set out overleaf, the monthly subscription detailed below, beginning from .....

Network and Telephone Number.		Time at which the connection is to be established.*	Duration of Call.	Is the connection to be established on Sundays and Feast Days ?	Monthly Tariff.
Caller.	Called.				
	Made at.....the.....				

* Legal time of the country where the subscription is made.

Typical Form of Subscription Contract (Reverse).

General Conditions of the Subscription.

ART. I.—The subscription calls take place daily between the same stations at the same time, as agreed in advance.

The duration of the subscription is for at least one month; it may be prolonged from month to month, by tacit consent.

The subscription can be cancelled by either party by notice given eight days before the expiration of the current month of the subscription.

ART. II.—The subscription calls must exclusively concern the personal business of the correspondents or that of their establishments.

ART. III.—The minimum duration of a subscription call is 3 minutes. Calls of a greater duration than 6 minutes can be allowed if the normal traffic on the circuits used permits this.

ART. IV.—Subscription calls are subject to the following charges :—

(*a*) During the period of light traffic† half the unit tax.
(*b*) During other periods‡ three times the unit tax.

The amount of subscription is calculated on a mean duration of 30 days. However, in connection with the subscription for exchange of conversations at three times the tax the mean duration used as a basis for calculating the monthly rate can be lowered to 25 days should the subscriber give up the use of his subscription on Sundays and Feast Days corresponding to Sundays in his own country.

The amount of subscription is collected in advance.

ART. V.—The subscription can be contracted from any date, but the monthly period only commences from the first of each month. The amount of subscription corresponding to the first monthly period may be increased, if necessary, by the part of the subscription corresponding to the period between the date of its coming into force and that of the commencement of the monthly period.

† From.....(time) To.....(time).
‡ From.....(time) To.....(time).

ART. VI.—The connection is to be officially established between the two stations indicated on the contract at the exact moment agreed upon unless another conversation is in progress or a demand for an urgent Government call is on hand.

It is to be officially disconnected at the expiration of the time allowed for each call if the correspondents have not already given the signal that the conversation is finished. However, the correspondents may continue their conversation if there is no other demand on hand, the additional conversation to be considered as an ordinary private call and taxed in three-minute units.

ART. VII.—No compensation to be given and no refund made if, by the act of the correspondents, the call has not taken place or has not had its prescribed duration.

A subscription call which, for some cause attributable to the telephone service, cannot be effected or has not lasted for the prescribed duration, shall be replaced or compensated for by a call of a duration equivalent to the unused period; if possible, before the end of the same tariff period.

If the call cannot be replaced or if compensation cannot be given, a refund is made on the demand of the subscriber. The refund is fixed at one-twenty-fifth or one-thirtieth of the monthly amount of the subscription if the conversation has not taken place or that part of the same fraction of the monthly subscription corresponding to the time lost if the conversation has been curtailed.

Checking the Number of Conversations by Terminal Exchanges on International Lines.

The International Consultative Committee—

Considering:—

That the daily check of the times of the conversation prescribed by the Regulations of International Service, Revision of Paris, Section O, § 9 (2), necessarily involves in practice an appreciable loss of time;

Unanimously advises:—

That Administrations should try out for three months at least, from January 1st, 1928, the following method and should follow this test with care, at the same time communicating to one another any observations necessary:—

1. Agreement of the taxable period should be made after each communication by saying: 3 *minutes* in the case of calls of 3 minutes' duration or less, and in other cases: 4 *minutes*, or 7 *minutes*, or 5 *minutes* (conversation of a duration of 8 minutes does not often occur); also, the category of the call should be given except in the case of an ordinary call, for example: urgent, lightning, with *préavis*, with *avis d'appel*.

In the case of a *préavis* or *avis d'appel* not followed by a conversation the following indication should be transmitted as soon as the interested exchanges know that the conversation cannot take place—*préavis* taxable or *préavis* not taxable, *avis d'appel* taxable or *avis d'appel* not taxable.

Operators should advise one another the moment the period of heavy traffic changes to a period of light traffic and vice versâ.

2. Instead of checking times, the exchanges should merely make known each day by telephone to one another the total number of minutes of conversations of each category they received the previous day for each of the zones of their territory as well as the total number of minutes of conversation on through calls for each category (ordinary, urgent, lightning, with *préavis* or with *avis d'appel*) and for each country.

3. The monthly accounts should continue to be established as in the past; but in this connection it will be of interest to present the accounts in such a manner that the total number of taxed minutes for each category on each circuit or group of circuits is shown.

4. At the end of the first quarter of the test the Administration should send to the General Secretariat of the International Consultative Committee a report showing :—

(*a*) If the method has given satisfaction in a general way.
(*b*) In what connection do they think it ought to be adopted.
(*c*) Observations from the result of its application.

Uniformity in the Hours of Light Traffic.

The International Consultative Committee—

Unanimously advises :—

That all Administrations should standardise the times which shall be regarded as the times at which light and heavy traffic commences,

Advises, with two dissentients :—

That from July 1st, 1928, the times uniformly adopted shall be 7 p.m. and 8 a.m. (legal time of the country of origin).

Designation of International Circuits.

The International Consultative Committee—

Considering :—

That it is advisable to standardise the method of designating international circuits;

That this result can be attained by designating each circuit either by the name of the localities which it connects or by a conventional number given to this circuit after a general agreement between all the Administrations;

That, further, a method of designation must be adopted which is as simple as possible for the operating personnel who are responsible for using this designation frequently in service conversations exchanged between one another;

Unanimously advises :—

1. That, from April 1st, 1928, the international circuits should be designated by the names of the two localities which they connect, followed by a serial number of the circuit, taking no account of its technical constitution, the names of the localities which comprise the designation being those which figure on the official plan of their country, the two names being placed in alphabetical order.

2. That, in order to facilitate the application of this procedure, each Administration should come to an agreement with the corresponding Administration on the designation of the circuits connecting one to the other and should communicate to the Secretariat of the International Consultative Committee before April 1st, 1928, a list of the official names of the terminal exchanges in its country.

3. That the form under which the nomenclature of the circuits will be established in future and kept up to date in accordance with the advice of the International Consultative Committee on page 45 in the White Book (English Translation, page 9) should be the subject of a new study.

Delivery of Avis d'appel.

The International Consultative Committee—

Considering :—

That the percentage of *avis d'appel* is very small;

That telegrams can replace *avis d'appel* and are cheaper on long-distance service;

That, moreover, on frontier connections and elsewhere in regions where the telephone network is not yet very well developed, the *avis d'appel* are of particular service to the public;

Unanimously advises :—

1. That Administrations who have already allowed *avis d'appel* on international telephone service should deliver them to the recipient without fixing any distance for distribution.

2. That the surcharge for delivery outside the radius for free delivery of telegrams should be the same as the tax demanded for an international telegraph service messenger in conformity with the publications of the International Bureau of Berne.

3. That the surcharge should always be paid by the caller.

4. That this surcharge should be included in the international accounts and assigned to the Administration receiving the message.

5. That, if the caller makes known when originating his call with *avis d'appel* that the called person lives outside the zone of free delivery and that the caller is paying the tax for the messenger, the transmission of the *avis d'appel* should be preceded by the words " messenger paid."

That, when the caller knows nothing of the manner in which *avis d'appel* may be delivered, he should be warned by the originating exchange that it is possible for a surcharge for delivery by messenger to be made.

That, when an exchange receives an *avis d'appel* for delivery not bearing the words " messenger paid " and the receiver of this message lives outside the zone for free delivery, the operator should inform the originating exchange who will tell her if the charge for delivery has been levied.

6. That the caller should also be informed that, although the Administrations endeavour to deliver in due time the *avis d'appel* to the called party they cannot give any guarantee when the called person lives outside the zone of free delivery of telegrams.

Occasional Calls at Fixed Time.

The International Consultative Committee—

Considering :—

That, amongst the numerous international connections, fixed time calls are allowed by subscription during hours of heavy traffic;

Unanimously advises :—

That in these connections occasional fixed-time calls should be allowed.

Considering :—

That it is desirable to avoid the introduction of such calls causing difficulties in the operation of the general service;

Unanimously advises :—

That fixed-time calls should be demanded at least an hour in advance, this period being subject to modification according to the practical results of this new service.

Considering :—

That it is necessary to specify the nature of the calls that have priority over fixed-time calls;

Unanimously advises :—

That fixed time calls should be established at the time specified unless a conversation is already in progress, in which case the fixed time call is delayed until the end of this conversation; or unless a lightning or an urgent Government call is waiting, in which case the latter have priority. If several fixed time calls are demanded for the same circuit at the same time they should be established in the order in which they were received at the controlling exchange.

Considering :—

That these fixed time calls have priority over private urgent calls,

Unanimously advises :—

That they should be liable to a tax equal to three times that of an ordinary call made during the same tariff period plus one-third of the unit charge, the minimum of this addition being 0 fr. 50 c.

Requests for Information.

The International Consultative Committee—

Considering :—

That it is to their interest to satisfy as far as possible all requests for information from the public and that it is legitimate to charge for those which necessitate service conversations between exchanges;

That, however, it seems desirable to confine themselves, at the outset, to giving information which can be found in the list of subscribers,

Unanimously advises* :—

That the following requests for information should be allowed in the international service :—

(*a*) If a certain person, designated by name and complete address, is a telephone subscriber?

(*b*) What subscriber corresponds to a certain number in a particular telephone network?

That the following proposed conditions should apply to these requests for information :—

1. The information which can be given by the exchange where the request has been made, or by another exchange of the same Administration, be considered as concerning the internal service.

* This advise replaces that which figures under the same heading on page 341 of the White Book (English Translation, page 269).

2. Requests for information which necessitate service conversations between exchanges of two (or three) Administrations be subject to a charge equivalent to one-third of the unit charge between the terminating networks with a minimum o fr. 50 c.; this tax not being entered in the International Accounts.*

3. Requests for information be transmitted as soon as possible from exchange to exchange. No through connection to be set up for transmitting these requests.

4. In the two cases above the request and reply take the following form :—

(*a*) Request : Paris Central 09.—99 asks if Mr. X..... Boulevard Anspach, 161 Brussels is a telephone subscriber ?

Reply : Reply for Paris Central 09—99 : Mr. X.....262-36 Brussels or Mr. X..... is not a subscriber or Mr. X..... is not on the list of subscribers.

(*b*) Request : Paris Central 09—99 asks name and address of City 53—96 London.

Reply : Reply for Paris Central 09—99 : City 53—96 is Green, H. R., Commission Agent, 3, Broadway, E.C.4, or City 53—96 is not included in the list of subscribers.

Assignment of the Serial Number to a Call.

The International Consultative Committee—

Considering :—

That the use of serial numbers has been prescribed by the Regulation for International Service, Revision of Paris, Section O, § 4 (6) on account of the facilities they give for checking, preparation of calls and daily control of completed conversations ; and

That, on the other hand, this serial number is assigned at the originating end in telegraphic preparation ;

Advises :—

1. That the serial number should be assigned by the terminal exchange at the originating end at the moment the request is passed to the incoming terminal exchange.

2. That even numbers should be reserved for calls in one direction and odd numbers for those in the other direction.

3. That the numbering should commence each day at midnight or, according to circumstances, at the commencement of the daily service.

4. That if circuits connecting two localities are distributed over several operators' positions, each position should have its own numbering series.

5. That the requests which pass through a transit exchange should receive at this exchange, irrespective of the number already given by the originating terminal exchange, a serial number assigned by the transit exchange.

Methods of reducing Lost Time on International Telephone Connections, due to the delay by the Subscriber in answering the Call of the Toll Exchange.

The International Consultative Committee—

Considering :—

That the application of the Operating Rules reproduced below and proposed by the International Consultative Committee in 1925, have not been tried in the international service and that trials made on internal service have not produced conclusive results ;

* This paragraph has been adopted by 10 votes to 6, the remainder being adopted unanimously.

Unanimously advises :—

1. That tests should be made in the international service by all Administrations on circuits arranged at each end for one circuit per operator or two circuits per operator.

2. That these tests should be made in the following way :—

The Administration occupying the highest position in alphabetical order shall suggest to the corresponding Administrations the circuits on which these tests be made. If they agree, the exchanges interested shall be advised. The two terminal exchanges shall be able to co-operate in these tests and the two Administrations shall communicate to one another the reports received concerning the tests made between the exchanges concerned.

Operating Rules for International Circuits proposed in 1925.

1. The operator should make the warning call immediately after the preceding call has commenced.

The subscribers (calling and called) are advised in the following manner :—

"Hold yourself in readiness to speak with X..... (name of exchange). I will call you again."

2. It is desirable that the lines of subscribers warned for a call should remain held.

3. The subscriber who has been previously warned should be recalled at the end of the call in progress.

4. In principle, operators should communicate with each other during the interval which occurs between the calling of the subscriber and his reply.

These service communications relate to :

(*a*) the checking of the duration of calls in excess of three minutes;

(*b*) the necessary data for establishing at least one call.

5. Immediately after the conversations between operators, mentioned in paragraph 4, have been exchanged, the toll circuit should be connected to the subscriber already called. The following intimation is then made openly (so as to be audible both on the toll line and on the subscriber's line) :—

Here is X.....	*or*	Call from Y.....
(name of called exchange).		(name of calling exchange).

6. If the subscriber does not answer to the warning call (para. 1) after half a minute, the operator should proceed with the next call in the same direction.

7. The operator should proceed with the second call immediately after the conversation has commenced. If the subscriber does not reply within half a minute the request should be forthwith cancelled and the operator advise the corresponding exchange :—

"No. X (number of ticket) is cancelled : no reply from subscriber."

8. If the subscriber has replied to the warning call but does not reply to the actual call, the operator should proceed after half a minute with the establishment of the next call and should act in accordance with paragraph 7 (second part).

9. In the case of telegraphic preparation the data mentioned in paragraph 4*b* should be exchanged by telegraph during the subscriber's conversation.

Moreover, Administrations are recommended to point out to subscribers the effects of their delay in answering calls from the exchange; verbal explanation given on the spot by

an official who is fully conversant with the facts and who has carefully investigated operating conditions, is preferable to a written communication.

Recommendations regarding Traffic Statistics.*

The International Consultative Committee—

Considering :—

The importance of knowing what traffic fluctuations there are on the principal groups of international circuits in the course of the same year;

Unanimously advises :—

That Administrations should send every year to the Secretariat of the International Consultative Committee the average daily call minutes during the hours of 8 a.m. and 9 p.m., as well as the average delay on a request for a call handed in between the hours of 9 a.m. and 11 a.m., for each quarter of the past year, these statistics being presented in the following form :—

Designation of the connection.	No. of circuits at the end of the year under consideration.	Average daily call minutes† between 8 a.m. and 9 p.m. for each quarter.				Average delay on a request‡ handed in between 9 a.m. and 11 a.m.				Remarks.
		1st Quarter.	2nd Quarter.	3rd Quarter.	4th Quarter.	1st Quarter.	2nd Quarter.	3rd Quarter.	4th Quarter.	

† The average daily call minute between 8 a.m. and 9 p.m. for each quarter shall be calculated as follows : Observations will be made during a certain number of working days each quarter and the average obtained by dividing the total number of calls by the number of days. The result of this division will be inserted in the column corresponding to the quarter considered.

‡ To determine the delay in a certain direction, test tickets shall be sent to the recording operators at different times between the hours of 9 a.m. and 11 a.m. and the recording operator shall forward them to the positions serving the particular circuits considered. The operator at this position shall classify them according to the order they would occupy if they happened to be ordinary requests for calls; when the turn for each of these tickets arrives she will insert the time on them. The operation shall take place on one or several working days during the quarter. The average waiting time shall be taken as the average of the difference of time noted on the test tickets.

Leasing International Lines, not comprising Submarine Sections, for Private Purposes.

The International Consultative Committee—

Considering :—

That, on several routes, there are available circuits in international cables;

That, though the leasing of circuits has not been allowed up to the present on international service, several Administrations have already had experience of leasing circuits on internal service;

* This replaces the recommendation given under the same title in the White Book, page 376 (English translation, page 293).

That several Administrations have already received requests to lease international telephone circuits for private purposes;

That, consequently, it is necessary to consider from now the question of eventually leasing permanently international telephone lines so as to allow Administrations to organise this new service on a suitable basis;

That it is necessary, however, to avoid the leasing being of such a nature as to cause any inconvenience in the general service or being able to permit misuse on the part of the subscribers who hire these circuits;

Unanimously advises :—

That Administrations who lease permanently international telephone circuits should be guided provisionally by the following principles until it is possible to benefit by practical experience on this question :—

1. International telephone lines on a given route should only be leased when the number of circuits serving that route allows such a disposal.

2. The leasing of an international telephone line having been agreed upon, the connections should be established once and for all so that the central exchanges need no longer interfere, but they must be able, technically, to control the conversations passed.

The stations so connected must not in any case be stations which are used habitually by the public. The conversations should concern exclusively personal matters of the correspondents or that of their businesses. The line must in no way be given over to a third person.

3. The lease should be made for at least a period of one year; it should be renewed after that every three months by tacit agreement. Notice of cancellation must be given by either party one month prior to the termination of the current period of subscription.

4. The Administrations should reserve the right to recover the leased line in the interests of the general service, at the same time giving the required notice of cancellation, as mentioned in paragraph 3.

5. The subscription should be paid in advance and quarterly.

6. In the case of interruption due to the telephone service, the originating Administration should make a refund at the request of the subscriber. The refund should be fixed at as many times the three-hundredth part of the annual subscription as there were days of interruption. If the period of interruption is less than a day no refund should be made; the period from 9 a.m. to 3 p.m. in this case should be regarded as a day.

The International Consultative Committee—

Considering :—

That the leasing of an international telephone line gives to the lessees the possibility of obtaining at any moment a no-delay call, being equivalent, therefore, to a lightning call, and confers upon lessees a very important privilege;

That, however, it is necessary to take into account the fact that the operating services of the Administrations do not intervene in the establishing of the connections;

Advises, with one dissentient :—

1. That the subscription should be equivalent to 120 units of tax of the same connection per day, assuming 300 days per year.

2. That in every case, even for frontier connections, the receipts should be included in the international accounts.

List of Questions relating to Traffic and Operating Submitted for Study.

1. What are the exchanges which must co-operate on questions of transmission in cases of bad audibility on an international connection?

What part must the two zone exchanges, the terminal exchanges and the transit exchanges respectively take in this co-operation?

2. Guiding principles for controlling the flow of traffic on international telephone connections where there are several routes having one or more circuits, in order to obtain good transmission in each case, to equalise as far as possible the waiting times in both directions on the same connection and to allow operators to be given very definite instructions for setting up connections.

3. Standardisation of systems of spelling and the establishment of a definite list of phrases to be used for operating the international circuits.

4. Examination of the information to be sent by the Administrations of Great Britain and Switzerland on methods of registering the duration of calls.

5. Is it advisable, in the case of an international telephone call, when conversation does not commence immediately after the reply to the call, to advise the operator of the exchange supervising the connection that the call has been accepted but that the called person is not yet at the telephone?

If the answer is "Yes," what verbal indication must be given in such a case? (International Regulations, Revision of Paris, Section L, § 2.)

6. Is it necessary to define the conditions under which the time chargeable for a telephone call may be reduced owing to bad audibility?

7. Various regulations concerning the treatment of calls with *préavis*.

(*a*) Can the *préavis* calls include several persons at the same telephone station?

(*b*) Can the *préavis* calls include several stations for one particular person?

(*c*) When the called subscriber informs his exchange that the called person has another telephone in the same network or of another network, must this exchange inform the originating exchange so that the caller may make a new request, or must the incoming terminal exchange connect to the new station given on its own accord?

(*d*) Is it necessary to transmit the name and eventually the number of the calling subscriber from the originating to the incoming exchange?

8. After placing a request for an ordinary call can this call, at the request of the calling subscriber, be established to a subscriber other than that originally requested, but in the same network?

9. Recommendations to be made to telephone exchanges for advising one another that a certain P.B.X. has been found to be faulty in the course of an international communication so that a test can quickly be made and this installation put in order. Typical form to be used.

10. Is it necessary to modify the recommendations of the International Consultative Committee on the question of setting up detail statistics of telephone traffic? (White Book, pages 375–383; English Translation, pages 293–301.)

11. Is it desirable for Administrations to issue for public use and based on a standard model a list of international telephone connections open to the public, indicating the facilities offered and the charges made for these connections?

Would it be of any use to add to such publications advice as to the method of requesting and effecting an international telephone call in order to avoid as far as possible false operation on the part of the subscriber and lost time? If the answer is " Yes," what advice should be given to the public?

12. The form in which the Nomenclature of international telephone circuits should be established to facilitate its use for operating purposes.

13. Recommendations to Administrations to allow the international service, when the telephone connections are being increased, to be extended to all networks in a particular geographical area rather than to confine it to certain definite networks.

14. Is it expedient when calculating international telephone charges, to follow up the research of a co-efficient, by which the lengths of the submarine sections should be multiplied in order to determine the equivalent length of underground cable?

15. Should collective calls (conferences) be allowed on international circuits? If so, on what condition is it necessary to organise this new service?

16. What regulations should be made in the arrangements as outlined in §§ 4 and 9 of Section L of the International Regulations (Revision of Paris, 1925) concerning calls, originated by, or incoming to, Stock Exchanges, Banks, etc. (International Regulation, Revision of Paris, 1927, Section L, § 10.)

COMITE CONSULTATIF INTERNATIONAL DES COMMUNICATIONS TELEPHONIQUES A GRANDE DISTANCE.

Plenary Session, Como, 5th–12th September, 1927.

VII.—MINUTES OF THE CLOSING MEETING.

(12th September, 1927.)

The session opened at 10 a.m., Mr. di Pirro presiding.

A telegram was read in which Mr. Serrao, Chief of the Portuguese Delegation, expressed the great regret of the Portuguese Delegation at not being able to attend the Conferences at Como, and sent greetings to the Plenary Conference with assurances of the interest with which he was following the proceedings.

The minutes of the last meeting of Traffic and Operating were then read.

After a discussion, in which Mr. Townshend and Mr. Milon participated, the form of the new question No. 6 which has been studied (page 3 of the minutes) was modified as follows :—

> " Is it necessary to define the conditions under which the time chargeable for a telephone call may be reduced owing to bad audibility ? "

The minutes of the last conference on Transmission were then read.

At the request of Mr. Cohen, the form of the new question studied and mentioned in the first line of page 2 is amended as follows :—

> " Coordination of wireless telephony and of wire telephony from the point of view of technical questions relating to the international system."

The minutes of the last Conference of Protection of Lines were then read, and these minutes were adopted without any amendment.

The minutes of the Conference of Chief Delegates were then read. After Mr. Townshend had spoken, the following sentence was added to the minutes of the meeting :—

> " Subject to the afore-mentioned reservations and also to the reservation that a fixed scale of salaries for the permanent staff of the Secretariat will not be drawn up, the budget scheme for 1928 is approved by the Plenary Assembly."

On the subject of para. 1, relating to the organisation of the C.C.I., Mr. Valensi asked the Plenary Assembly if it would not be advisable to appoint for each Commission of Assessors not only the Administration which has the duty of nominating the Chief Assessor, but also another Administration to take care of the appointment of a deputy Chief Assessor.

After a discussion, in which Messrs. Milon, Breisig and di Pirro took part, it was decided not to effect any modification in the customary procedure, and the minutes of the Conference of the Chief Delegates were approved without any modification.

The minutes of the Conference of the Sub-Commission for the Telephone Vocabulary were then read.

Concerning the work of revision of the Vocabulary in draft form (page 2, line 7) Belgium and Switzerland are added to the list of Administrations appearing under " a."

The Conference then proceeded to discuss the symbols (mathematical symbols representing magnitudes in calculations or on diagrams, or also graphical symbols representing the various objects of telephone equipment in drawings).

Following a discussion, it was decided that a Commission will be entrusted with the task of studying the various questions pertaining to symbols and more particularly to symbols relating to long-distance telephony; it will commence by investigating the present position of these questions as soon as possible.

The members of this Commission will be nominated respectively by the telephone Administration of Germany, France, Great Britain, Italy, Holland and Switzerland. This Commission will be presided over by Mr. Muri (Switzerland).

A folder containing the text of the new Recommendations issued by the International Consultative Committee for telephony during the proceedings of the Plenary Assembly at Como was then handed to each delegate.

This folder, after having been approved by the Administrations belonging to the C.C.I., will be published as an official text of which certain portions modify or supplement certain passages of the Livre Blanc (White Book) published by the C.C.I. after the Plenary Assembly in Paris, 1926.

The Plenary Assembly then nominated the Administrations to appoint the Chief Assessor of each of the Commissions of Assessors formed to study the new questions or questions already studied which require further examination.

Seven Commissions of Assessors are elected, as follows :—

FIRST COMMISSION OF ASSESSORS.

Questions relating to the protection of telephone lines against the disturbing influences of power installations or atmospheric discharges :—

1. How may the disturbing influences of harmonics from generators and continuous current traction motors be characterised? Examination of the permissible limits of the amplitude of these harmonics. Measures to be adopted in case of parallelism between international telephone lines and continuous-current traction lines.

2. Permissible limits of noise induced on open-wire circuits and on cable circuits.

3. The effect of earthing the neutral point of power installations on the importance of operating troubles of adjacent telephone lines.

4. Importance of good conductivity of rails in electric traction single-phase or polyphase alternating-current systems on the effects of induction caused in parallel telephone lines. (This question should be considered as sufficiently studied : it is included as a memorandum because a final decision has still to be made on this subject.)

5. Possibility of adopting special arrangements for the protection of telephone lines in cases where the disturbing power lines with neutral point insulated are specially maintained and supervised so that no prolonged earthing of the neutral could occur.

6. Protection devices to be placed on lines and telephone installations to protect the staff against any possible risks due to the influence of power lines or to atmospheric discharges.*

Administrations participating.

Germany (Mr. Brauns, Chief Assessor), Austria (Mr. Pfeuffer), France (Messrs. Rochas and Collet), Great Britain (Mr. Bartholomew), Italy (Mr. .....), Sweden (Mr. Holmgren).

* This new question has been included for study at the request of the U.R.S.S. Delegation.

SECOND COMMISSION OF ASSESSORS.

Questions relating to the corrosion of telephone cable sheaths :—

1. Protection of cables against corrosion due to electrolysis.
2. Protection of cables against corrosion due to chemical action.

Administrations participating.

Germany (Dr. Breisig, Chief Assessor), France (Mr. Collett), Great Britain (Mr. Bartholomew), Italy (Mr. .....).

THIRD COMMISSION OF ASSESSORS.

Questions relating to Transmission and Maintenance.

1. Possibility of unification of long-distance telephone systems.
2. Limits imposed by transient phenomena and methods by which these limits may be reduced (*see* White Book, page 73; English Translation, page 32).
3. Method of measuring cross-talk intended to replace voice tests.
4. New specifications and revision of existing specifications concerning repeater stations :
   - (*a*) Terminal equipment and protection devices.
   - (*b*) Two-wire and four-wire repeaters.
   - (*c*) Power-supply installations.
   - (*d*) Signalling devices.
   - (*e*) Balancing devices for two-wire repeaters.
   - (*f*) Echo suppressors.
5. Revision of typical specifications of the C.C.I., taking into consideration recent progress in cable manufacture (especially concerning the numerical data characterising the regularity of manufacture).
6. List of phrases usually employed in fault location and testing services and in repeater stations for the maintenance of international communications.

Administrations participating.

Germany (Mr. Höpfner, Chief Assessor), France (Mr. Lange), Great Britain (Messrs. A. B. Hart and C. Robinson), Italy (Mr. .....), Holland (Mr. Petritsch), Sweden (Mr. Holmgren).

Mr. Shreeve, representative of the American Telephone and Telegraph Company, will participate in the work of this Commission.

FOURTH COMMISSION OF ASSESSORS.

Questions relating to Reference Systems for Telephone Transmission.

1. What are the various methods acceptable for applying secondary reference systems?
2. Does the number 0·05 volts per dyne per cm.^{2} (volts per bar) provisionally specified in the proposals of the London Conference for the zero point of the transmitter system correspond adequately with the practical efficiency of standard receiver systems of commercial type used by the various Administrations as working standard for current tests?

3. Does the number 50 dynes per cm.^{2} per volt (bars per volt) specified for the zero point of the receiver system correspond adequately with the practical efficiency of standard receiver systems of commercial type used by the various Administrations as working standards for current tests?

4. Method of measuring the transmission equivalent of apparatus and subscribers' lines so that a subscriber's station (including the subscriber's line, connecting apparatus, etc.) may satisfy the required conditions of international service.

5. According to what general method of application should one proceed to carry out articulation tests on the international circuits?

6. Relation between the "Articulation of syllables" (*see* White Book, page 52; English Translation, page 16) and "Articulation of words in a continuous conversation" (intelligibility) mainly in the case of very long telephone circuits.

Administrations participating.

Great Britain (Mr. Cohen, Chief Assessor), Germany (Dr. Breisig), France (Mr. Chavasse).

Mr. Martin, representative of the American Telephone and Telegraph Company, will attend the meetings of this Commission.

The fourth Commission of Assessors will have scope to make all necessary decisions (if found advisable) concerning the European Fundamental Reference System for telephone transmission prior to the Plenary Assembly of the C.C.I. in 1928.

It must particularly examine the following questions and proposals relating to the organisation of the Fundamental System Laboratory and make all useful decisions on this subject.

(*a*) **Questions.**

1. Examination Syllabus for the enrolment of operators for the European Fundamental Reference System Laboratory and programme of the training period.

2. Determining the tariff for calibrations of primary or secondary systems and for calibration work.

3. Scientific or technical work which the Fundamental Reference System may permit to be carried on apart from regular calibration work.

General rules to apply to execution of special work and scale of charges for such work.

(*b*) **Proposals.**

The American Telephone and Telegraph Company will despatch and install the apparatus for the European Fundamental System in the early part of 1928. It is proposed that during the installation an experienced engineer of the French Administration of P.T.T. (who will later occupy a part of his time in general supervision of the Laboratory) and an Assistant (who will later be in charge of the calibration work under the supervision of the Engineer and will devote all his time to this work) shall be placed at the disposal of the representatives of the American Telephone and Telegraph Company to give them any assistance required, and at the same time to obtain from them as much information as possible during the period of installation and test. It is expected that the Engineer-in-charge of general supervision of the Fundamental System will devote at most one-third of his time to this work. The International Consultative Committee will endeavour to secure the services of Mr. Chavasse, who is a member of the Reference System Commission.

When the calibration work commences, three operators will be necessary to carry out the comparative voice and ear tests as well as articulation tests and the alternating-current

measurements, including the calibration of the Fundamental System itself and the graph of the amplitude-frequency characteristics of the Primary System apparatus or of the Secondary System as a whole.

The senior of these three operators will be the afore-mentioned Assistant placed at the disposal of the C.C.I. by the French P.T.T. Administration; he should have the requisite technical ability and, in addition, must comply with the phyiscal and physiological conditions necessary to undertake the voice and ear tests and the articulation tests. It is proposed that, in the first instance, the other two operators be recruited in Germany and Great Britain respectively. With regard to Great Britain, the Post Office could release a young man of the grade of " transmission assistant " for, say, one year; at the end of this period this assistant could be replaced by another, so that ultimately a certain number of operators could obtain experience with the Reference System and at the same time improve their knowledge of the French language.

If it is considered desirable, the British Post Office is willing to receive the Engineer and the Chief of operating staff at the Research Laboratories at Dollis Hill for one month's study of the technique of voice and ear tests or articulation tests.

FIFTH COMMISSION OF ASSESSORS.

Co-ordination of wireless telephony and of telephony concerning technical questions arising in the international systems.

Administrations participating.

Great Britain (Mr. Hansford, Chief Assessor), Germany (Mr. Höpfner), Denmark (Mr. Christiansen), Spain (Mr. A. Nieto), France (Mr. Le Corbeiller).

Mr. Shreeve, representative of the American Telephone and Telegraph Company, will participate in the work of this Commission.

SIXTH COMMISSION OF ASSESSORS.

Questions relating to Traffic and Operating.

1. What are the exchanges which must co-operate on questions of transmission in cases of bad audibility on an international connection?

What part must the two zone exchanges, the terminal exchanges and the transit exchanges respectively take in this co-operation?

2. Guiding principles for controlling the flow of traffic on international telephone connections where there are several routes having one or more circuits in order to obtain good transmission in each case, to equalise as far as possible the waiting times in both directions on the same connection and to allow operators to be given very definite instructions for setting up connections.

3. Standardisation of systems of spelling and the establishment of a definite list of phrases to be used for operating the international circuits.

4. Examination of the information to be sent by the Administrations of Great Britain and Switzerland on methods of registering the duration of calls.

5. Is it advisable, in the case of an international telephone call, when conversation does not commence immediately after the reply to the call, to advise the operator of the exchange supervising the connection that the call has been accepted, but that the called person is not

yet at the telephone? If the answer is " Yes," what verbal indication must be given in such a case? (International Regulation, Revision of Paris, section L, § 2).

6. Is it necessary to define the conditions under which the time chargeable for a telephone call may be reduced owing to bad audibility?

7. Various regulations concerning the treatment of calls with *préavis* :—

(*a*) Can the *préavis* calls include several persons at the same telephone station?

(*b*) Can the *préavis* calls include several stations for one particular person?

(*c*) When the called subscriber informs his exchange that the called person has another telephone in the same network or of another network, must this exchange inform the originating exchange so that the caller may make a new request, or must the incoming terminal exchange connect to the new station given on its own accord?

(*d*) Is it necessary to transmit the name and eventually the number of the calling subscriber from the originating to the incoming exchange?

8. After placing a request for an ordinary call, can this call, at the request of the calling subscriber, be established to a subscriber other than that originally requested, but in the same network?

9. Recommendations to be made to telephone exchanges for advising one another that a certain PBX has been found to be faulty in the course of an international communication so that a test can quickly be made and this installation put in order. Typical form to be used.

10. Is it necessary to modify the recommendations of the International Consultative Committee on the question of setting up detailed statistics of telephone traffic? (White Book, pages 375–383; English Translation, pages 293–301).

11. Is it desirable for Administrations to issue for public use and based on a standard model a list of international telephone connections, open to the public, indicating the facilities offered and the charges made for these connections?

Would it be of any use to add to such publications advice as to the method of requesting and effecting an international telephone call, in order to avoid as far as possible false operation on the part of the subscriber and lost time? If the answer is " Yes," what advice should be given to the public?

12. The form in which the nomenclature of international telephone circuits should be established to facilitate its use for operating purposes.

13. Recommendations to Administrations to allow the international service, when the telephone connections are being increased, to be extended to all networks in a particular geographical area rather than to confine it to certain definite networks.

14. Is it expedient, when calculating international telephone charges, to follow up the research of a co-efficient, by which the length of the submarine sections should be multiplied, in order to determine the equivalent length of underground cable?

15. Should collective calls (conferences) be allowed on international circuits? If so, on what conditions is it necessary to organise this new service?

Participating Administrations.

Holland (Mr. Van Embden, Chief Assessor), Germany (Mr. Wiehl), Belgium (Mr. Fossion), France (Mr. Barillau), Great Britain (Mr. Townshend), Sweden (Mr. A. Lignell), Switzerland (Mr. Moeckli).

SEVENTH COMMISSION OF ASSESSORS.

Questions relating to Conversations between "Bourses."

What alterations should be made to the regulations in §§ 4 and 9 of Section L of the International Regulations, Revision of Paris, 1925, concerning the conversations originating from or proceeding to commercial, financial or other exchanges? (International Regulation, Revision of Paris, Section L, § 10.)

Participating Administrations.

Holland (Mr. Van Embden, Chief Assessor), Germany (Mr. Wiehl), France (Mr. Barillau), Great Britain (Mr. Trayfoot), Switzerland (Mr. Moeckli).

The delegates of the Seventh Commission will have to move about in order to obtain the information necessary for their work in any country involved.

Mr. Barillau, in the name of the Conference, thanked Mr. Van Embden for the high degree of efficiency and the amiability with which he presided over the Traffic and Operating Conferences, and hoped that Mr. Van Embden would continue to preside over the Commission of Assessors studying these questions.

Mr. Van Embden thanked Mr. Barillau for his eulogistic speech and for the trust placed in him. Meanwhile, as he had not the authority to continue with his duties as Chief Assessor, he was unable to make any promises.

Mr. Barillau was certain that he expressed the wishes of the entire Conference in requesting the Secretariat to ask the Dutch Administration to be good enough to authorise Mr. Van Embden to continue his duties as Chief Assessor of the Sixth and Seventh Commissions of Assessors, who, apart from new questions, are to continue studying various questions of traffic and operation not yet completed.* (Applause.)

Mr. Valensi requested that the Chief Assessors would submit to him the list of points concerning the various new questions to which the attention of the Administrations should be drawn, particularly concerning questions of a general type, and of which the text is clearly ambiguous.

Mr. Di Pirro requested the Conference to select the town in which the Committee will meet again in 1928.

Mr. Milon proposed that the Committee meet again in Paris. This proposal was unanimously approved by the Conference, and the date of the next meeting fixed for the 11th June, 1928.

The General Secretary then observed that as there are a certain number of countries in Europe which have not yet participated at the Conferences of the C.C.I. it would be desirable to send them the "Livre Blanc" and to draw their attention to the importance of the C.C.I. work and to the interest which these Administrations should take in belonging to it, in view of the future extension of the international telephone network. The Plenary Conference approved of this proposal.

He then proceeded to nominate three auditors for the year 1927–1928, viz., that Colonel Purves, Mr. Di Pirro and Mr. Van Embden will continue to carry out these functions.

Mr. Milon.—I am certain I am expressing the unanimous wishes of all the members of the C.C.I. in thanking Mr. Di Pirro both for the excellent and impartial manner in which he

* After the Closing Plenary Session at Como—1927—the Dutch Administration authorised Mr. Van Embden to continue the functions of Chief Assessor to the Sixth and Seventh Commissions of Assessors.

presided over our work, and for the welcome that has been accorded to us here. We have all known Mr. Di Pirro for a long time, and we all knew beforehand that we were going to fulfil a most agreeable duty in coming to Como; but it can be said that the reality exceeded our expectations. We will all carry away with us an unforgettable memory of the welcome accorded to us here. We also request Mr. Di Pirro to thank the Italian Administration for the accommodation placed at our disposal. Mr. Di Pirro personally is especially deserving of our gratitude, as during this year he has been confronted with the almost overwhelming task of organising and presiding over the many Conferences, and we are all the more grateful to him because of the opportunity this gave us of meeting eminent personalities. I therefore once again express our warmest sympathy to Mr. Di Pirro and also, allow me to say, our affectionate gratitude. (Applause.)

Mr. Di Pirro.—I thank Mr. Milon for his kind speech. He attributes virtues to me which I certainly do not possess. I am very much attached to the C.C.I., and it has been a great pleasure to me to render this meeting as pleasant as possible. I observed my colleagues' faces every day, and I was content when they were happy.

I must also thank the Assembly for the interest that it has taken in our work; I also thank the Vice-Presidents, Dr. Breisig, Mr. Van Embden and Mr. Milon.

I must also add that I have been assisted in my work by the Executive Committee, to which I express my thanks. Finally, I thank our General Secretary and all his assistants.

The work of the Committee and the efforts of its members have been greatly appreciated, and on this account you have received a hearty welcome from everyone.

The Minister of Communications, His Excellency Admiral Costanzo Ciano, has come from Rome to express his satisfaction concerning the results of our work, as well as His Excellency Signor Pennavaria, Under-Secretary of State for Posts and Telegraphs; also Professor G. Pession, General Director of Posts and Telegraphs, who was here to greet us, has telegraphed a pleasant message from Rome; finally, the Mayor of Como, who has found pleasure in receiving us in this town.

This is why I am taking the liberty of repeating Mr. Milon's proposal and of sending the following telegrams to the Minister, to the Under-Secretary of State, to the General Director of the P.T.T. and to the Mayor of Como.

" H. Ex. Admiral Ciano, Minister of Communications, Rome.

" On the completion of our work, the International Consultative Committee for Long-Distance Telephony assembled together at the Plenary Conference renders devoted homage to Your Excellency, and expresses the warmest gratitude for the cordial reception accorded to them in Como, for the various facilities granted to them, for the great honour which Your Excellency conferred on them by personally taking part in one of our sessions, as well as for the sympathetic words which you kindly spoke on that occasion.

" President Assembly,
" DI PIRRO."

" Honourable Pennavaria, Under-Secretary of State Posts and Telegraphs, Rome.

" The International Consultative Committee for Long-Distance Telephony on completing its work, recalls the gracious words of thanks for this work which were expressed by Your Excellency in Como, and sends sincere cordial greetings.

" President Assembly,
" DI PIRRO."

"**Prof. Pession, General Director of Posts and Telegraphs.**

"On the occasion of its last meeting the C.C.I. Plenary Session recalls the support given by Your Excellency to the Conference in Como, and I send my heartiest thanks and greetings.

"President Assembly,
"DI PIRRO."

"**Hon. Baragiola, Mayor of Como.**

"On the occasion of its last meeting the International Consultative Committee for Long-Distance Telephony expresses its hearty thanks for the cordial reception received in the town where A. Volta was born and where he lived, happy that it has been able to fulfil its work with such great enjoyment on the banks of the beautiful and inspiring lake.

"President Assembly,
"DI PIRRO."

I shall say no more, because I know well that on account of the sympathy which connects us the words I have already uttered have been sufficient to evoke an affectionate echo in your hearts. I merely request you to remember that I shall always be happy to place my services at the disposal of the C.C.I. within the modest range of my ability.

My dear colleagues, let us take leave of one another with every wish for the greatest success in our forthcoming work. *Au revoir* until Paris. (Applause.)

Dr. Breisig.—Allow me to express our gratitude to the General Secretary and to the officials who have rendered us great assistance in our work. (Applause.)

Mr. Valensi.—I am certain that your thanks are a great help to the Assistant Secretaries and to the Permanent Secretariat. As for me, I do not deserve those eulogistic words because my duties have been greatly facilitated. They have in the first case been facilitated by the cordial welcome and by the great practical comfort which we found at Como. I once more express my gratitude to Mr. di Pirro, to the Provincial Director of Posts and to the Delegates of the Italian Administration, who have given us their co-operation, particularly the engineers, Messrs. Gorio and Baldini.

Apart from this, our task has been similarly facilitated by the great amount of work prepared by the Commission of Assessors, and I beg the Chief Assessors, Messrs. Breisig, Cohen, Höpfner and Van Embden, to be good enough to accept the sincere thanks of the Secretariat.

In the new organisation the function of the General Secretary will be reduced to that of a connecting link, and his duty will be made the more easy by the ties of friendship which have been established between us, the force of which the President pointed out just now. (Applause.)

The meeting was closed at 12.30 p.m.

VIII.—RECAPITULATION OF THE QUESTIONS DEALT WITH BY THE INTERNATIONAL CONSULTATIVE COMMITTEE FOR LONG-DISTANCE TELEPHONE COMMUNICATION DATING FROM THE INCEPTION OF ITS WORK.*

I.—QUESTIONS OF GENERAL ORGANISATION.

Organisation and working of the International Consultative Committee for Long-Distance Telephone Communication, L.B., 40–43; English Translation, pages 6–7.

Distribution of the expenses incurred in the operations of the Permanent Secretariat, L.B., 43; English Translation, page 8; and L.R., 19; English Translation, page 16.

Representation of Private Telephone organisations on the International Consultative Committee, L.B., 44; English Translation, page 8.

Technical collaboration between the C.C.I. and the technical organisations dealing with questions likely to have a bearing on international telephony, L.B., 44 and 45; English Translation, pages 8–9.

Official language to be employed at the meetings, L.B., 45; English Translation, page 9.

Nomenclature of the international circuits and plan of the international cables, L.B., 45; English Translation, page 9; and L.R., 63–67; English Translation, pages 49–51.

Vocabulary of technical telephone expressions, L.R., 20 and 21; English Translation, pages 16–17.

Regulations for the permanent Secretarial Staff of the C.C.I., L.R., 21; English Translation, page 17.

II.—QUESTIONS OF TRANSMISSION, MAINTENANCE AND SUPERVISION.

(*a*) General.

Transmission Unit, L.B., 49; English Translation, page 14.

Method of expressing frequency, L.B., 50; English Translation, page 14.

Definitions of some expressions used in questions of telephone transmission, L.B., 50–53; English Translation, pages 15–18; and L.R., 81; English Translation, page 62.

Telephone Transmission Reference System, L.B., 53–66; English Translation, pages 19–21; and L.R., 83–92; English Translation, pages 62–68.

Uniform value to be given to the Impedance of International Circuits, L.B., 67; English Translation, page 29.

Combinations of International Circuits, L.B., 68; English Translation, page 29.

Practical Limits of Transmission Equivalents, L.B., 68; English Translation, page 29; and L.R., 23–24; English Translation, page 18.

Allowable limits of variation in the transmission equivalent with frequency for long 2-wire and 4-wire International Circuits, L.B., 69; English Translation, page 30.

Adoption of arrangements in regard to Type of Loading and Gauge of Conductors other than those prescribed by the C.C.I., L.B., 70; English Translation, page 30.

Echo effects, L.B., 70–73; English Translation, pages 31–32.

Transient phenomena, L.B., 73; English Translation, page 32.

* The abbreviation L.B. signifies "Livre Blanc" (Minutes of the Plenary Session at Paris, 29th November–6th December, 1926, of the International Consultative Committee for Long-Distance Telephone Communication), on sale at the Committee Secretariat, 23, Avenue de Messine, Paris. The abbreviation L.R. denotes "Livre Rose" (Minutes of the Plenary Session at Como, 5th–12th September, 1927, of the International Consultative Committee for Long-Distance Telephone Communication), that is to say, this book. The numbers following the letters L.B. or L.R. indicate the numbers of the pages.

General Recommendations concerning Mixed Lines. General conditions to be satisfied by the cable sections inserted in open-wire lines in so far as it affects the loss of efficiency and impedance irregularities, L.B., 97; English Translation, page 49; and L.R., 27–29; English Translation, pages 20–23.

Transmission Equivalents and Distortion of Mixed Lines, L.B., 97; English Translation, page 49.

(*e*) Maintenance and Supervision of the Lines and Installations.

Rapid Re-establishment of International Communications, L.B., 99 and 100; English Translation, page 53.

Testing points on International Circuits, L.B., 100 and 101; English Translation, page 53.

Restriction of the number of Test points on International Cable Lines, L.B., 101; English Translation, page 54.

Supervision of the lines by means of Patrol Service, L.B., 101; English Translation, page 54.

Maintaining Satisfactory Transmission (periodical tests), L.B., 101–113; English Translation, pages 55–62.

Function and Duties of the Control Station, L.B., 114–119; English Translation, pages 63–66.

Instructions for putting into operation and the maintenance of international telephone circuits, L.R., 69–74; English Translation, pages 52–61.

Maintenance of circuits used for Relaying Broadcast Transmission, L.B., 119; English Translation, page 67.

Division of Responsibility between Telephone Administrations and Radio Broadcast Services (State or private) regarding the Maintenance of Circuits used for the Relaying of Broadcast Transmissions, L.B., 120; English Translation, page 67.

Technical Responsibilities in Connection with the Renting of International Telephone Circuits to Broadcasting Authorities, L.B., 120; English Translation, page 67.

(*f*) Co-existence of Telephone and Telegraph Circuits in the same Cable.

L.B., 127–135; English Translation, pages 75–82; L.R., 93–96; English Translation, pages 69–70.

III.—QUESTIONS OF TRAFFIC AND OPERATION.

(1) General.

Duration of Service, L.B., 332 and 333; English Translation, page 262.

Decentralisation of International Traffic, L.B., 333; English Translation, page 262.

Obsolete Lists of Subscribers, L.B., 333; English Translation, page 262.

Maximum waiting time for Ordinary International Calls, L.B., 334; English Translation, pages 262–263.

Designation of International Circuits, L.R., 110; English Translation, pages 81–82.

(2) Various Classes of Calls and Facilities to be offered to the Public.

Calls by Subscription, L.B., 340 and 341; English Translation, pages 268–269.

Agreement to be made between exchanges and subscribers for the exchange of subscription calls, L.R., 105–108; English Translation, pages 78–80.

Requests for information, L.B., 341; English Translation, page 269; L.R., 112–113; English Translation, pages 83–84.

Occasional calls at fixed time, L.R., 111 and 112; English Translation, pages 82–83.

Leasing of international communication routes for private service, excluding submarine sections, L.R. 117–119; English Translation, pages 86–87.

(3) Methods of Operating.

Establishment of Calls during Heavy Traffic, L.B., 345; English Translation, page 272.

Standardisation of hours of light traffic, L.R., 109; English Translation, page 81.

Method of establishing calls with *Préavis* or *Avis d'appel*, L.B., 345–348; English Translation, pages 272–274.

Delivery of calls with *Avis d'appel*, L.R., 110 and 111; English Translation, page 82.

Operation of International Circuits, L.B., 348; English Translation, page 274.

Assignment of serial numbers of a call, L.R., 114; English Translation, page 84.

Instructions to the Personnel at Telephone Exchanges, L.B., 348 and 349; English Translation, page 274.

Preparation of Calls, L.B., 349; English Translation, page 275.

Suitable methods of reducing the losses of time in international calls due to the delay caused by the subscribers in replying to the call from the Toll exchange, L.R., 114 and 115; English Translation, pages 84–85.

Telegraphic Preparation of Telephone Calls, L.B., 349; English Translation, page 275.

Suggested International Regulations for the Telegraphic Preparation of Telephone Calls, L.B., 350–354; English Translation, pages 275–277.

Operating rules for the international transit traffic, L.B., 355 and 356; English Translation, page 278.

Conditions which should be fulfilled concerning the Operation of Intercommunication Systems between International 4-wire and 2-wire circuits, L.B., 357; English Translation, page 279.

(4) Rates and Tariffs.

No reply from a subscriber, L.B., 362; English Translation, page 283.

Tolerance and Arrangements for Registering the Duration of Calls, L.B., 363; English Translation, page 284.

Comparison of the number of calls between the international exchanges, L.R., 108 and 109; English Translation, pages 80–81.

Calculation of International Telephone Charges, L.B., 363 and 364; English Translation, pages 284–285.

Minimum Traffic to be guaranteed to Transit Country, L.B., 365 and 366; English Translation, pages 285–286.

Relationship between the cost of leasing a circuit and the value of the cut-off frequency of this circuit, L.B., 366 and 367; English Translation, page 286.

(5) **Proposed Typical Form of Agreement between Administrations for International Telephone Service.**

L.B., 369–374; English Translation, pages 287–291.

(6) **Traffic Statistics.**

L.B., 375–383; English Translation, pages 293–301; and L.R., 116 and 117; English Translation, page 86.

IV.—QUESTIONS CONCERNING THE PROTECTION OF LINES.

1. Protection of telephone lines against interference caused by heavy current or high-tension power circuits.

   See the pamphlet published in 1926 by the International Consultative Committee on Long-Distance Telephone Communication under the heading:

   " Instructions concerning the precautions to be taken in order to protect telephone lines against interference from heavy current or high-tension power circuits " (on sale at the Committee Secretariat, 23, Avenue de Messine, Paris).

2. Protection of telephone cables against corrosion due to electrolysis, L.R., 123–147.*

3. Protection of telephone cables against corrosion due to chemical action, L.R., 148–150.*

* English Translation printed as a separate volume.

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