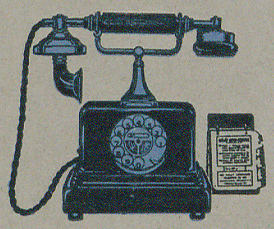
THE RELAY AUTOMATIC TELEPHONE SYSTEM



MARCONI HOUSE STRAND
LONDON.W.C.2.

RELAY

THE "RELAY"

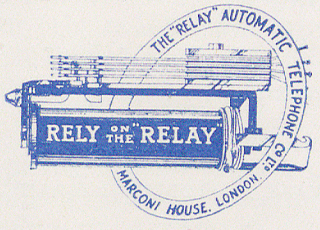
AUTOMATIC TELEPHONE SYSTEM

ADMIRAL VISCOUNT JELLICOE
O.M., G.C.B., G.C.V.O.

After viewing an Automatic Installation, said—"It is one of the greatest wonders of the world. It is as human as it is uncanny."

PROFESSOR J. H. FLEMING
M.A., D.Sc., F.R.S.

Said—"The Automatic Telephone is the nearest conception of an artificial brain that has yet been conceived."



REGISTERED TRADE MARK

THE RELAY AUTOMATIC TELEPHONE COMPANY, LIMITED

MARCONI HOUSE, STRAND, LONDON, W.C. 2
Telephone, CITY 281 Telegrams, "RELAYMATIC, PHONE, LONDON"

WORKS, RELAY HOUSE, STREATHAM HILL, LONDON, S.W. 2
Telephone, STREATHAM 3200 Telegrams, "RELAYMATIC, PHONE, LONDON"

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THE "RELAY"
AUTOMATIC TELEPHONE SYSTEM

Foreword

THE telephone is admittedly one of the greatest aids to the effective prosecution of business affairs, and it is difficult to conceive how modern commerce could be conducted without it. Nowadays social and industrial modern progress demands a grade of service that the manually operated and usual "house-telephone" systems are incompetent to give. The vital need is for a *thoroughly efficient* service, which only automatic plant can uniformly deliver.

This, then, was the idea that guided the original design of the "Relay" Automatic Telephone System, and the same idea has exercised its influence on every subsequent development and improvement of this system.

To the telephone user, the chief advantages of automatic service lie in its economy, impersonality, secrecy, speed and accuracy, and the uniformity of these features at all times. When a telephone user can establish a connection in three seconds at any time of the day or night without the aid of any operator, it is not difficult to understand the prevailing preference for automatic plant.

"Relay" Installations

Some advantages of the "Relay" P.A.X.

"Relay" Installations are manufactured from 6 to 10,000 Lines, and are of three types: "Relay" P.A.X. (for private automatic internal communication), "Relay" P.A.B.X. (for combined private internal and Public Exchange Service), "Relay" Minor (a simplified private automatic exchange for 6 to 24 lines only).

The "Relay" Automatic Telephone System gives a constant day and night service, and is as ready to handle a rush of connections at midnight as at midday. Connections are effected between any parts of an establishment in three seconds. No waiting, no wrong numbers. The transmission of speech is clear, conversations are protected from overhearing, and cross connections never occur. Replacing the receiver gives instant disconnection. No operators have to be paid or accommodated—the "Relay" substitutes for their service an automatic and scientifically assured electric operation.

"Relay" installations can be supplied for any number of lines without limit, and the system can be put into any office, building, works, factory, or

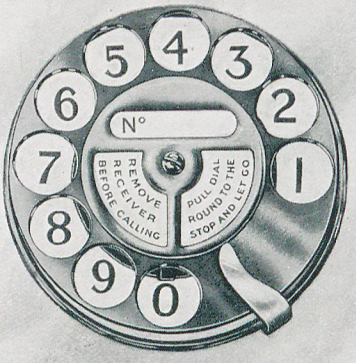


SHELL-MEX LIMITED, LONDON.

"With reference to the 160 line Switchboard which was installed in our building some years ago, we have to state that same is giving us entire satisfaction, and is, in our opinion, the most efficient form of internal telephone we have so far met."



TABLE TYPE WITH HAND
COMBINATION TELEPHONE



THE DIAL SWITCH



TABLE TELEPHONE
BRITISH POST OFFICE TYPE

other establishment with a minimum of trouble and inconvenience. The wiring is simple and easy as only two wires are needed between the switchboard and each instrument. The switchboard needs no attendant, it can be placed in any part of the premises from roof to basement, and the system can be extended at any time without disturbing the service.

How the "Relay" Works

The "Relay" Telephones are similar to those employed on modern manual systems, except that a calling device known as the dial is fitted to each instrument. To call a number—64, for example—the receiver is first taken off with the left hand, and the tip of the index finger of the right hand placed in the hole through which the figure "6" can be seen, and the circular plate is rotated until the finger reaches the stop. The finger is then withdrawn and the plate returns to its original position. The operation is repeated with the finger inserted in the hole over number "4." The plate again returns to its normal position and the call is through, the called party's bell continuing to ring until the call is answered. Should the caller wish to abandon a call at any moment, the mere replacement of the receiver is sufficient to restore all apparatus to normal. The "Relay" effects its connection between any parts of an establishment in three seconds; a manual operator takes from eight to ten times as long; a significant fact which cannot be disregarded where greater economy and increased efficiency are desired.

"Relay" Special Facilities

Priority Service (Executive's right-of-way)

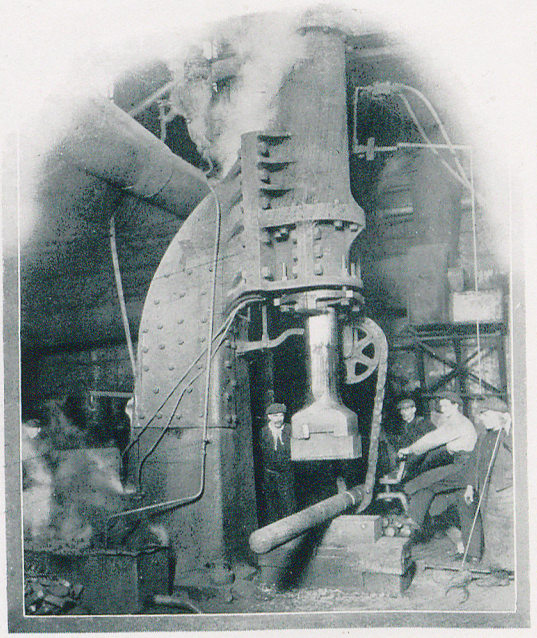
Priority of Service can be given to a Senior Official to enable him to obtain any number instantly, even if it be engaged. By operating the special switch fitted to the instrument affording this facility, the caller is able to break in on any conversation and is immediately in communication with the person to whom he wishes to speak.

Conference Lines

An Executive sometimes desires to confer by telephone with several officials simultaneously. The "Relay" enables such a conference to be held by a number of people while remaining at their desks. The official calling the conference dials the other parties in the ordinary way and asks them to assemble on the Conference Line. The Conference Key which is fitted to each of the instruments giving this facility is then depressed, when the discussion can take place forthwith.

Secretarial Control

Important officials can have all their calls "filtered" through their Secretaries. Trivial calls can be intercepted and dealt with by the



STEAM HAMMER, DEAD WEIGHT 45 CWTS., STRIKING FORCE 98 TONS.

MESSRS. J. G. KINCAID & CO., LTD. GREENOCK.

"We have pleasure in certifying that we have had the 'Relay' Automatic Telephones in use in our Office and Works for the last four years. Notwithstanding the fact that we have several power hammers in close proximity to the switchboard, and considerable vibration is experienced, the installation has given us every satisfaction."

Loud Speaking and Throat Transmitting Telephones



WALL TYPE
TELEPHONE



LOUD SPEAKING TELEPHONE



THROAT TRANSMITTER

Secretary, but when a call is received requiring the Chief's personal attention, the Secretary can extend it, and the mere lifting of the receiver by the Chief automatically cuts out the Secretary and gives secret conversation. This arrangement, however, does not preclude the Chief from making his own calls direct, should he wish to do so.

Loud Speaker

A loud speaking telephone can be fitted instead of the ordinary type if required. With this instrument the user may converse from any part of the room without it being necessary to hold the receiver or speak close to the transmitter. Both hands are thus free to take down notes, refer to documents, etc. When a third party is present, and it is not desired that the conversation shall be overheard, the hand receiver carried on the side of the cabinet may be used; the lifting of this receiver from the hook automatically cuts out the Loud Speaker.

The "Relay" Throat Transmitter

The "Relay" Throat-Transmitter is designed specially for use in noisy works, machine shops, factories, or those parts of a ship where the telephone has to be used amidst extreme external noise.

This instrument is insensitive to air-borne sounds, and it excludes all extraneous noises from being transmitted over the telephone line, only the voice of the speaker being heard at the other end. Instead of the usual mouthpiece, the transmitter is fitted with a "button," as depicted in the illustration, which is held against the throat. With this Throat-Transmitter, the speaker can be heard perfectly when speaking from the noisiest situations. In practice the instrument is held so that the "button" rests lightly against the throat.

Typists' Dictation Circuit

This very useful service is provided by means of a small auxiliary switch-board which works in conjunction with the Automatic Exchange, and is made to hang on a wall.

By dialling a predetermined digit—say, "4"—a caller may obtain the services of a disengaged typist in the Correspondence Room and dictate letters on the automatic 'phone, while the typist can remain at her desk. The hanging up of the caller's receiver effects immediate disconnection.

Code Calling

Should a member of the Staff be absent from his room when he is urgently required, he may be notified that he is wanted by a Code Call on bells or hooter which automatically continue to give out the signal until the wanted person goes to the nearest telephone and answers the call.

Multi-Exchange Working

Cases arise where two or more establishments situated some miles apart may require inter-communication between the two premises. A "Relay" Exchange can be installed in each place, and the two automatic plants

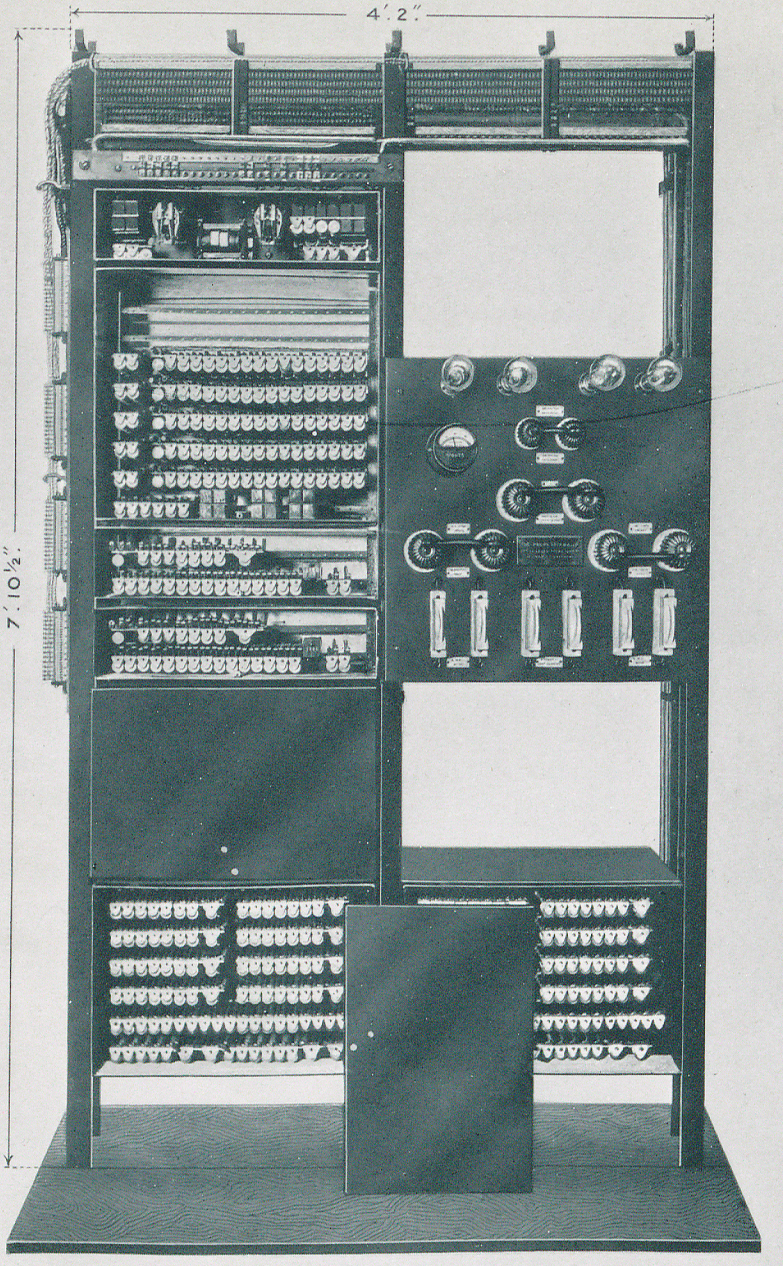


THE LARGEST HOSPITAL IN ENGLAND.

THE LONDON HOSPITAL, LONDON.

"The saving effected by the abolition of the manual operators in the previously existing telephone service justified the capital expenditure of installing the 'Relay' Automatic Telephone System. The installation has now been in use about 4½ years and has materially assisted the administration of the hospital by its efficiency, speed and secrecy."

50-Line "Relay" P.A.X.



50 LINE P.A.X. SWITCHBOARD, EQUIPPED FOR 30 LINES.

inter-connected by one or more outside tie-lines. This scheme can be applied to link up several widely separated premises covering a large area.

Ships' Telephones

The " Relay " is pre-eminently suitable for ships' installations, as being entirely free from mechanical devices it cannot be disturbed by vibration or motion of the ship. The " Relay " is unaffected by climatic conditions, and is equally alert at midnight as midday. The switchboard requires no oiling nor cleaning and can be stored away in any part of the vessel.

The " Relay " Automatic Exchange

The "Relay" employs no human operator, therefore no special accommodation is required for the Exchange, which consists of an iron frame into which the relay groups are fitted in unit form. The installation can be increased at any time to its ultimate capacity without interrupting the service. " Relay " Exchanges require neither oiling nor cleaning, and they are not affected by reasonable quantities of dust, heat or damp. There are no moving parts to wear out in the " Relay," and no skilled attention is required to keep it in working order.

Simplicity and Maintenance

The wonderful simplicity of the " Relay " System makes the question of maintenance practically negligible. We maintain all installations for 12 months free of all charge, whilst after that period we will remain responsible for the maintenance and upkeep for a purely nominal sum.

" Relay " Reliability

Perhaps the best note on which we can close this brief summary of the capabilities of the " Relay " Automatic Telephone System is to give you the facts and figures of an official report on the Maintenance of " Relay " Installations. The report covers a period of 11½ months, and deals with various private installations which have been erected and used between 1916 and 1921.

These facts emerged :—

The number of calls registered was over three and a quarter millions.

The number of pairs of contacts in operation was 96,000.

Out of 96,000 pairs of working contacts, only 47 pairs required cleaning during the 11½ months.

Those are the facts—now let the figures talk.

The figures show :—

One fault in relay contacts per working telephone in 40 years.

One exchange fault per working telephone in 7·4 years.

Systems are judged by their results. Practical men and those responsible for the smooth working of great industries want facts and figures ; we have given the foregoing without any elaboration.

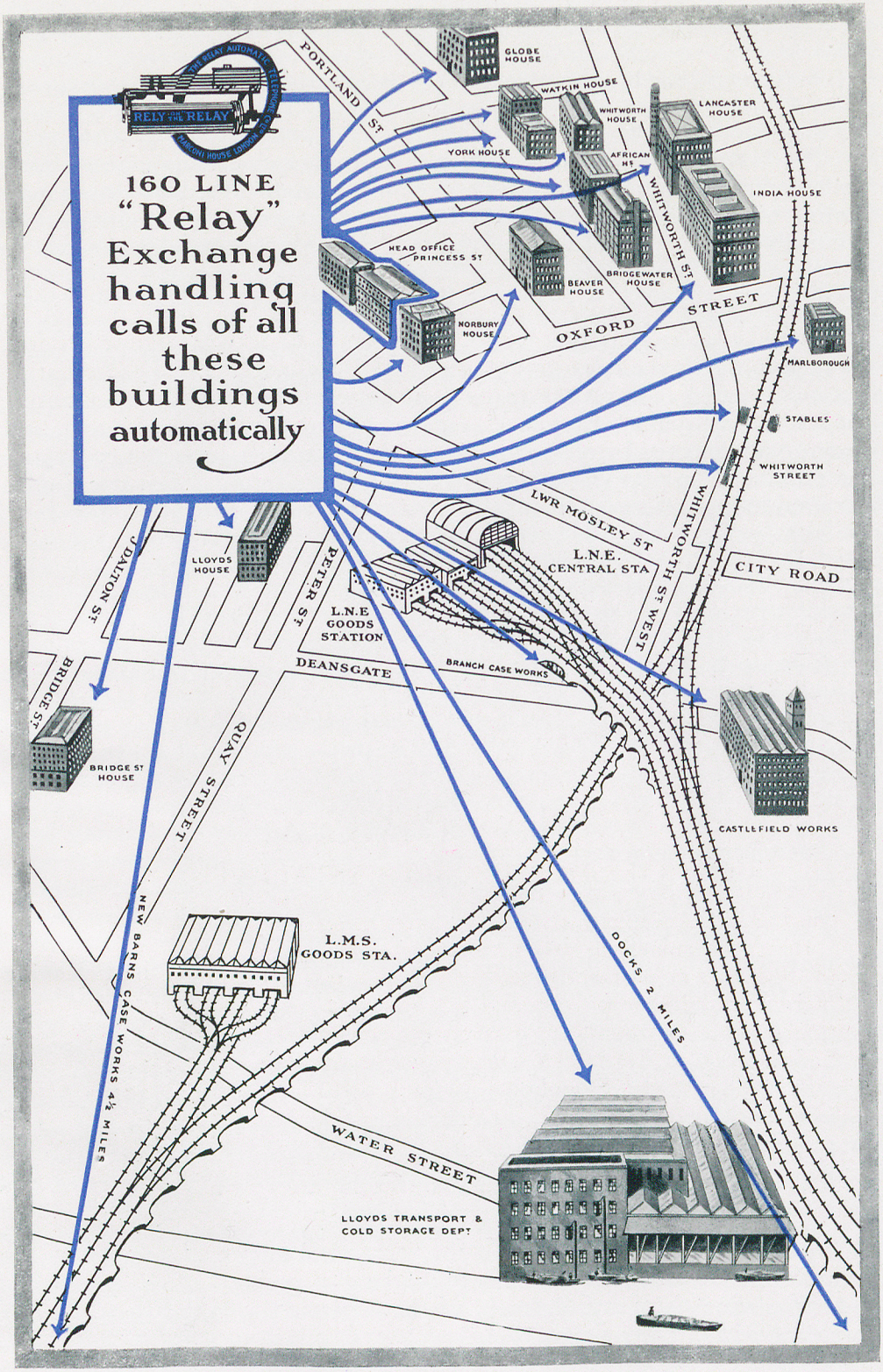


BARCLAYS' BANK, LIMITED, LONDON.

" We installed the ' Relay ' Automatic Telephone System in July, 1919, and believe we were the first British Bank to do so. We find the service so expeditious that the apparatus might easily be overworked were it possible to do so.

" During the time in which the ' Relay ' has been in operation here it has given entire satisfaction, and we must say we really do not know what we should do without it."

160-Line Relay P.A.C.X. at Messrs. Lloyd's Packing Warehouses Ltd. Manchester



The analysis has been made on installations varying in age from one to six years, and in sizes from 10 to 200 lines. Quite a number of the standard plants which were included have been fitted in basements without any special precautions being taken to protect them from dust or damp.

"Relay" P.A.B.X.

COMBINATION SERVICE

This type of installation gives private automatic internal communication between departments and access to the Public Exchange service through the same instrument. No operator is required in connection with the internal calls, but it is necessary for an operator to deal with all calls to and from the Public Exchange, so that the various incoming calls may be properly distributed. The presence of an operator on the manual attachment serves to prevent individuals making unauthorised Public Exchange calls, and enables a check to be kept on toll and trunk calls. The operator being relieved of the internal calls, can give better attention to public calls and enquiries, and, in addition, can undertake filing or other duties.

Where only a few telephones require public exchange facilities, it is usually more economical to keep the two services separate. Where, however, manual private branch exchanges exist, the Relay Automatic Telephone Company can arrange on behalf of the user to replace these with a " Relay " P.A.B.X. on a rental basis.

"Relay" P.A.C.X.

CENTRAL SWITCHBOARD INSTALLATIONS

Controlling Inter-departmental and Public Calls

This is a feature of considerable value to all organisations having Offices, Branches or Works situated in different districts. In general practice, such Departments are frequently a considerable distance apart, and each Department is fitted with an independent Telephone Switchboard for Public Exchange Calls.

In some cases the buildings are connected up by private lines ; in other instances, all connections are made *via* the Public Exchange, while not infrequently some of the buildings are individually equipped with a separate Private Telephone Exchange for Inter-Departmental Service. These methods are extravagant, and entail enormous loss of time owing



QUETTA PUBLIC EXCHANGE BUILDING.

OFFICE OF DEPUTY POSTMASTER-GENERAL, SIND AND BALUCHISTAN.

"I am completely satisfied with the Quetta Exchange. It has given no trouble whatever, and the opinions of the subscribers whom I have asked about the service are unanimously favourable. I congratulate you on the successful installation of an excellent system."—(Sgd., M. N. Crawford).

to the difficulty in effecting rapid connections between the various Departments ; in addition to which, there is the expense attached to the employment of telephone operators in the different Branches.

To solve this important problem on an economical and efficient basis, the " Relay " Automatic Telephone Company has designed a Service whereby all telephone traffic between the different buildings is centralised through a Main Switchboard, which can be installed in any one of the buildings, and which replaces the various individual Switchboards located in the several buildings in question. The necessity for operators in any building except the central one is eliminated by the P.A.C.X. Notwithstanding which, all premises are linked up together in a service which effects connections in three seconds, and Public Exchange calls are originated and received by all such Departments and premises through the one central operator.

The illustration on page 16 demonstrates an actual installation which has been fitted by us, the use of which has resulted in the Company being able to dispense with 24 Switchboards and six Operators, and at the same time eliminate various Private Systems, which not only cost a good deal of money to maintain, but also had the disadvantage that they were unable to communicate with other than a limited number of stations. The general result of installing this installation will be to save hundreds of working hours per year on the Internal Traffic, and the operator being able to give her individual attention to Public Service, its efficiency will be increased some 50 per cent.

In cases where organisations consist of branches which are scattered over different areas, and which require an extensive internal telephone service in each branch, it will probably be more expedient to take advantage of the facilities afforded by the multi-exchange system.

Technical Information

NOTES OF INTEREST TO ENGINEERS, CONTRACTORS, ETC.



SWISS FEDERAL RAILWAYS, SWITZERLAND.

"We have the honour to inform you that the 'Relay' Automatic Telephone System which has been working since February, 1922, has worked faultlessly to date."

The Principle of the " Relay " System

The relays in the switchboard take the place of the human operator, and by a series of electrical circuits actuated through the dial on the telephone instruments, the caller can automatically make connection with any number in three seconds.

All the operations of number selecting, connecting and disconnecting are automatically performed by telephone relays. It is this feature which constitutes the keystone of this wonderful invention, allowing the business man to get into instant touch with any part of the organisation, day or night, without the intervention of human operators and

without the mistakes and delays which arise from human fallibility.

There are no electro-mechanical switches or other cumbersome mechanical devices, therefore the " Relay " System does not need attention for constant adjustments, oiling or cleaning. The " Relay " is not affected by varying climatic conditions, nor by reasonable quantities of dust, heat or damp.

The whole of the operations on the " Relay " switchboard are controlled and actuated electrically. There are no parts that can wear out. The only moving parts in the " Relay " Switchboard are small armatures which have a maximum movement of one thirty-second of an inch.

Power Board and Accumulators

The functions of these are to distribute and store the electric energy for working the Switchboard; the power used for this purpose is usually supplied from a small 24-volt Battery of Accumulators (fitted in duplicate), which can be charged from the existing Electric Light System, either direct or through a Motor Generator.

The Power Board also carries the necessary instruments for showing the voltage, etc., together with the usual switches for "changing over" from one battery to the other. This operation can be carried out by any unskilled attendant.

Relays

The working of all modern manual and automatic exchanges depends on relays, and experience during the past 20 years has shown them to be thoroughly reliable when well designed. Other automatic systems not only rely on relays for setting up the connections, but employ, in addition, complicated electro-mechanical switches. We also originally employed such switches, and it was in effecting improvements that the principle was discovered which enabled us to eliminate the troublesome mechanical part of the apparatus and resort to relays only.

Experience of the working of the system during the past seven years confirms the original opinion that even in damp and dusty situations the " Relay " system works perfectly. In this connection, it must be borne in mind that the contact pressure of our relays is approximately three times that usually employed on the wipers of electro-mechanical switches.

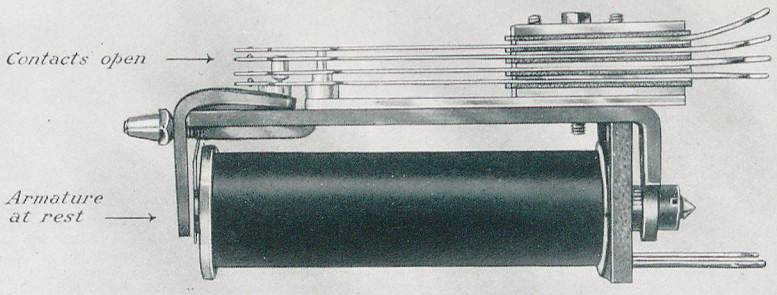
" Relay " Apparatus

The apparatus used in the "Relay" System consists of relays of a type well known in manual practice, but modified in its details of construction so as to reduce the spare parts necessary for maintenance purposes to a minimum. These modifications consist of making the spring banks and coils removable without interfering with the relay as a whole, and the coil tags have been modified to give a much more robust construction than is usually met with,

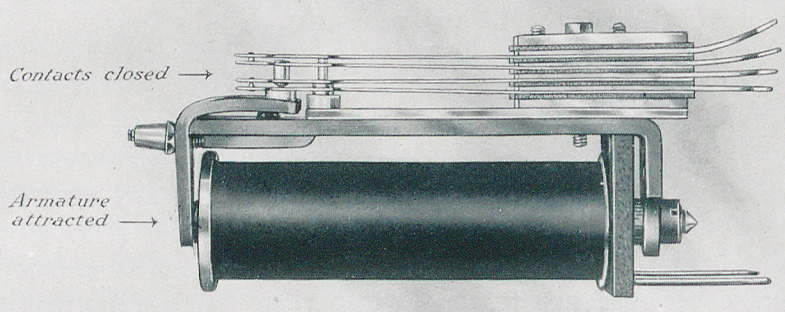


STANDARD BANK OF SOUTH AFRICA LIMITED, CAPE TOWN.

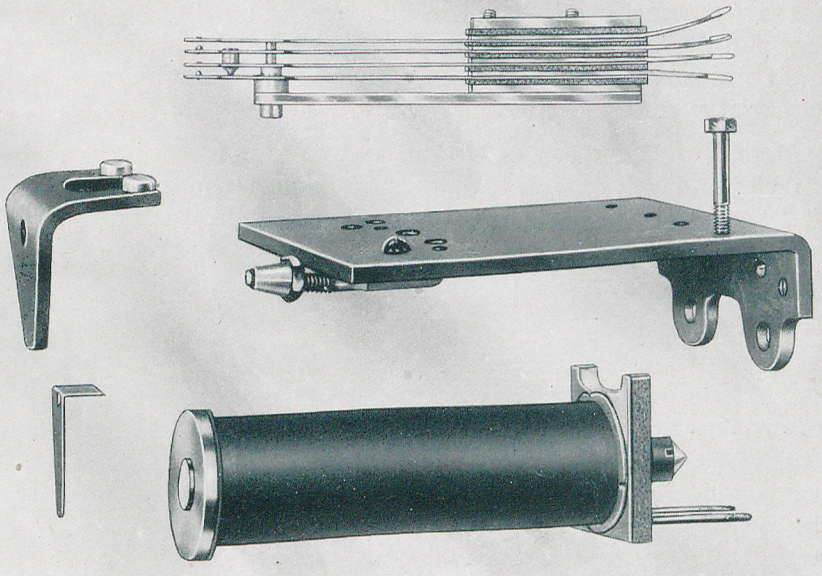
" We wish to say that the ' Relay ' Automatic Telephone System, which was installed in the building about a year ago, has proved its value and is operating satisfactorily. We may add that we have also been pleased to demonstrate the advantages of the system on several occasions to interested parties."



RELAY AT REST



RELAY IN OPERATION



COMPONENTS OF A RELAY

so preventing these tags from coming loose with the heat necessary to solder or unsolder connections. The majority of the relays have six springs made up in two banks, and have similar functions to those used in the British Post Office central battery manually operated exchanges, where 25 years' experience has proved their undoubted reliability, and that, after careful initial adjustment, they seldom require attention.

In the design of the relay care has been taken that as few parts as possible should be adjustable, consistent with satisfactory working, and to this end the travel of the armature and the air gap, both when operated and in normal position, are fixed in the factory. Each relay is wound so that the excitation is sufficient to permit of the contacts having a heavy contact pressure, thus ensuring positive action.

Relays never require lubrication, and with adequate contact pressure, they are unaffected by damp, dust and heat.

Contact Springs

The contact springs are stamped from a special alloy which both experience and tests have proved will retain its tension indefinitely, while the arrangement of the springs insures that contacts will make and break in the correct order.

Erection of Installations

It should be noted that our Estimates for Private Automatic Switchboards include the Main Distribution Frame, Ringing Vibrator, and usual auxiliary apparatus, including Batteries and Charging Board for charging same through a resistance from a D.C. Supply. Should only A.C. Supply or other non-electrical power be available, we are prepared to quote on application for the Generators necessary for transforming or generating the required current.

Unit Construction

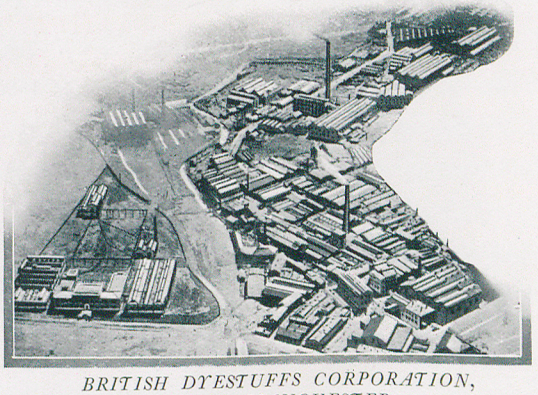
Each piece of apparatus is wired up in unit form in the factory, that is to say, the individual relays, with their associated wiring, are enclosed in a sheet iron case and the requisite number of these cases are then mounted up on H. iron uprights to form the complete installation. This method of assembly enables the complete switchboard to be tested out in the factory, and consequently reduces the work to be executed on the site in connection with the erection and testing of the switchboard.

Batteries

The Batteries supplied consist of two sets of accumulators giving 24 volts.

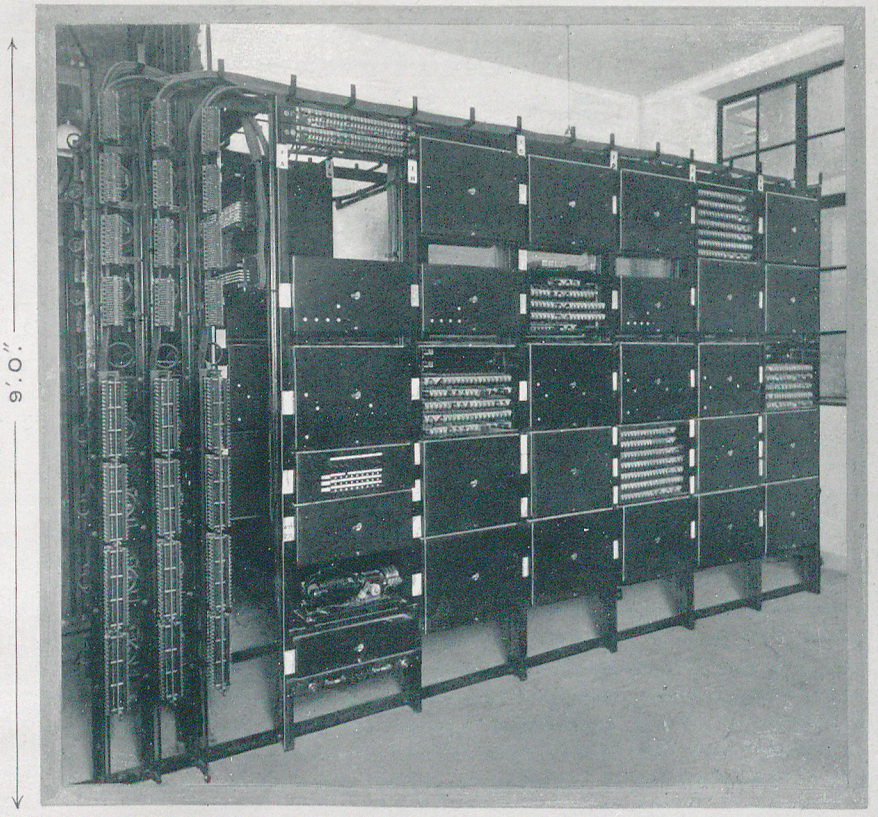
Wiring

It is essential in wiring installations that proper telephone wire and cable should be used, *i.e.*, a twisted pair is absolutely essential, and the insulation should be reasonably good. The class of wire which we recommend is similar to that used by the British Post Office



BRITISH DYESTUFFS CORPORATION, near MANCHESTER.

"We have pleasure in stating that the 90 line 'Relay' Automatic Telephone installation in operation at Blackley Factory gives satisfactory means of communication between the various departments, offices and laboratories, despite the extremely severe conditions met with in a large chemical factory of this nature. It is, in our opinion, the most efficient system of inter-communication we have tried. About 300,000 calls are put through per annum with little delay and at little cost."



THE 300/500 "RELAY" AUTOMATIC TELEPHONE EXCHANGE WHICH SERVES BRITANNIC HOUSE, LONDON. THE OFFICES OF THE ANGLO-PERSIAN OIL COMPANY.

and consists of two 10lb. copper conductors (23 S.W.G.), each wire being covered with enamel, then with two lappings of cotton in opposite directions thoroughly impregnated with wax, and the whole covered with a lead sheath ; the two conductors being twisted together so as to form a pair. In the case of multiple cables, these should be made up of a number of similar pairs twisted both on themselves and relative to each other, the whole then being enclosed in the lead sheath. There is no objection to a heavier gauge of conductor being used, but the size given is sufficiently large for all ordinary purposes.

"Relay" apparatus will work satisfactorily, using the wiring previously mentioned, with lines having a length of about 1¼ miles, and in the event of it being necessary to work at a greater distance than this, it is only necessary to use a heavier conductor. Where the length of the line is very considerable, subsidiary apparatus can be fitted on the individual line, which would enable same to work up to 20-30 miles, depending entirely upon the size of the conductor used.

The satisfactory working of the system does not demand stringent maintenance conditions, either of the line or the dial calling devices. The insulation of the line can be as low as 15,000 ohms. The dial calling device is a simple robust piece of apparatus, and it will be readily understood that maintenance is rendered more facile by the fact that the "Relay" exchange will operate properly with a dial speed ranging from seven impulses per second to twenty impulses per second.

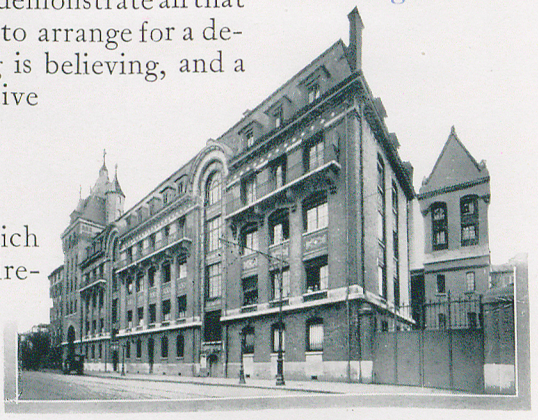
The absence of moving parts, as generally understood, reduces to a minimum the liability for apparatus to get out of order through wear and tear. Relays require neither oiling nor cleaning. There are no cords, brushes, slip rings, etc., in the switchboard to demand periodical attention. With relays the only moving part is a light armature having a movement of not more than one thirty-second of an inch, and with practically no inertia. This makes the "Relay" System the speediest and most reliable on the market.

The "Relay" Automatic Telephone System is offered as a proved practical proposition to practical men. We are therefore prepared to demonstrate all that we claim for it on a working plant. We shall be very happy to arrange for a demonstration at any time that is convenient to you. Seeing is believing, and a practical demonstration will, undoubtedly, be more effective than anything we may say.

Seeing is Believing

The "Relay" Minor

The "Relay" Minor is a smaller type of installation which has been specially devised for organisations whose requirements do not exceed 24 lines. It is a full automatic exchange, and is a distinct improvement on the ordinary inter-communicating systems, but is cheaper to instal than the P.A.X. type of automatic installation.

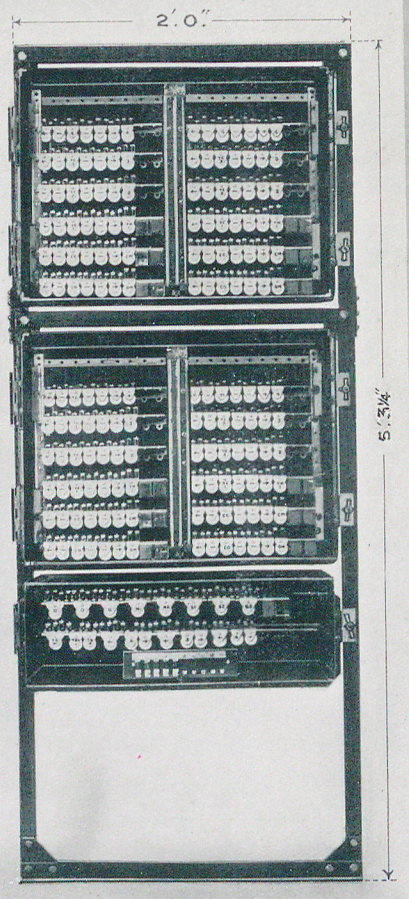


CHEMIN DE FER METROPOLITAIN, PARIS.

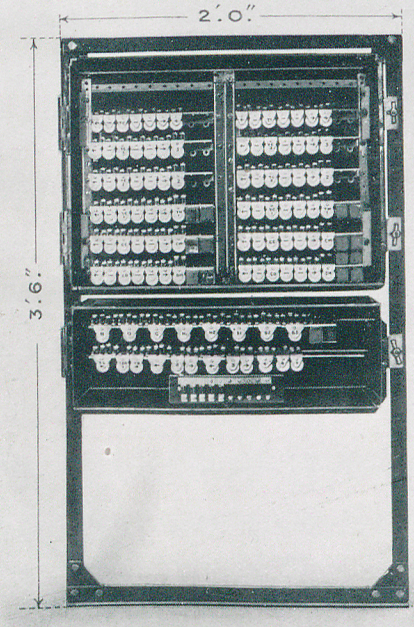
"I have the honour to inform you that the 'Relay' Automatic Telephone Installation fitted by you in our Exploitation Offices, Quai de la Rapée, gives us entire satisfaction, not only as regards working, but also in the certainty and speed of the connections obtained with this System."



RELAY MINOR TABLE TELEPHONE



24-LINE RELAY MINOR SWITCHBOARD
(COVERS REMOVED)



12-LINE RELAY MINOR SWITCHBOARD
(COVERS REMOVED)

The "Relay" Minor possesses all the reliability and absolute secrecy of the larger type. It is just as simple, just as efficient, and it gives the same constant day and night service entirely independent of human operators. The "Minor" System is designed for private service only, and to accommodate offices and works that require anything from 6 to 24 lines. The smaller sizes can be added to quite easily from time to time until the maximum of 24 lines is reached.

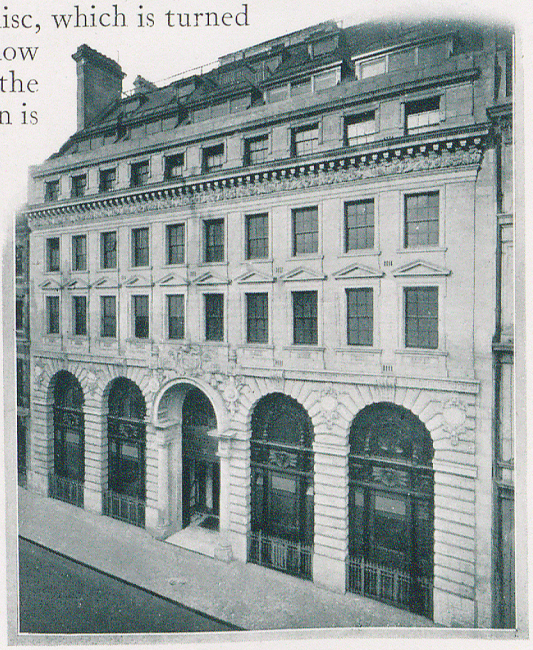
The " Minor " Exchange is built up entirely of simple relays, and, as in other " Relay " Installations, the absence of cumbersome mechanical switches assures its perfect reliability and reduces its maintenance cost to negligible proportions.

The Switchboard is arranged to stand close to a wall, the apparatus being hinged so that complete access back and front is provided whenever necessary. The floor space occupied is approximately 1ft. by 2ft., and the exchange is 3ft. 6in. high for 6 and 12 line installations, the height increasing to 5ft. 3¼in. for the 18 and 24 line sizes.

The whole of the electrical energy required is supplied by a battery of primary cells, which will, without attention, run an exchange from six to twelve months. The usual set of accumulators, power board and charging arrangements are entirely dispensed with. The use of primary batteries is made possible by the low current consumption, and by the very wide variation in voltage over which the exchange will work satisfactorily.

The " Minor " employs a novel method of number selection; the ordinary automatic dial has been replaced by a rotatable disc, which is turned round until the required number is seen through the window of the instrument (see illustration), and then the key at the side is momentarily depressed. This method of selection is extraordinarily rapid, the actual connection being made in a fraction of a second. The ringing is automatic, the called party's bell continuing to ring until he answers or the caller abandons the call. The conversation is absolutely secret, there is no risk of overhearing, and a third party cannot intrude upon an engaged line. At the conclusion of conversation either party hanging up immediately restores all apparatus to normal. Should it be desired to call the same number again, it is only necessary to lift the telephone off the rest and push the button.

Another special feature of the system is that receivers accidentally left off do not engage any of the automatic exchange apparatus nor cause any current to be consumed.



WM. CORY & SON, LTD., LONDON.

" Prior to the occupation of our new building, exhaustive tests were made as to the most suitable internal intercommunicating telephone system to adopt. The 'Relay' was installed, and in operation has fully proved all that has been claimed for it. Communication with any Department in the building is now instantly established, and it is an essential adjunct to our Office equipment."

Special Features

Several special features have been incorporated in the design of the "Minor" System :—

(1) CONFERENCE. Any number of telephones may be connected together to enable conference to be held. The person calling the conference merely rings up those whom he requires and requests them to call the conference number. This feature is standard on all "Minor" boards. Conference facility takes up one point on the Switchboard, and if this facility is required, the total number of instruments which can be connected to the switchboard is 23.

(2) SECRETARIAL CONTROL. Two instruments can be connected to one line so that calls may be originated from either, but incoming calls are received on one only. The call can be picked up on the other instrument if required. The increased cost here is merely that of the second telephone.

(3) PRIORITY SERVICE (Executive's right-of-way). Included as a standard feature is the special facility for a Master Station always to obtain the desired connection if the wanted line be engaged. This means that ordinarily all conversations are secret, but that the Master Station has the power to tap all engaged lines ; if an absolutely secret system is required, the master facility may be dispensed with.

(4) CODE CALL (Round Call, General Call). By installing the necessary hooters, an efficient system for locating wanted persons in or about the premises, but away from their telephones, may be provided. Every telephone is equipped with a key for sending out the codes, and upon recognising his code, the wanted party can immediately reply to the caller from any telephone.

The "Relay" Minor is entirely unique. It is automatic in every sense of the word. Nothing could be quicker, simpler or more reliable. The switchboard needs no oiling, no cleaning, and no attention to keep it in working order. It possesses all the advantages of the "Relay" P.A.X. at a lower cost to those whose automatic requirements will not exceed 24 lines. For the smaller organisation it is the ideal system.



SIAMESE STATE RAILWAYS, SIAM.

"The great working range of the Exchange is shown by the long distance between the two points Bangkok Noi and Wat Soi Thong Stations (about 18 km.). During the eighteen months of service the Exchange has been working very satisfactorily. The usefulness and popularity of the 'Relay' are clearly demonstrated by the average number of calls per day, whereas the old manual exchange was little used."

"Relay" Minor for Ships

This system is particularly adapted for ships where, generally speaking, telephone communication is required only among navigating officers, engineers, doctors and pursers. The apparatus, like the "Relay" P.A.X., is immune from any liability to derangement through climatic fluctuations, vibrations, coal dust, and all other severe conditions imposed in sea-going service.

The "Relay" Code Calling Device

An ever-present problem in a very great number of large establishments is the inability to locate a particular person at any moment. In a large factory the General Manager may be required urgently on the telephone, and is known to be " about the Works, somewhere," but before he can be found, the caller has tired of waiting and has rung off and the firm may have lost a valuable order. Or it may be a Hospital—the House Surgeon is wanted urgently—a matter of life or death. He is " somewhere on the premises." Again, in a large Store, a Sub-Manager is wanted by the Managing Director for a conference, but is " in one of the Departments."

That is a very unsatisfactory state of affairs, and means considerable wastage of time of the highest paid and most important people, and indicates lack of efficiency in the organisation.

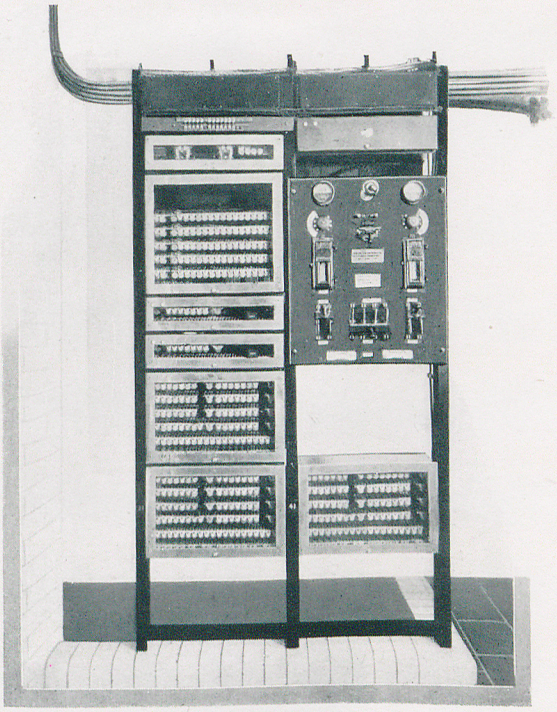
These difficulties can be overcome, and the whereabouts of the wanted party immediately ascertained by employing the " Relay " Code Call System to locate your man.

This system is an electrically operated signal service which sounds a call for the wanted party on bells, horns, or hooters throughout the premises. Each person has his own individual call, which he can immediately recognise when it is sounded, and which is the only one he requires to know, so that while he instantly recognises it, the call does not disturb other members of the concern.

The " Relay " Code Call installation consists of a Central Code Calling Station (capable of calling up to a maximum of 25 different codes), and a motor generator supplying the ringing current.

To find the wanted person, the operator merely inserts the plug into the jack indicated for the person in question, and the code commences automatically, and so continues until the wanted party answers, or the plug is withdrawn from the jack.

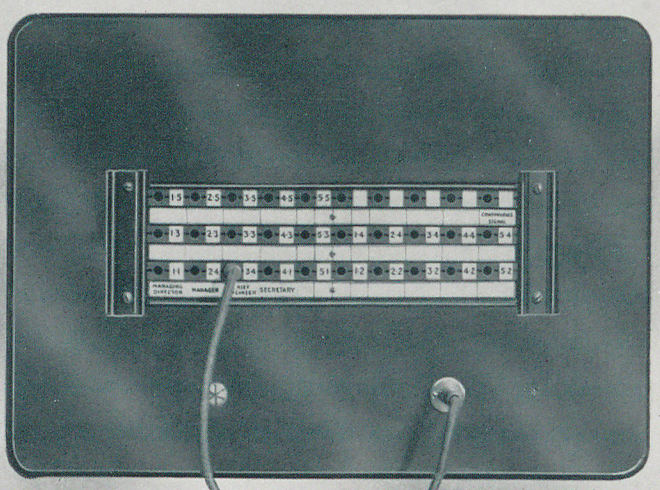
For illustrations of " Relay " Code Calling Device see page 22 (overleaf).



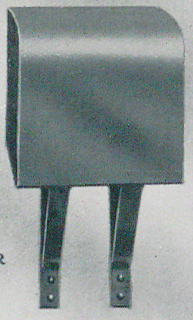
WALES, LTD., BIRMINGHAM.

" With regard to the Installation as a whole, we cannot tell you how very delighted we are with this. We wish to thank you also for the way in which your expert has worked with us on this matter, and we wish to testify to the excellent work he has done during the process of installation. We think that undoubtedly we have got the finest small works installation in the country." (50-Line P.A.X.)

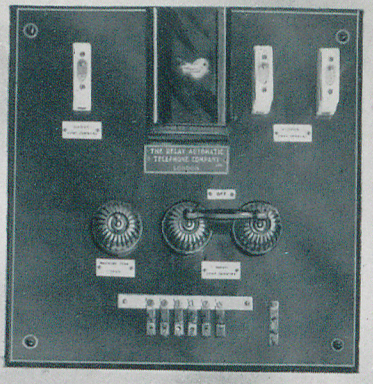
"Relay" Code Calling Device



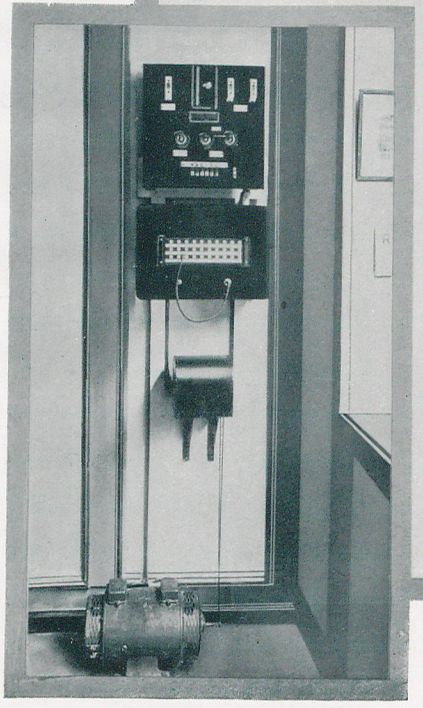
AUTOMATIC CODING PANEL

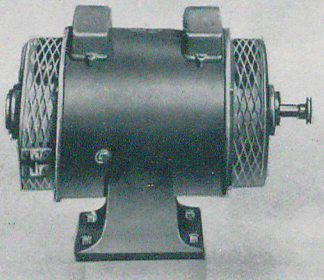


CODER



POWER BOARD





MOTOR GENERATOR

SOME GOVERNMENT AUTHORITIES AND REPRESENTATIVE CONCERNS

WHO HAVE ADOPTED THE "RELAY" SYSTEM

GOVERNMENTS AND ADMINISTRATIONS.

Great Britain.
Australia.
India.
South Africa.
Brazil.
France.
Denmark.
Germany.
Japan.
Laurenco Marques.
Peru.
Portugal.
Siam.
Sudan.
Switzerland.

ADMIRALTY ESTABLISHMENTS.

*†H.M. Dockyard, Chatham.
H.M.S. Vernon, Portsmouth.
Royal Naval College, Greenwich.
Royal Naval Hospital, Chatham.
R.N. Ordnance Depot, Priddy's Hard and Bedenham.

COMMONWEALTH OF AUSTRALIA.

Australia House, London.

BANKING INSTITUTIONS.

Anglo-South American Bank, Bradford.
Anglo-South American Bank, London.
Banco Guipuscoano, San Sebastian.
Bank of Australasia, London.
†Bank of England, London.
†Banque Belge pour L'Étranger, London.
Banque Belgo-Luxembourgeoise, Brussels.
Banque Buurmans, Brussels.
Banque Cahen, Paris.
Banque de Courtrai, Courtrai.
Banque de Commerce, Antwerp.
Banque D'Anvers, Antwerp.
Banque D'Outremer, Brussels.
Banque Generale Belge, Antwerp.
Banque Nationale de Belgique, Brussels.
Banque Nationale de Belgique, Antwerp.
Barclays Bank Ltd., London.
British Trade Corporation, London.
Caisse D'Epargne de Guipuscoa, San Sebastian.
Caisse Générale D'Epargne, Brussels.
Caisse Hypothecaire Anversoise, Antwerp.
Caja de Ahorros Provincial, San Sebastian.

BANKING INSTITUTIONS—*contd.*

Chartered Bank of India, London.
Commercial Banking Co. of Sydney, Sydney, N.S.W.
Cox & Co., Charing Cross, London.
Crédit General Hypothécaire et Mobilier, Brussels.
Effectenbeurs, Amsterdam.
†Higginson & Co., Ltd., London.
Hong-Kong & Shanghai Banking Corporation, London.
¶Lloyds Bank, King William Street, London.
¶Lloyds Bank, Lombard Street, London.
Lloyds Bank, Antwerp.
Société Générale de Belgique, Rue Royale, Brussels.
Société Générale de Belgique, Agence du Centre, Brussels.
Société Mutuelle Mobilière et Immobilière, Brussels.
†Standard Bank of South Africa, Cape Town.
Union Bancaire Anversoise, Antwerp.
Westminster Bank Ltd., London.

BREWERS.

†Ansells Brewery Ltd., Birmingham.
Bass, Ratcliff & Gretton, Ltd., Burton-on-Trent.

BRITISH EMPIRE EXHIBITION.

Administration Offices, Wembley.
Dominions and Colonies Buildings, Wembley.

COLLIERIES.

Charbonnage de Wérister, Belgium.
*Denby Colliery Co., Ltd., Nr. Derby.
Newton Chambers & Co., Sheffield.
Powell-Duffryn Steam Coal Co., Ltd., Cardiff.

COMMERCIAL & GENERAL ESTABLISHMENTS.

†Achille Serre Ltd., London.
†Aplin & Barrett, London.
†Brown, Muff & Co., Ltd., Bradford.
E. Boustead & Co., London.
Compagnie Continentale du Gaz, Brussels.
I. J. & G. Cooper, Ltd., Manchester.
*†Coopers & Co., Stores, Glasgow.

COMMERCIAL & GENERAL ESTABLISHMENTS—*contd.*

Wm. Cory & Sons, Ltd., London.
Dalgety & Co., Ltd., London.
†J. Duckworth, Ltd., Rochdale.
Educational Supply Association, Ltd., London.
†Fassett & Johnson, Ltd., London.
Fours à Coke de Zeebrugge, Belgium.
Heilbut & Symons & Co., Ltd., London.
†Higgs & Hill, Ltd., London.
†Imperial Cold Storage, Ltd., Cape Town.
†Isobel, Ltd., London.
Lazard Brothers, London.
†Lloyd's Packing Warehouses, Ltd, Manchester.
†Ormerod & Sons, Ltd., Rochdale.
†Osborne Peacock & Co., Ltd., Manchester.
†J. & N. Phillips, London.
†J. & N. Phillips & Co., Ltd., Manchester.
†Pocock Bros., London.
†Rowntree & Sons, Scarborough.
Samuel Samuel & Co., Tokyo. 2 Exchanges.
Service de Ville de Paris, Bois de Boulogne, Paris.
Simpson & Godlee, Ltd., Manchester.
Société Générale des Minerais, Brussels.
Société Internationale Forestière et Minière du Congo, Brussels.
Solvay et Co., Brussels.
*†Spillers Milling & Associated Industries Ltd., London.
Stotherts, Ltd., Atherton.
Swedish Chamber of Commerce, London.
Tréfileries de Douai, Douai.
Trust Houses Ltd., London.
Wales, Ltd., Birmingham.
*Walter Webb & Baker & Co., Ltd., London.
†Warrington Co-operative Society, Ltd., Warrington.
*Winchcombe Carson, Sydney, N.S.W.
*Wigglesworth & Co., London.

DEPARTMENTAL STORES.

John Barker & Co., Ltd., London.
Boots Pure Drug Co., Ltd., London.
†Cooper & Co., Ltd., Liverpool.
†Debenhams, Ltd., London.
*†George Henry Lee & Co., Ltd., Liverpool.
†Magasins de Louvre, London.

EDUCATIONAL ESTABLISHMENTS.

Université Libre de Bruxelles, Solbosch, Belgium.
University of Bristol (Merchant Venturers' Technical College), Bristol.

ENGINEERS.

†Babcock & Wilcox, Ltd., London.
Berguis Co., Ltd., Glasgow.
W. Bayliss & Co., Ltd., Nairobi, East Africa.
¶†Burndept Ltd., London (Bedford Street).
¶†Burndept Ltd., London (Blackheath).
†Charing Cross Electricity Supply Co., Ltd., London.
¶City of London Electric Lighting Co., London (Bankside).
¶City of London Electric Lighting Co., Ltd., London (Falcon House).
Clayton, Son & Co., Leeds.
Crompton & Co., Ltd., Chelmsford.
Kincaid & Co., Ltd., Greenock.
H. Leloup & J. Oury, Liege.
Marconi's Wireless Telegraph Co., Ltd., Marconi House, London.
Marconi's Wireless Telegraph Co., Ltd., Radio House, London.
Marconi's Wireless Telegraph Co., Ltd., Marconi Works, Chelmsford.
†Morris Engines (Coventry) Ltd., Coventry.
*†Morris Motors Ltd., Oxford.
†North-Eastern Marine Engineering Co., Wallsend.
Platt Bros. & Co., Ltd., Oldham.
Thomas Robinson & Sons, Ltd., Oldham.
Société Générale Belge D'Entreprises Electriques, Brussels.
Société Métallurgique de Sambre et Moselle, Montigny-sur-Sambre.
Studebakers Ltd., London.
†John Taylor & Sons, London.
†Ward & Goldstone, Ltd., Manchester.
Westminster Electric Supply Corporation, Ltd., London.
*†Wireless Telegraph Co. of South Africa, Cape Town.

HOSPITALS AND INSTITUTIONS.

*Bolingbroke Hospital, London.
†Cardiff Royal Infirmary, Cardiff.
Chelsea Hospital for Women, London.
Dorset Mental Hospital, Dorchester.
Duff House, Ruthin, N. Wales.
Edinburgh Royal Asylum (West House), Edinburgh.
Holborn & Finsbury Hospital, London.
Hospital for Consumption and Diseases of the Chest, London.
London Hospital, London.
London Fever Hospital, London.
London Temperance Hospital, London.
†Middlesex Hospital, London.
*National Children's Home and Orphanage, Highbury, London.

HOSPITALS AND INSTITUTIONS—*contd.*

National Hospital for the Paralysed and Epileptic, London.
Paddington Hospital, London.
†Perth Royal Infirmary, Perth.
Poplar Hospital, London.
Royal Gwent Hospital, Newport, Mon.
Royal Naval Hospital, Chatham.
Royal Northern Hospital, London.
Royal Victoria Hospital, Belfast.
*St. Monica's Home of Rest, Bristol.
South London Hospital for Women, London.
†Star & Garter Homes, Richmond.
Westminster Hospital, London.

INSURANCE COMPANIES & BROKERS.

Assurance Lejeune, Antwerp.
Compagnie D'Assurances de L'Escaut, Antwerp.
Gresham Life, Fire & Accident Insurance Offices, London.
Guardian Assurance Co., Ltd., London.
Provident Mutual Life Assurance Association, Ltd., London.
†United Kingdom Temperance & General Provident Institution, London.
†Willis, Faber & Co., London.

MANUFACTURERS.

Aluminium Plant & Vessel Co., Ltd., London.
Anderston Foundry, Ltd., Middlesbrough.
Ateliers de Construction de et à Willebrock, Belgium.
Ateliers de Construction Gilain, Tirlemont, Belgium.
Ateliers de Construction la Brugeoise et Nicaise et Dulcère, Bruges.
Beldam Tyre Co. (1920), Ltd., Brentford.
Birmingham Aluminium Casting Co., Birmingham.
British Dyestuffs Corporation (Blackley) Ltd., Manchester.
†British Xylonite Co., Ltd., Manningtree.
*Carborundum Company, Ltd., Manchester.
*Carreras Ltd., London.
Chiswick Polish Co., Ltd., London.
Chocolaterie Duc, Antwerp.
Cochrine & Co., Middlesbrough.
Compagnie Générale de Téléphonie et de Télégraphie, Paris.
Elliotts Metal Co., Birmingham.
Etablissements Brépols, Turnhout, Belgium.
Faiencerie de Nimy, Nimy, Belgium.
†Sir J. Farmer Norton & Co., Ltd., Manchester.
*Ferodo, Ltd., Chapel-en-le-Frith.
Fullers, Ltd., London.
¶W. Gossage & Sons, Ltd., Widnes & Liverpool.
†Greengate & Irwell Rubber Co., Ltd., Manchester.

MANUFACTURERS—*contd.*

*†Greaves Cotton Co., India.
†Samuel Heap, Ltd., Rochdale.
Henry Jones & Co., Hobart, Tasmania.
James Keiller & Sons, Ltd., Dundee.
†Jaeger Co., Ltd., London.
*†London Electric Wire & Smith's Ltd., Walthamstow.
Macfarlane, Lang & Co., London.
†Macfarlane, Lang & Co., Glasgow.
Michelin & Cie., Cataroux, France.
Michelin & Cie., Clermont-Ferrand, France.
Henry Milward & Sons, Ltd., Redditch.
New Antwerp Telephone & Electrical Works, Antwerp.
Nobel Industries, Ltd., London.
North British Steel Works, Sheffield.
†Oxendale & Co., Manchester.
¶Pease & Partners, Middlesbrough.
Produits Chimiques Poulenc, Paris.
S.A. des Acieries d'Angleur à Renory, Belgium.
S.A. des Acieries d'Angleur à Tilleur, Belgium.
Société Générale de Matériel D'Entrepreneurs, Herentals, Belgium.
Solvay et Co., Brussels.
Sucreries de Moerbeke, Moerbeke, Belgium.
Sucreries de Wanze, Wanze, Belgium.
Sucrerie Wittouck à Selzaete, Belgium.
Richard Thomas & Co., London.
Thompson & Norris Manufacturing Co., Ltd., London.
W. Timpson, Ltd., Kettering.
†United Glass Bottles, Ltd., London.
Usines Griffin Merxem, Antwerp.
Usines Remy, Wygmael, Belgium.
*W. D. & H. O. Wills, Ltd., Bristol.
Wilson Bros. Bobbin Co., Ltd., Liverpool.
†J. Wix & Sons, Ltd., London.
Wormalds & Walker, Ltd., Leeds.

MUNICIPAL AUTHORITIES.

†Hampstead Borough Council, Hampstead.
†Leyton Urban District Council, Leyton.

NEWSPAPERS.

*†Daily Express, London.
†Daily News, London.
†Glasgow Herald, Glasgow.
†Hastings Observer, Hastings.
†Liverpool Courier, Liverpool.
Oldham Chronicle, Oldham.
Power Engineer, London.
Railway Gazette, London.
Shipbuilding and Shipping Record, London.
*†Times of India, Bombay.
*†Yorkshire Observer, Bradford.

OIL COMPANIES.

Anglo-Mexican Petroleum Co., London.
Anglo-Persian Oil Co., London.
Hull Oil Manufacturing Co., Ltd., Hull.
Purfina, Ertvelde.
¶Sarawak Oilfields, Ltd., Miri and Lutong, Sarawak.
†Scottish Oils Ltd., Grangemouth.
Shell-Mex, Ltd., London and Manchester.(†)
*Vacuum Oil Co., Ltd., Cape Town.

PRINTERS.

Cornwall Press Ltd., London.
†Curwen Press, London.
†Speaight & Sons, Ltd., London.

PROFESSIONS.

Davidson & Syme, Edinburgh.
Price, Waterhouse & Co., London.

RAILWAYS.

Chemin de Fer Metropolitain, Paris.
Chemins de Fer du Bas Congo au Katanga, Brussels.
Compagnie Belge de Chemins de Fer et d'Entreprises, Brussels.
Great Western Railway, Paddington, London.
†Great Western Railway, Goods Dept., London.
*New South Wales Government Railways, Randwick.
Siamese State Railways, Bangkok.
Swiss Federal Railways, Bellinzona.
Western Australian Government Railways, Perth, Australia.

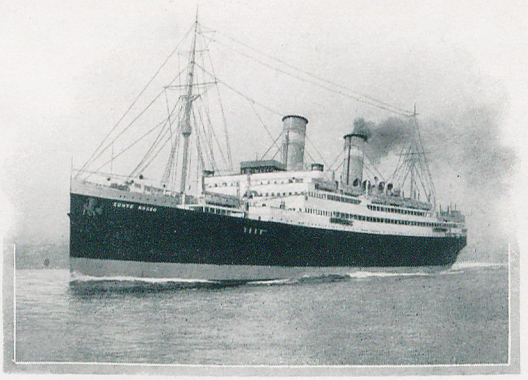
SHIPPING AND DOCKS.

Ardrossan Drydock & Shipbuilding Co., Ltd., Ardrossan.
Furness Shipbuilding Co., Ltd., Haverton Hill-on-Tees.
Harland & Wolff, Ltd., Glasgow.
Hong-Kong & Whampoa Dock Co., Hong-Kong.
†Port of Bristol, Avonmouth Docks.
John Readhead & Co., South Shields.
R.M.S. "Conte Rosso," Lloyd Sabaudo Line.
R.M.S. "Conte Verde," Lloyd Sabaudo Line.
†Smith Docks Co., Ltd., North Shields.
Zeevaartmaatschappy "Zeeland," Flushing, Holland.

MILLS.

Airedale Combing Co., Shipley, nr. Bradford.
Ahmedabad Textile Mills, India.
Auty & Co., Ltd., Batley, Yorkshire.
Ely Paper Mills, Cardiff.
John Foster & Sons, Ltd., Queensbury, Yorkshire.
Geo. Fox & Sons, Ltd., Dewsbury, Yorkshire.
J. & T. M. Greeves, Ltd., Belfast.
†Jute Industries, Ltd., Dundee.
Mellish, Richardson & Co., Leeds.
Patons & Baldwins, Ltd., Halifax, Yorkshire.
G. J. Stubley & Co., Ltd., Batley, Yorkshire.
†Salts (Saltaire), Ltd., Shipley, Yorks.
Thornton, Marsden & Sons, Huddersfield.
Willey & Pearson, Halifax.

†P.A.B.X. *In course of construction. ¶Inter-connected Exchanges.



S.S. "Conte Rosso," 18,500 Tons.

LLOYD-SABAUDO LINE, GENOA AND AMERICA.

"We are indeed very pleased to inform you that, as per advices received from the Master of the S.S. 'Conte Rosso,' the 'Relay' Automatic Telephone System fitted on said vessel has been and is still working most satisfactorily."

"RELAY" P.A.X.

RELIABLE SIMPLE ECONOMICAL

Reliable because

It is secret
It is unaffected by Climate
It cannot give you a wrong number
It gives you instantaneous connection
It gives you instantaneous disconnection
It is designed by highly skilled specialists

Simple because

It requires no skilled attention
It requires neither oiling nor cleaning
It has no mechanical devices to go wrong
It requires only two wires to each telephone
It can be extended without disturbing the service

Economical because

It saves space
It cannot wear out
It is on duty day and night
It saves the expense of rent
It does not require skilled attention
It gives you a reply in three seconds
It does not require oil, heat or ventilation
It saves the expense of operators' salaries

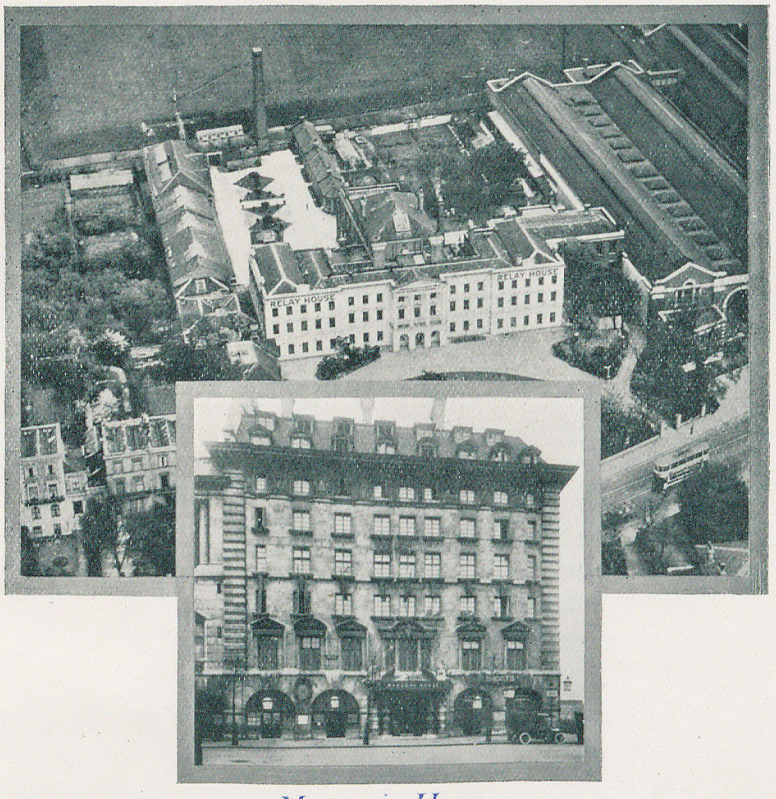
The Company will be pleased to demonstrate the System in operation—either in London or in the Provinces—if you will arrange an appointment by letter or telephone.

THE RELAY AUTOMATIC TELEPHONE COMPANY, LIMITED
MARCONI HOUSE, STRAND, W.C.

Telephone, CITY 281

Telegrams, "RELAYMATIC, PHONE, LONDON"

Works
Relay House
Streatham Hill
London, S.W.2



Marconi House
Strand, W.C.2

The Relay Automatic Telephone Co. Ltd.

Marconi House, Strand, London, W.C.2

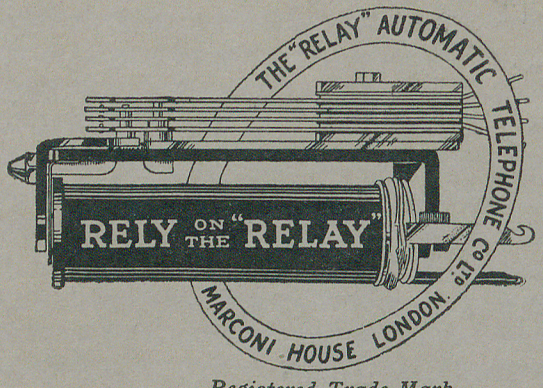
TELEPHONE CITY 281

District Offices

BELFAST	Shaftesbury Works. Telephone: 663.
BIRMINGHAM	309, Daimler House, Paradise Street. Telephone: Midland 3380. (*Relaymatic*).
DUBLIN	Marconi (Ireland) Ltd., 40 and 41, Dame Street. Telephone: Dublin 4529.
GLASGOW	81, St. Vincent Street. Telephone: Central 540. (*Relaymatic*).
MANCHESTER	Princes Chambers, 16, John Dalton Street. Telephone: Central 444. (*Relaymatic*).
LEEDS	Ernest Jones & Co., 7, Greek Street. Telephone: Leeds 22121.
NEWCASTLE-ON-TYNE	90, Pilgrim Street. Telephone: Central 2022. (*Relaymatic*).
NORFOLK & SUFFOLK	Mann, Egerton & Co., Ltd., 5, Prince of Wales Road, Norwich. Telephone: Norwich 217.
OXFORD	Hill, Upton & Co., 22, George Street. Telephone: Oxford 602.

Foreign and Colonial

AUSTRALIA	Australectric Ltd. SYDNEY, 97, Clarence Street. MELBOURNE, 44, Market Street.
BELGIUM & HOLLAND	New Antwerp Telephone Works, 22, Rue du Verger, Antwerp.
CANADA	Signal Systems Ltd., 11, Wellington Street East, Toronto.
CHILE	Thomas C. Sargent, Casilla 490, Santiago.
CZECHO-SLOVAKIA	Telegraphia Co., Narodini Trida 25, Prague.
DENMARK	Sophus Berendsen Ltd., Copenhagen.
FRANCE	Compagnie Générale de Télégraphie et de Téléphonie, 26, Rue du Quatre Séptembre, Paris (II^{er}).
INDIA & CEYLON	Indian States & Eastern Agency, Bombay.
IRAQ	Cotterel & Greig, Ltd., Bagdad.
ITALY	Societa Adriatica Telefoni, Rome & Genoa.
JAPAN	Samuel Samuel & Co., Tokyo & Yokohama.
NEW ZEALAND	Australectric Co., Australasia Chambers, Wellington. G.P.O. Box 830.
PORTUGAL	Agencia Tecnica e Commercial Lda, Rua do Alecrim 33, Lisbon.
RANGOON	London - Rangoon Trading Co., Ltd., 68, Merchant Street. P.O. Box No. 65.
SIAM	Kluzer & Co., Bangkok.
SOUTH AFRICA	P.O. Box 2055, Kodak House, Shortmarket Street, Cape Town.
SPAIN	New Antwerp Telephone Works, 22, Rue du Verger, Antwerp.
TASMANIA	Medhurst & Sons, Burnet's Chambers, 95, Collins Street, Hobart.



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