THE
Post Office Electrical Engineers' Journal

PICTURE TELEGRAPHY.
SIEMENS—KAROLUS—TELEFUNKEN SYSTEM.

G. E. CARR.

THIS article deals chiefly with the particular photographic equipment and methods employed at the P.O. installation, G.P.O. (West), London. An article describing the general systems of Phototelegraphy (Belin, Bell and Siemens-Karolus) was published in this Journal in October, 1928, and a description of the London Official Station was given in last April issue.

In phototelegraphy the ideal transmission condition is to reproduce all the tones and half tones which may be present in the original to be transmitted.

DESCRIPTION OF DARK ROOM AND APPARATUS.

The present apparatus is designed for dish development by time and inspection methods.

Entrance to the Dark Room is by a specially curtained doorway, giving free entrance and exit at any time without permitting white light to enter. The outer and inner curtains are arranged on runners so that they can easily be drawn aside and close the opening again when released. The interior of this entrance chamber is painted dead black, but the dark room itself is in the usual colours used for office decoration, cream and blue-grey.

The floor is asphalte, covered with strips of lino. This latter has proved to be unsatisfactory when wet and will be replaced with fluted india-rubber matting.

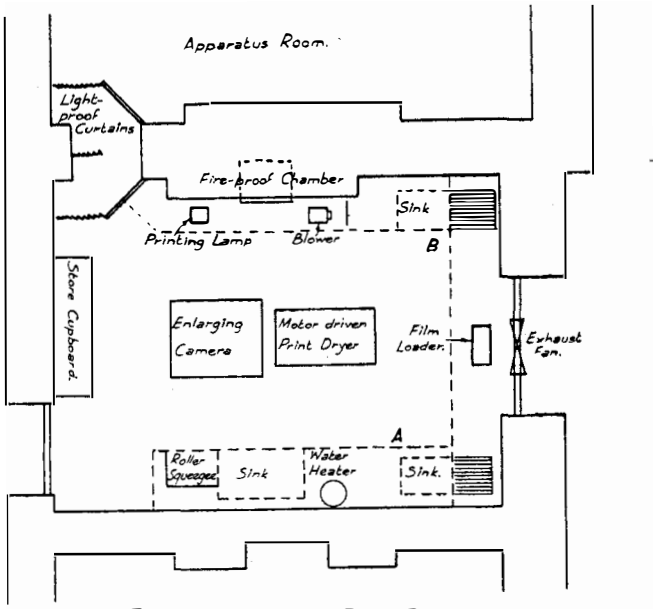


FIG. 1.—LAY-OUT OF DARK ROOM.

Making a tour round the dark room, the bench on the left has drawers in which are kept the various grades of printing paper. Suspended above this bench is the lamp used for making exposures by contact in a printing frame. This lamp is fitted into one of the standard type of

dark room lamps and the intensity of the light can be reduced readily by using one or more sheets (10 × 8) of opal or ground glass. When exposing a gaslight paper the direct light is used. By this means the exposure for various negatives and papers may be kept within reasonable limits, *i.e.*, not too fast for a soft bromide or too slow for a gaslight paper.

Sunk into the wall just above the bench is a sheet steel chamber fitted with a drop shutter. This contains the stock of unexposed celluloid films.

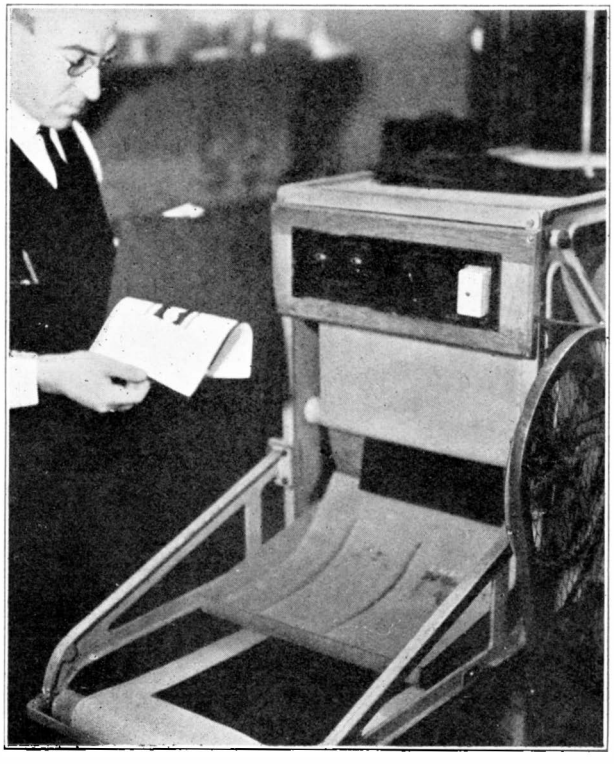


FIG. 2.—PRINT DRYER.

To the right is the apparatus used for drying the developed film. It consists of an electric air blower, giving hot or cold air, such as is used for drying purposes; in principle it is the same as the machines used for " Hair-drying," but is much more robust. The heater and fan are designed to deliver 600 cu. ft. of air per minute at a temperature of approx. 50°F. above room temperature.

The film (which is unbacked) to be dried is pinned upon a board placed in front of the fan. The exposed prints are developed at position B (See Fig. **1**), where the developing dish, hypo bath and sink are together. Over the hypo bath is suspended a white light for close inspection of a print.

The automatic film loader is shown below the ventilating fan. In this part of the room the stock of developers is prepared from raw materials.

On the bench at the right, development of the film is carried out. On the right hand side of the sink is the developing bath and on the left the special hypo bath and hardening bath.

The warm water used for the rapid washing of films and prints is drawn from a thermostatically controlled water heater affixed to the wall to the left of the large lead lined sink, in which the washing operations are carried out.

At the end of the bench is a roller pattern squeegee machine used in the glazing process for prints.

In the centre of the room is the enlarger and, alongside, the print dryer. The enlarger is of the vertical condenserless type capable of taking negatives 12″ × 10″ in the carrier and is fitted with a 12″ focus Cooke Aviar lens F4.5.

The illuminant is a mercury vapour arc in the M form tube contained in a lamp house, the diffusion sheets of opal or ground glass being fixed between this and the negative.

The negative carrier in the horizontal position is convenient for taking wet films. The M.V. lamp is operated by an automatic starter; this saves much time and enables accurate exposures to be made.

Graduated scales fitted to the vertical supports and the camera of the enlarger facilitate the copying, reduction or enlarging of a negative.

The print dryer, Fig. **2**, is of the rotary type, consisting of an endless canvas band which passes over a rotating drum, containing two electric heating elements. The speed of rotation and temperature of the drum can be regulated from a small switchboard on the machine.

When in use, the general illumination comes from two ceiling reflector lamps, 12 × 10, one dark red and the other deep orange; the latter is used generally, but not when film loading or negative developing is being carried out. At convenient points are situated smaller safelights, 7″ × 5″, and the switches controlling these are readily reached from the developing positions.

Two low temperature radiators of 3 kW capacity fitted with three heat control switches are situated under the benches. By means of these the room can be readily maintained at a temperature of 75°—78°F., which is the normal working temperature. A recording thermometer is situated in a position to register the temperature variations.

Ventilation is provided by an exhaust fan fitted within the framework of the window, which is boarded to exclude all white light. The fan has a capacity of 30,000 cu. ft. per hour, and is fitted with a speed regulator. Whilst this is more than ample for general ventilation, it is necessary to remove as quickly as possible the formaldehyde given off by the hardening baths and during the glazing process.

All sinks are fitted with spray nozzles on swing arms and separate $\frac{1}{2}$" bib cocks. In the large sink is a $\frac{3}{4}$" tap fitted with an " antisplash " used for the rapid washing of films.

A timing clock having a large dial (see Fig. 3)

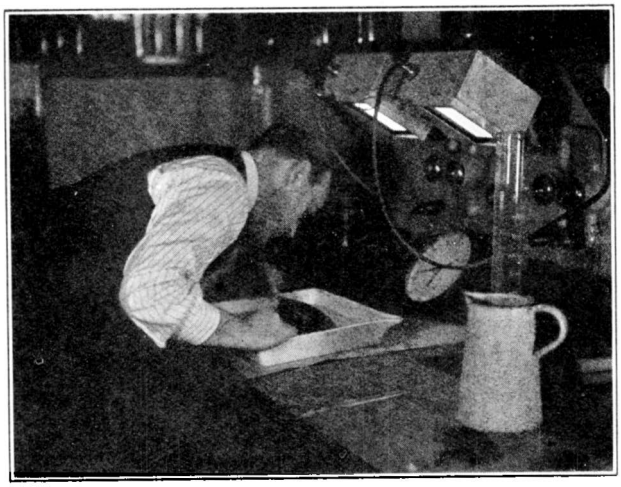


FIG. 3.—DEVELOPING FILMS.

and a swinging pendulum, which rings a bell each second, is used for the timing of exposures and operations.

Cupboards with sliding doors are fitted beneath the benches and shelving is provided for bottles and solutions, etc.

DESCRIPTION OF OPERATIONS.

The film used by the Department is supplied by a well known British firm manufacturing photographic materials and is similar to that used by many of the newspapers who employ phototelegraphy.

The particular film used is single coated (*i.e.*, minus gelatine on the back). The celluloid base is 18.4 × 27.2 cms. and 5/1000 inch thick and the emulsion is rated at 500 H and D.

To load a receiving cylinder the dark slide containing a cylinder is placed in a carrier which slides on the rails of the special loading machine, Fig. 4. By moving the carrier with a sliding motion the cylinder engages on a tapered cone

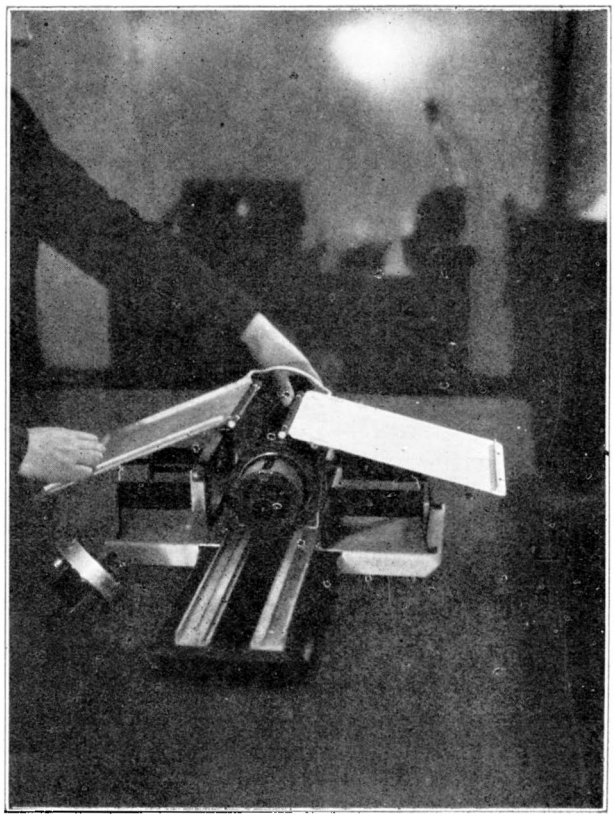


FIG. 4.—PREPARING TO LOAD RECEIVER CYLINDER WITH UNEXPOSED FILM.

mandril, which is the same size and shape as that on the receiver spindle, and the outer dark slide passes along to the end. One end of the film is clipped to the cylinder and, by turning a milled head fitted with a ratchet, it is wrapped round the cylinder and the end is then clipped on to the latter. By this means, handling of the film is avoided.

Assuming that exposure has taken place, the film is unclipped, and the top right hand corner

turned up and creased. This serves two purposes, identification of direction of running, etc., and provides a means of lifting the film from the solutions.

Development is carried out in a dish using a metol - hydroquinone developer. Experiments have shown the following composition to be suitable for these films :—

Metol	1.75	grams.
Hydroquinone ...	4.0	,,
Sodium Sulphite ... (Anhydrous salt).	75	,,
Sodium Carbonate ... (Anhydrous salt).	35	,,
Potassium Bromide ...	1.5	,,
Water to	1000	,,

This formula compares favourably with many well balanced M.Q. developers, with the exception that the alkaline content—Sodium carbonate —is a little higher, which quickens the developer.

At a temperature of 75° the Watkin factor for this developer is 4.5 to 5 and complete development normally takes place in 1.75 minutes. When developing black and white transmissions the Watkin factor is increased to 6½ to give greater density.

After a brief rinse in running water the film is transferred to a rapid acid fixing bath, composed of :—

Sodium Thiosulphate ...	200	gm.
Potassium Meta-bisulphite .	25	,,
Ammonia Chloride ...	35	,,
Water to	1000	cc.

With continued rocking, the emulsion is cleared in about 1½ minutes. This time clears the film, but does not necessarily "fix" the emulsion, as there are left double salts of silver and ammonia, but these in no way effect the density of the deposit.

The film is then washed for two minutes under the full jet of water from the tap in the large sink. During this period the major portion of the thiosulphates is washed from the film.

Hardening the gelatine film is done by immersion for 1½ minutes in the following solution :—

Formaldehyde 40% solution..	1 part.
Water to	9 parts.

When not in use this bath is kept in a covered case to prevent inconvenience caused by the irritating vapour of formaline.

A further washing of two minutes is given, finishing with warm water, when the surplus moisture is removed from the gelatine by means of a pad of chamois leather.

If a print only is required, the film negative is squeegeed to a glass support, and the positive is made by means of the enlarger. The major portion of the received work is of a topical pictorial character for press agencies and newspapers, who require the delivery of the actual film. In these cases the wet film is pinned upon the special drying board and the hot air blast started, Fig. 5. Drying is usually completed in 4½-5 minutes.

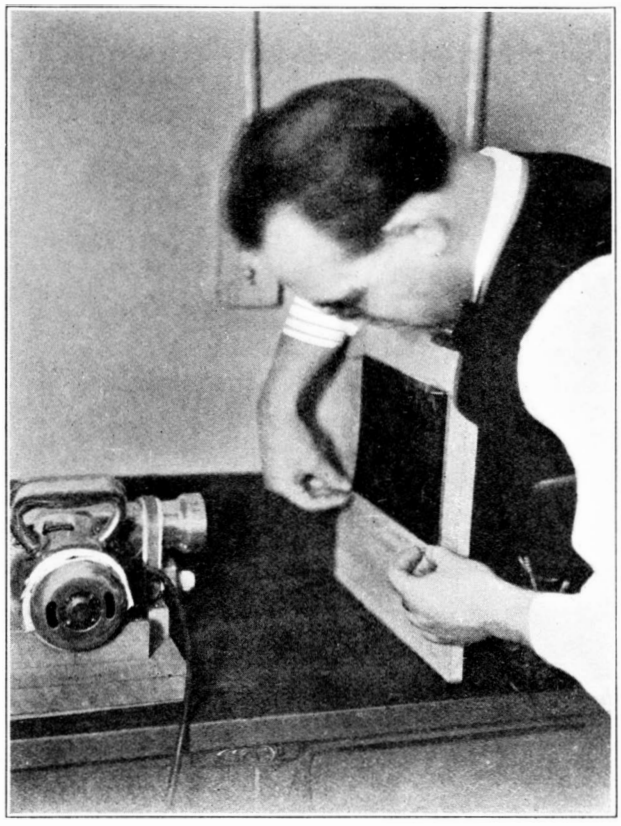


Fig. 5.—Fixing Film for Drying.

It is necessary to make two copies for record purposes from all films delivered and this is the next step.

The following procedure applies to both methods of printing, *i.e.*, through the enlarger or by contact in a printing frame.

The negative is viewed and, according to its density and contrast, a suitable printing paper is used for the positive.

The stock of printing papers, which all are "Glossy," consists of soft, normal and hard bromide emulsions and soft and vigorous chlorobromide (silver chloride) emulsions, supplied by well-known makers.

The type of negative obtained depends upon:

1. Voltage on receiving lamp.
2. Voltage on Kerr Cell.
3. Setting of Nicol prisms.
4. Black and white original transmitted without compensation.
5. Tone scale original transmitted with various compensations.
6. Photographic treatment of exposed emulsion.

1, 2, 3 and 6 are variables, which are controlled at the receiving end and are adjusted within certain limits to suit the type of film used.

Where the original is black and white in character (or devoid of any half tones) it is transmitted without compensation and advantage is taken of the characteristic curve of photographic emulsions. The resulting negative has only two tones, one very light and the other of full density. Any short-range printing paper is suitable for printing from such a negative.

If too little or too much compensation is given distortion of the tone scale results. Too little has the effect of producing a hard negative and loss of low shadow tones, whilst over compensation produces a flatness similar in effect to "over exposure" in ordinary photography.

This flatness may to some extent be corrected by using a suitable printing paper having a short exposure scale.

By alteration of the electrical circuit arrangement of the picture and compensation photo cells, "Positive" reception can be made when the receiver drum is loaded with a sheet of rapid bromide paper in place of a negative film and, by the usual development, a positive print is obtained direct.

Provision is made in the switching arrangement of the apparatus for the following conditions:—

Transmitted.	*Received.*
Positive Print.	Negative Film.
,, ,,	Positive Print.
Negative Film.	,, ,,
,, ,,	Negative Film.

Experiments show that three types of film emulsion and three kinds of bromide printing papers will cover all the required conditions on the photographic side.

The developer used for printing paper is that suggested by the makers of the particular paper.

The print, after development, is transferred, after washing for a brief period, to an acid fixing bath and vigorously agitated for a few seconds, to stop the action of the developer. Inspection is then made with a white light and, if necessary, reference is made to the negative to ascertain that a reasonably correct exposure has been made.

It has been shown by Warwick that, providing a print is vigorously agitated in a fresh fixing bath, fixation takes place very rapidly and is of the order of 30 seconds.

Following a washing in a turbine pattern washer, the print is transferred to a bath containing a glazing solution. This bath is composed of formaline, oxgall and water. The positive is then transferred to a ferrotype glazing sheet, 14 × 10, previously swabbed with the glazing solution and, after being squeegeed by hand, is placed between fluffless blotting sheets and passed twice through the roller squeegee to remove the surplus moisture and ensure even contact between the print and the glazing support. After passing through the print dryer, which takes about seven minutes, the print is stripped off the ferrotype sheet and is ready for enclosing in an envelope for delivery in the usual way.

The following table indicates the time taken to produce (1) a finished film and (2) a finished print:—

(1)	Development	2 minutes.
	Washing	5 seconds.
	Fixing	1½ minutes.
	Washing	2 ,,
	Hardening	1½ ,,
	Washing	2 ,,
	Drying	5 ,,
	Total	14 mins. 5 secs.

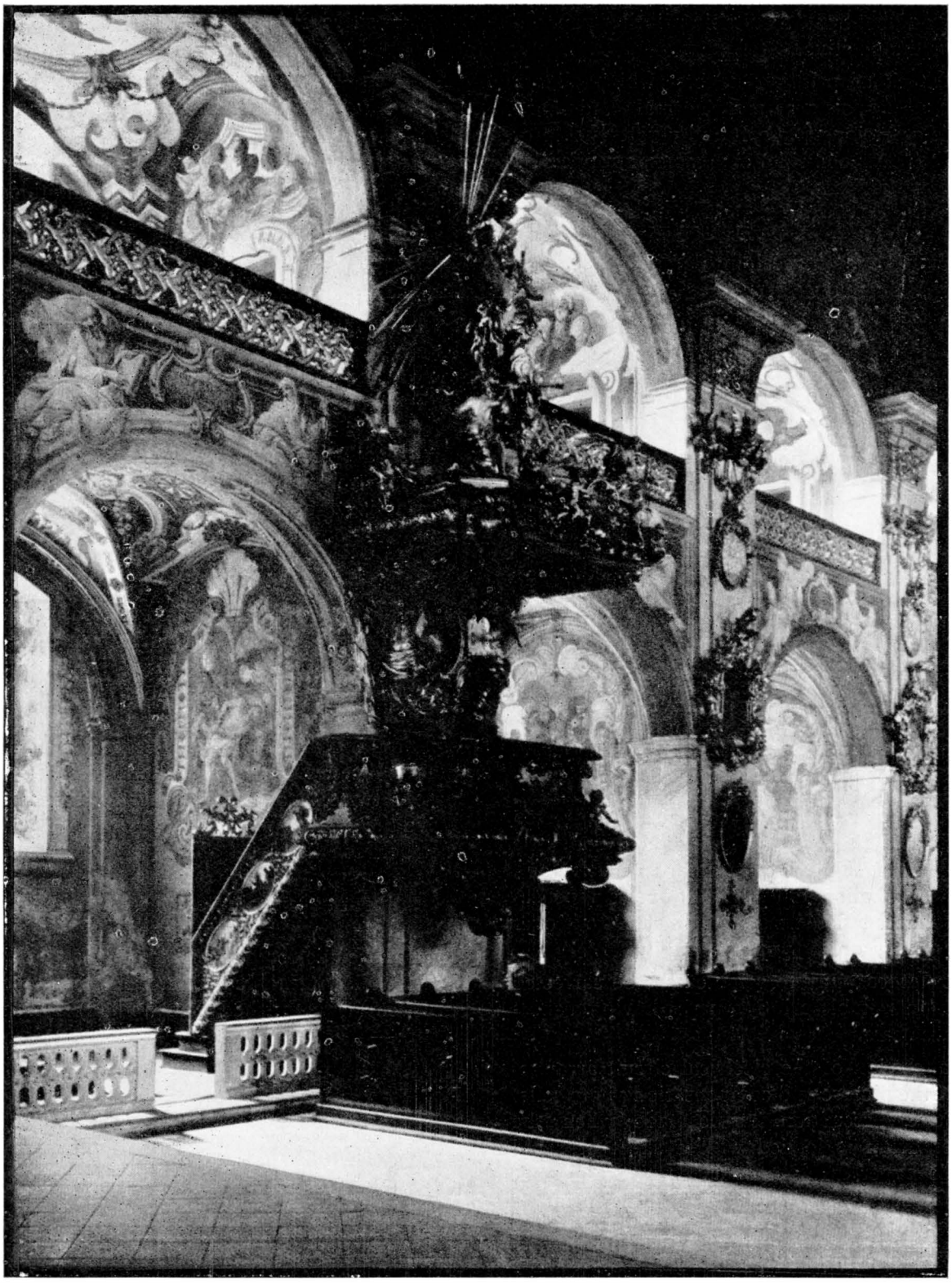
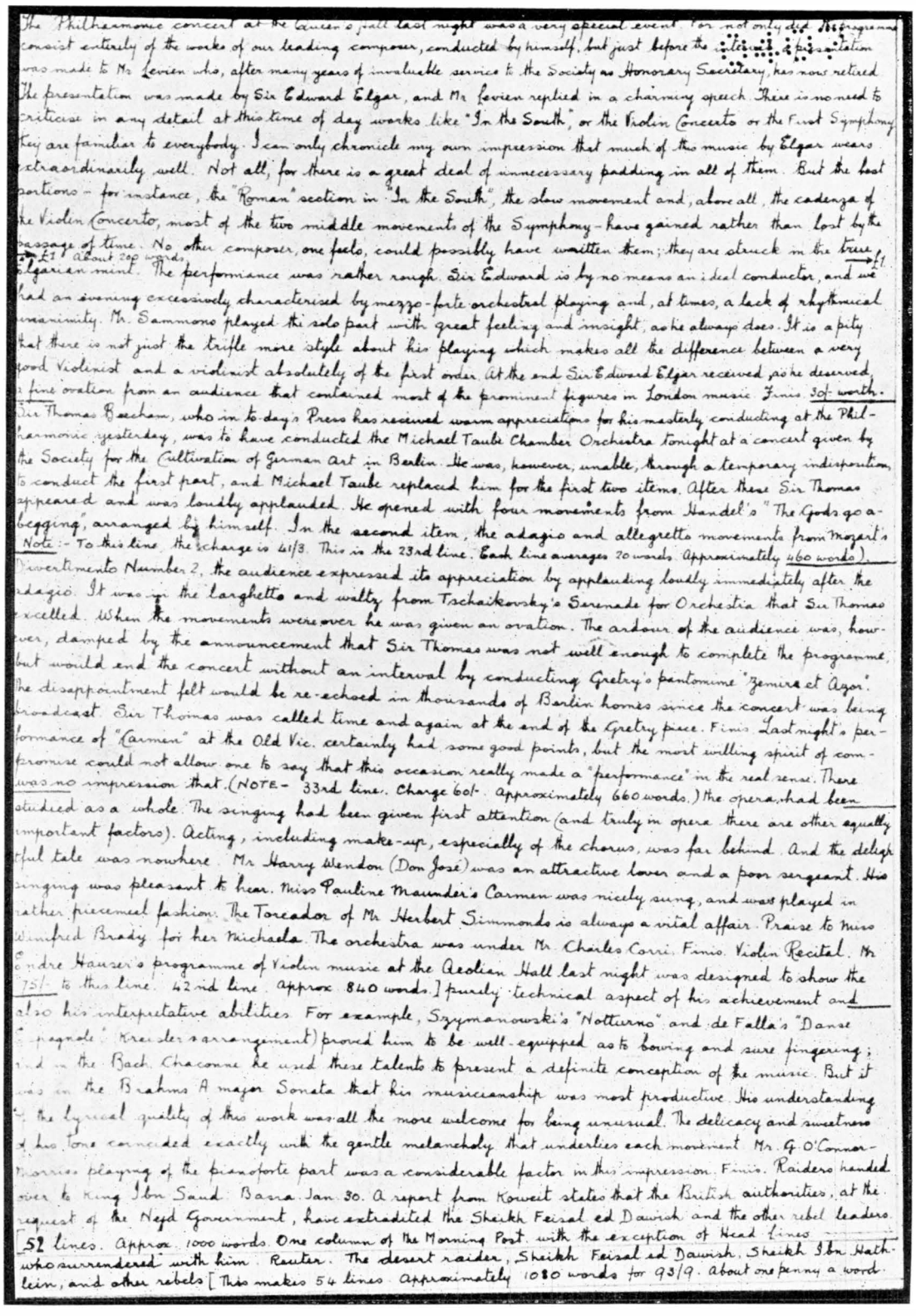


FIG. 6.—SPECIMEN OF RECEPTION, LONDON-MUNICH.



The Philharmonic concert at the Queen's Hall last night was a very special event. For not only did the programme consist entirely of the works of our leading composer, conducted by himself, but just before the [illegible] presentation was made to Mr Levien who, after many years of invaluable service to the Society as Honorary Secretary, has now retired. The presentation was made by Sir Edward Elgar, and Mr Levien replied in a charming speech. There is no need to criticise in any detail at this time of day works like "In the South," or the Violin Concerto or the First Symphony. They are familiar to everybody. I can only chronicle my own impression that much of the music by Elgar wears extraordinarily well. Not all, for there is a great deal of unnecessary padding in all of them. But the best portions – for instance, the "Roman" section in "In the South", the slow movement and, above all, the cadenza of the Violin Concerto, most of the two middle movements of the Symphony – have gained rather than lost by the passage of time. No other composer, one feels, could possibly have written them; they are struck in the true £1 about 200 words. Elgarian mint. The performance was rather rough. Sir Edward is by no means an ideal conductor, and we had an evening excessively characterised by mezzo-forte orchestral playing and, at times, a lack of rhythmical uniformity. Mr. Sammons played the solo part with great feeling and insight, as he always does. It is a pity that there is not just the trifle more style about his playing which makes all the difference between a very good Violinist and a violinist absolutely of the first order. At the end Sir Edward Elgar received as he deserved, a fine ovation from an audience that contained most of the prominent figures in London music. Finis. 30/- worth.

Sir Thomas Beecham, who in to-day's Press has received warm appreciations for his mastery, conducting at the Philharmonic yesterday, was to have conducted the Michael Taube Chamber Orchestra tonight at a concert given by the Society for the Cultivation of German Art in Berlin. He was, however, unable, through a temporary indisposition, to conduct the first part, and Michael Taube replaced him for the first two items. After these Sir Thomas appeared and was loudly applauded. He opened with four movements from Handel's "The Gods go a-begging", arranged by himself. In the second item, the adagio and allegretto movements from Mozart's Note:- To this line the charge is 41/3. This is the 23rd line. Each line averages 20 words. Approximately 460 words. Divertimento Number 2, the audience expressed its appreciation by applauding loudly immediately after the adagio. It was in the larghetto and waltz from Tschaikowsky's Serenade for Orchestra that Sir Thomas excelled. When the movements were over he was given an ovation. The ardour of the audience was, however, damped by the announcement that Sir Thomas was not well enough to complete the programme, but would end the concert without an interval by conducting Gretry's pantomime "Zemire et Azor". The disappointment felt would be re-echoed in thousands of Berlin homes since the concert was being broadcast. Sir Thomas was called time and again at the end of the Gretry piece. Finis. Last night's performance of "Carmen" at the Old Vic. certainly had some good points, but the most willing spirit of compromise could not allow one to say that this occasion really made a "performance" in the real sense. There was no impression that (NOTE- 33rd line. Charge 66/- Approximately 660 words.) the opera had been studied as a whole. The singing had been given first attention (and truly in opera there are other equally important factors). Acting, including make-up, especially of the chorus, was far behind. And the delightful tale was nowhere. Mr Harry Wendon (Don José) was an attractive lover and a poor sergeant. His singing was pleasant to hear. Miss Pauline Maunder's Carmen was nicely sung, and was played in rather piecemeal fashion. The Toreador of Mr Herbert Simmonds is always a vital affair. Praise to Miss Winifred Brady for her Michaela. The orchestra was under Mr Charles Corri. Finis. Violin Recital. Mr Andre Hauser's programme of violin music at the Aeolian Hall last night was designed to show the 75/- to this line 42nd line. Approx 840 words.] purely technical aspect of his achievement and also his interpretative abilities. For example, Szymanowski's "Notturno" and de Falla's "Danse Espagnole" (Kreisler's arrangement) proved him to be well-equipped as to bowing and sure fingering; and in the Bach Chaconne he used these talents to present a definite conception of the music. But it was in the Brahms A major Sonata that his musicianship was most productive. His understanding of the lyrical quality of this work was all the more welcome for being unusual. The delicacy and sweetness of his tone coincided exactly with the gentle melancholy that underlies each movement. Mr. G. O'Connor-Morris's playing of the pianoforte part was a considerable factor in this impression. Finis. Raiders handed over to King Ibn Saud. Basra. Jan. 30. A report from Koweit states that the British authorities, at the request of the Nejd Government, have extradited the Sheikh Feisal ed Dawish and the other rebel leaders. 52 lines. Approx. 1000 words. One column of the Morning Post. with the exception of Head Lines who surrendered with him. Reuter. The desert raider, Sheikh Feisal ed Dawish, Sheikh Ibn Hathlein, and other rebels [This makes 54 lines. Approximately 1080 words for 93/9. About one penny a word.

FIG. 7.—SPECIMEN OF RECEPTION. A COMPETITOR TO HAND AND MACHINE TELEGRAPHS.

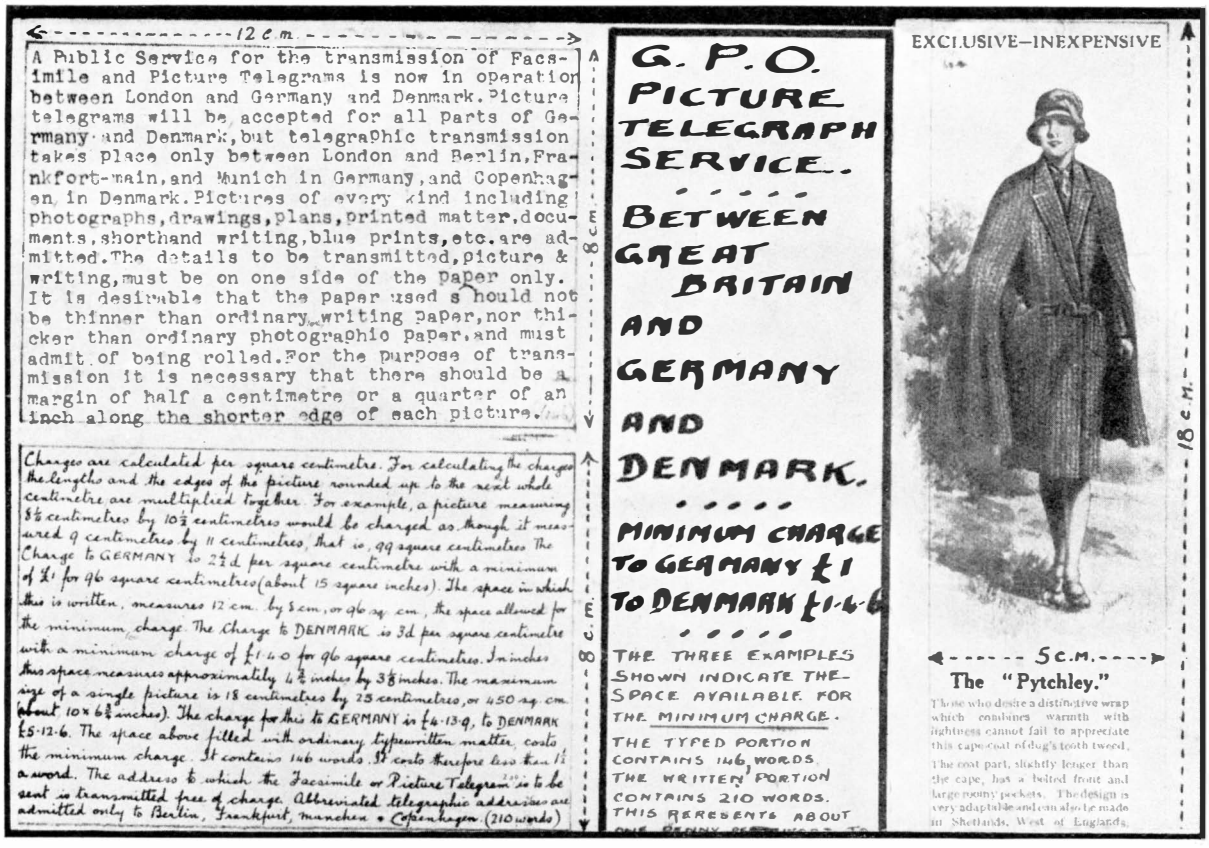


FIG. 8.—SPECIMEN OF RECEPTION, INDICATING POSSIBILITIES OF SERVICE.

(2) Printing either by enlarger or contact	3	minutes.
Developing	2	,,
Fixing	1	,,
Washing	2	,,
Hardening	10	,,
Glazing		
Drying		
Extras, etc.	3	,,
Total	21	,,

Celerity is the chief factor in the production of these films and prints, and consequently permanency is not closely studied. Nevertheless, films and prints made two years ago under similar conditions during the experimental trial of the system do not show any signs of deterioration. Samples of experimental work are shown in Figs. **6**, **7** and **8**.

MANCHESTER AUTOMATIC TELEPHONE SYSTEM.

RECENT DEVELOPMENTS.

L. F. MORICE, A.M.I.E.E.

A PRELIMINARY article on the Manchester Automatic Telephone System was published in this Journal in January, 1928, and a further article, describing the construction of the new underground plant in Manchester, appeared in January, 1930. Certain additions and alterations to the arrangements described in the preliminary article have since been decided upon and, as the three first automatic exchanges in the area have recently been brought into use, the opportunity is now taken of bringing the information up to date, and furnishing a brief summary of the more important changes that have taken place, together with the various considerations which have led to their adoption.

Exchanges opened.

The first stage of the Manchester programme was duly accomplished on June 7th, 1930, when the following automatic exchanges were opened for service :—

Name of Exchange.	Installed by	Capacity of Subscribers Multiple.	
		Initial.	Ultimate.
Ardwick	Siemens Bros. & Co., Ltd.	3400	5500
Collyhurst	Standard Telephones & Cables, Ltd.	2100	3500
Moss Side	General Electric Co.	1900	2900

Auto Manual Board.

The auto manual equipment necessary to provide Toll, Enquiry, and other auxiliary manual facilities for these three exchanges was also brought into use at the same time.

This equipment forms an advance portion of the main auto manual switchboard for the area, which is being installed at Telephone House, Chapel Street, Salford, by Messrs. The Automatic Telephone Manufacturing Co., Ltd., of Liverpool. The magnitude of this equipment will be appreciated by reference to the following schedule :—

Type of Position.	No. of Positions required at		
	Opening Date.	Main Transfer (1931)	Ultimately (1951)
"B" Positions.			
Key-Sending (7-Digit)	—	18	22
Key-Sending (4-Digit)	10	22	—
Plug-Ended	—	12	15
"A" Positions.			
Toll	33	102	287
Enquiry	10	63	117
Service P.B.X.	—	6	11
Totals	53	223	452

Fig. 1 shows the lay-out of these positions in the manual switchroom, which is reputed to be the largest in the world. Figs. 2 and 3 are views

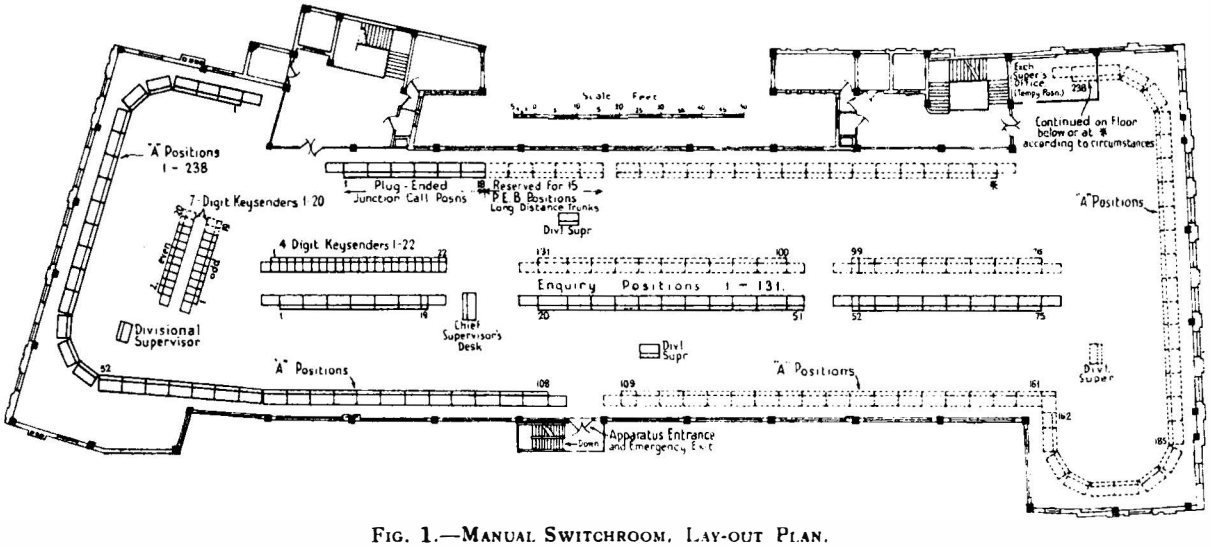


FIG. 1.—MANUAL SWITCHROOM, LAY-OUT PLAN.

of a portion of this room. The Enquiry positions are on the right hand side and the Toll suite on the left. In the far centre of Fig. **2** is the Divisional Supervisor's Desk No. 1, on the top of which will be seen the traffic recorders. These are actually ammeters, calibrated to indicate the number of calls awaiting attention at any instant on the 4-digit or 7-digit key-sending positions respectively. In the near centre of Fig. **3** will be seen the Divisional Supervisor's Desk No. 2.

Manchester claims to be the focal centre of the largest industrial area in the British Empire and,

FIG. 2.—VIEW OF MANUAL SWITCHROOM.

FIG. 3.—ANOTHER VIEW OF MANUAL SWITCHROOM.

as all Toll traffic for the Automatic Area—except for a small proportion which will be handled at Ashton and Main (Oldham) manual centres—will have to be dealt with at this switchboard, the number of junctions (over 3,000 ultimately) in the outgoing junction multiple is unusually large for an exchange associated with automatic equipment. It has been found necessary therefore to introduce special features in the design of this equipment. Special 3 position, 8 panel sections of the C.B.1 type have been designed to meet the requirements of this and similar provincial director Areas. The multiple extends over six panels. " Visual Engaged " signals have been abandoned, owing to the heavy drain on the battery which would result from their use in an exchange of this size.

In place of these signals a system of " first choice testing " has been introduced for all large outgoing groups. For this purpose such a group will be used as first choices, one or more circuits in this portion being allotted as first choices at each appearance of the multiple. The right hand portion is known as the " pool." The whole of the circuits are available to each operator, who will, however, test them in the following order:—

(*a*) First choice circuits for her particular section of the multiple.
(*b*) The " pool."
(*c*) First choice circuits for other sections of the multiple.

The jacks of the circuits in group (*a*) and the first jack in group (*b*) are suitably marked to assist the operators.

Each five circuits will have a tone superimposed on the click test when all the five circuits are in use. Operators can therefore rapidly test the groups and, on finding an idle group, will test the individual jacks in the group. It has been estimated that, by adopting this scheme, the number of tests made per operator will be reduced by as much as 50% where very large groups are concerned.

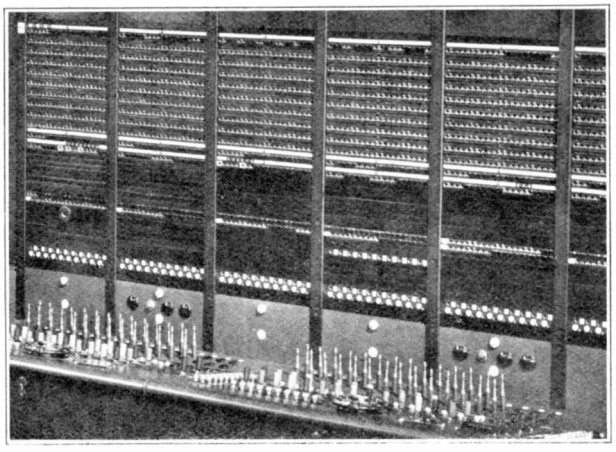


FIG. 4.—TOLL POSITIONS (DIAL TOL).

Fig. 4 is a view of a Toll position, and Fig. 5 shows the Plug-Ended "B" positions. A Key-Sending 7-Digit position appears in Fig. 6. The 4-Digit position is similar, except that the digit key designation strip engraved with the code letters is not provided. The Enquiry positions, which are partly 8-panel and partly 6-panel sections, are shown in Fig. 7.

Area Conversion Programme.

The first 10,000 line automatic exchange in the Chapel Street building, to be known as Blackfriars, is at present under construction by Messrs. The Automatic Telephone Manufacturing Co., Ltd., and will probably be ready for service during next year. The remaining automatic exchanges in the area will be opened at various dates within a period of about 15 years, the exact date in each case being determined by the condition of the existing manual plant and the growth in the number of subscribers' lines.

The total number of exchanges in the area for which design is proceeding is now 36, as the Hyde Exchange, being situated outside the seven mile radius from Manchester Town Hall, has been excluded from the scheme.

Coder Call Indicator (C.C.I.) Equipment.

Eight positions at the City and Central manual exchanges have been equipped with C.C.I. apparatus, for dealing with calls from the automatic exchanges. This equipment has also been supplied by the Automatic Telephone Manufac-

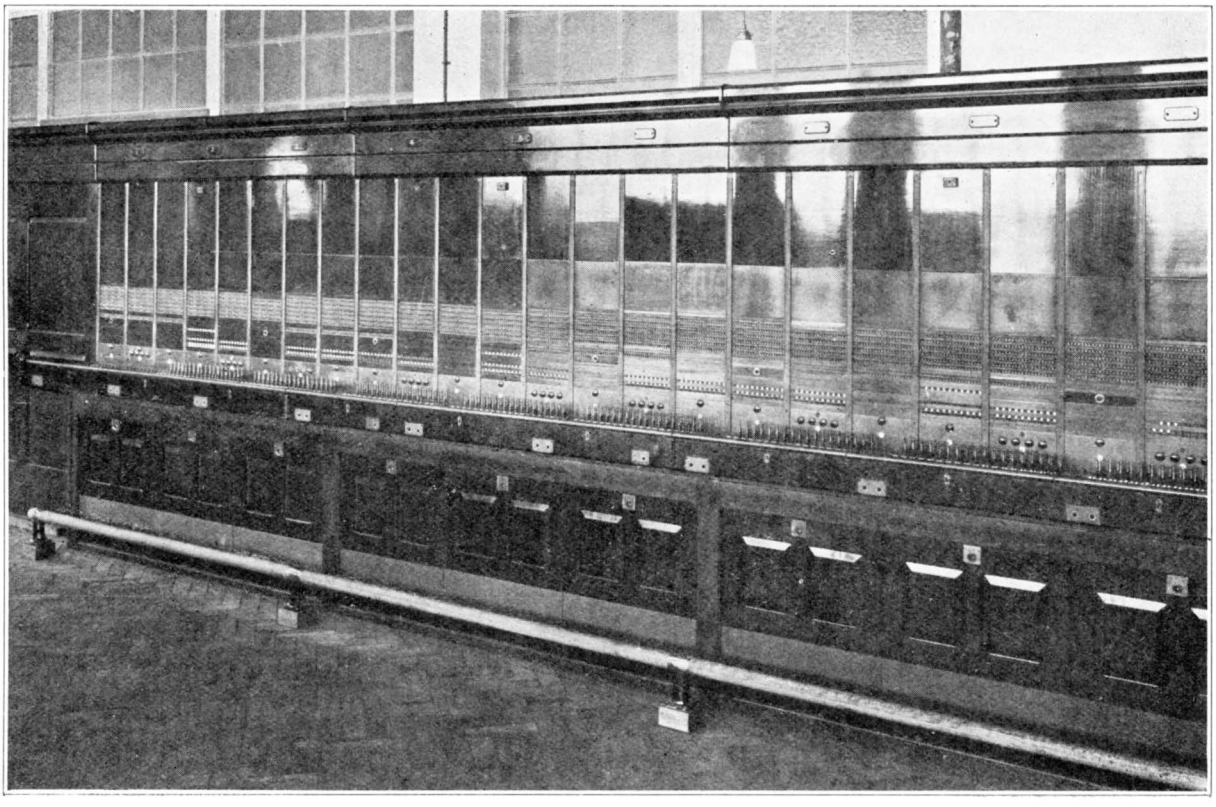


FIG. 5.—PLUG-ENDED "B" POSITIONS.

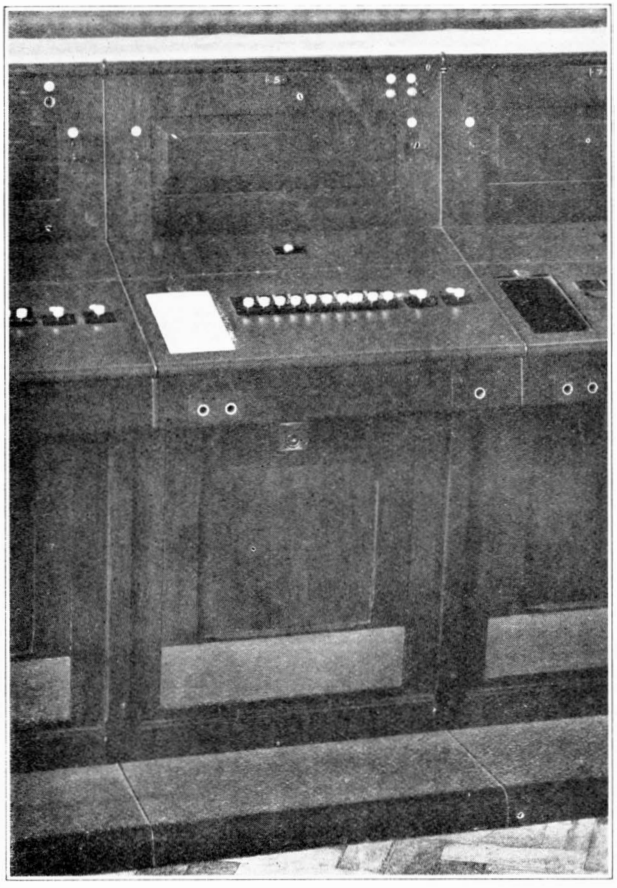


FIG. 6.—KEY SENDING (7-DIGIT) " B " POSITION.

turing Co., Ltd. A number of C.B. and C.B.S. Exchanges, which are to be retained in service for some years, will be similarly equipped some time in 1931. In the meantime the automatic subscribers will obtain connections to all manual

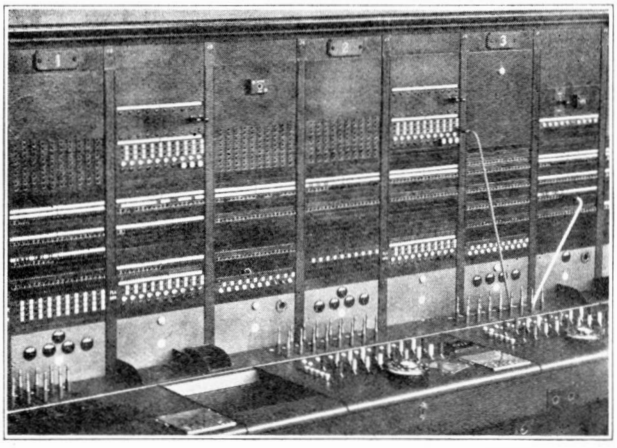


FIG. 7.—ENQUIRY POSITIONS (DIAL 0).

exchanges, other than City and Central, *via* the new Toll exchange, by dialling TOL.

Straightforward Junction System.

The method of operating " B " positions known as " order wire key sending," which is now in use at the London Tandem and automatic exchanges, is to be replaced by a new method known as " straightforward junction working." The new system, which has been devised by the Department's engineers, has been tried out experimentally at the London Tandem exchange and a detailed description will no doubt be given at some future date. This constitutes an important step forward in the method of handling traffic over groups of junctions from manual exchanges. By its means, any one of a group of junction circuits between two exchanges, on being taken into use by an " A " operator at the originating exchange, is automatically connected to a disengaged " B " operator's telephone set at the distant exchange or tandem centre. The junction circuit is then used temporarily as an order wire, so that the provision of a separate pair of wires for this purpose is obviated. As soon as the " B " operator extends the junction circuit to the line required, her telephone circuit is released from the junction and is then available for the receipt of another call. The control of the call throughout is vested in the " A " operator who originates it.

Provided the junctions are not repeatered circuits, or side circuits of phantom loaded conductors, it is possible to deal with small or large groups of incoming or both way lines for through or terminating traffic from C.B., C.B.S., Magneto, or Trunk exchanges by this means, and very considerable economies may therefore be effected. In Manchester, for example, the jack-ended " B " positions have been dispensed with and the whole of the traffic at the " B " end is dealt with by one or other of three groups of operators as follows:—

Terminating calls are dealt with by operators at the Key-Sending 4-digit positions.

Through calls for various automatic and C.C.I. manual exchanges in the automatic area are handled at Key-Sending 7-digit positions.

Through calls for Non-C.C.I. manual ex-

changes in the automatic area, and for all exchanges outside this area, are received at the Plug-Ended " B " positions.

The Key-Sending operator is only associated for the purpose of setting up the automatic call, whilst the operator at a plug-ended " B " position has not only to complete the connection but also to clear same at the termination of the conversation. In either case, however, the " B " operator is only in circuit for the short period necessary to complete the connection, hence a substantial saving in " B " operators has been found possible. The calls are received at the operators' positions in cyclic order, and positions in each of the three groups can be shut down and rendered engaged by merely withdrawing the operator's instrument plug in the usual manner. The calls are then automatically distributed to the remaining (staffed) positions.

It will be seen that this new method of operating junction groups has the following advantages :—

(*a*) Order - wire operating facilities are afforded without the provision of a special order-wire circuit. It becomes economical therefore to adopt this method of working for the smallest groups of junctions.

(*b*) For the reasons stated in (*a*) the bulk of the incoming junction traffic from manual exchanges can be automatically concentrated on suites of Key-Sending or Plug-Ended " B " positions, and the less rapid " signalling junction " method is therefore eliminated.

(*c*) Since the " B " operator has not to assign a junction the possibility of error, which existed under the older system, is avoided and operating time, both at the " A " and " B " ends, is reduced. This should result in an increase in the load possible per " A " and " B " position, and a consequent reduction in the number of these positions required.

(*d*) Only one " A " operator is connected to the " B " operator's telephone circuit at any given moment. The interruptions which are apt to occur on a common order-wire circuit are thus avoided.

It is not intended however to convey the impression that this system represents the high water mark in manual methods of junction operation. A system for keysending from " A " positions is now under trial, and this has the further advantage of completely eliminating " B " operators so far as calls to automatic or C.C.I. exchanges are concerned. There will still be a field, however, for the straightforward junction method of working for calls to manual (non-C.C.I.) exchanges *via* the Tandem Centre in an area such as Manchester.

Some idea of the saving effected by the straightforward junction scheme will be gained by reference to the following comparative requirements for the Manchester case for the period 1931 to 1936, under the two methods of operating :—

Item.	Order Wire "B" Scheme.	Straight-forward Junction Scheme.
	No.	No.
Junction Circuits, incoming and bothway.		
Long Distance plug - ended Junctions	73	—
Order-Wire Junctions ...	1115	—
Order-Wires	69	—
Incoming Signal Junctions ...	96	—
Bothway Signal Junctions ...	54	—
Incoming to Auto (Key-Sending)	—	336
Incoming to Manual (Plug Ended)	—	250
Incoming to Auto or Manual (Key-Sending or Plug-Ended)	—	520
Bothway to Auto or Manual (Key-Sending or Plug-Ended)	—	111
Totals	1307	1217
Operators' positions.		
Jack-Ended " B "	12	—
Plug-Ended " B " (without key-senders)	7	12
Plug-Ended " B " (with key-senders)	33	—
Key-Sending (7-digit)... ...	—	18
Key-Sending (4-digit)... ...	24	22
Totals	76	52
First code selectors for key-sending groups.	(33×36) =1188	666

It will be observed that 90 junction circuits, 24 " B " positions and 520 first code selectors are saved at the initial period, and somewhat larger savings will be effected at the ultimate date.

The 7-digit key-sending and the plug-ended " B " equipment will not be available until some time in 1931, but the 4-digit key-sending positions were brought into use in connection with the opening of the first three automatic exchanges. All traffic from City, Central, and a number of other manual exchanges (from which separate groups are justifiable) to Ardwick, Collyhurst, and Moss Side automatic exchanges, is dealt with at these 4-digit positions.

The application of the scheme will be readily understood by reference to Figs. **8** and **9** and the following notes:—

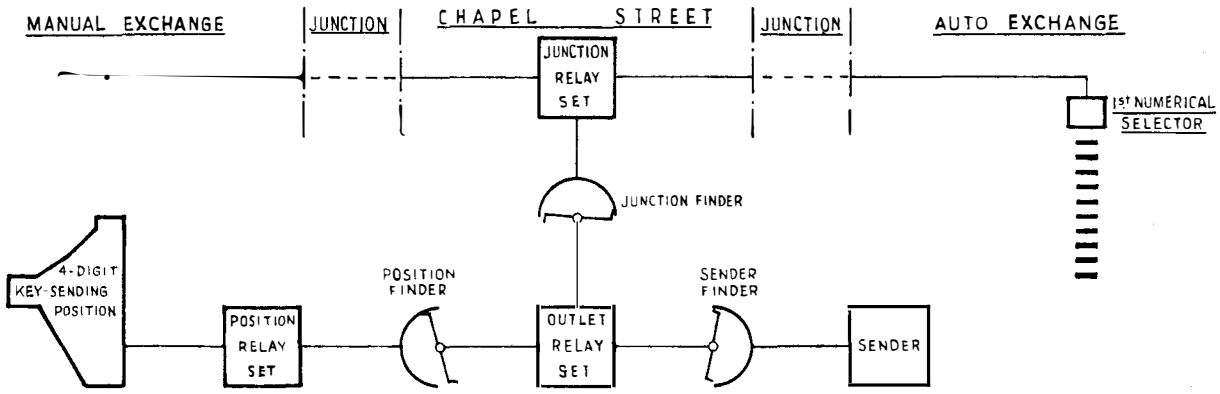


FIG. 8.—DIAGRAM SHOWING " STRAIGHTFORWARD JUNCTION " SYSTEM (TERMINATING CALLS).

Terminating Calls. (See Fig. **8**).

Consider a call from Central Exchange to an Ardwick subscriber. The Central operator will test the outgoing Ardwick junction group in the ordinary way and, on finding a disengaged circuit, will insert the calling plug into the outgoing jack. The supervisory lamp associated with the calling plug will then glow. The junction relay set at the Chapel Street end will then cause a junction finder to search and, having

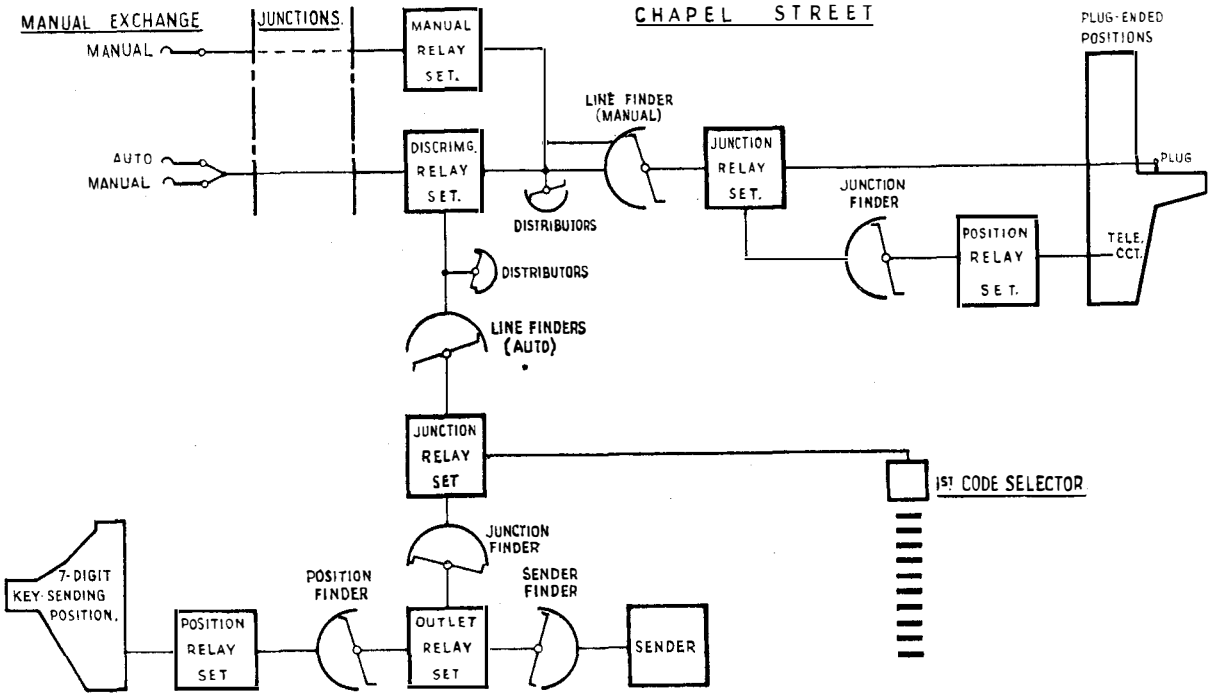


FIG. 9.—DIAGRAM SHOWING " STRAIGHTFORWARD JUNCTION " SYSTEM (THROUGH CALLS).

found the calling junction, to connect the latter to an outlet relay set. Associated with the outlet relay set are two other finders, one of which finds a sender and the other a 4-digit key-sending position. The sender finder hunts simultaneously with the junction finder, but the sender finder switching relay does not operate until the junction finder switching relay has operated, thus preventing the unnecessary holding of a sender. By this means the sender is generally preselected, and will be connected up immediately the junction finder seizes the junction relay set. As soon as the sender is connected up, the position finder searches for a disengaged key-sending operator. When the latter is found and connected up, a lamp lights at the key-sending position to warn the " B " operator that an order is about to be given. The supervisory lamp at the " A " position is extinguished, also a " pip pip " tone signal (400 p.p.s.) is returned to the " A " operator at Central to advise her that a key-sending operator awaits her demand. The " A " operator thereupon states the number required, *e.g.*, 2345, and the key-sending operator keys this up immediately. When the last digit key is depressed the lamp on the key-sending position is extinguished, and the position becomes dissociated from the junction and ready for the next demand. Also the supervisory lamp at the " A " position relights until the called subscriber answers.

The Sender, Sender Finder, Position Finder, Junction Finder and Outlet Relay Set all remain associated with the junction until the train of impulses corresponding to the last digit has been sent out by the sender, when they are all released and become available for another call. The Junction Relay Set, which contains the transmission element, remains in circuit until the end of the conversation.

There are many interesting points in connection with the grouping of the relay sets and the various finders, but these hardly come within the scope of this article and must await the fuller description of the scheme referred to above.

Through Calls.

A 7-digit *automatic* call would be dealt with in a similar fashion to that described above for terminating calls, except that 7-digit senders and key-sending positions are required. Also, as such calls will generally be originated over junctions on which the through *manual* traffic will require to be routed, a discriminating relay set will be necessary. The scheme for through calls is indicated in Fig. **9**. It will be seen that this caters for both kinds of junction circuits, viz. :—

(*a*) Circuits incoming for through manual calls only.

(*b*) Circuits incoming for through manual or automatic calls.

In case (*a*) the originating " A " operator, on plugging into the jack of a free outgoing junction, engages the relevant manual relay set. This causes the line finder to search and, having found the calling circuit, to connect the latter to a free junction relay set. The latter is associated with a particular plug-ended cord, and the calling lamp associated with this cord glows until the " B " operator has completed her previous call. When this has taken place the junction finder will search and, on finding the calling circuit, will connect it to the " B " operator's telephone set. As soon as the latter is connected, the calling lamp associated with the plug-ended cord will flash, to indicate to the " B " operator the cord of the junction over which the next demand will be received. The supervisory lamp on the " A " position is extinguished, and a " pip pip " tone signal (400 p.p.s.) is returned to the " A " operator, advising her that a " B " operator awaits her demand. The " A " operator states the exchange concerned, and the " B " operator completes the connection *via* the outgoing junction multiple. As soon as this is done the supervisory lamp on the " A " position relights, the calling lamp on the " B " position is extinguished, and the " B " operator's telephone set is released and made available to deal with the next call. Arrangements have been made to allow a maximum of three calls to be waiting at any one moment at any position.

In case (*b*) there are two jacks in the outgoing junction multiple at the manual exchange, one for calls to automatic and C.C.I. exchanges, and the other for calls to manual exchanges. If the " A " operator plugs into the *manual* jack, the discriminating relay set allows the associated *manual* junction relay set to be taken into use, and the call proceeds as described in case (*a*). If, on the other hand, the operator plugs into the

auto jack, the discriminating relay set allows the *auto* junction relay set to be appropriated, and the call proceeds as described for the 4-digit (terminating) calls. In this case, however, a 7-digit sender and key-sending position will be associated for the purpose of setting up the call.

Multiple Fee Calls, Automatic Registration.

Calls between exchanges in the Manchester multi-exchange area (which comprises the area within a radius of 7 miles from the Manchester Town Hall) will be charged at 1d., 2d. or 3d., according to the radial distances concerned.

Hitherto it has been contemplated that it would be necessary to divert all 2d. and 3d. calls to the manual board, in order that these might be recorded and the appropriate junction fee debited to the subscriber's account in due course. Schemes have now been devised, however, by the Department's engineers under which the subscriber's meter will be operated twice on 2d. calls and thrice on 3d. calls, thus avoiding the necessity for the intervention of an operator.

The first scheme (called for convenience the " Director Translation " method) and the one to be adopted at Manchester Exchanges, is briefly as follows :—

The code digits sent into the Director are translated into one " fee discriminating " digit followed by 1 to 5 " routing " digits, instead of the usual 1 to 6 " routing " digits only. Each 1st code selector is provided with a special vertical marking bank and wipers, associated with which are two discriminating relays. A slight change is also necessary in the code selector circuit proper. The fee discriminating digits may, for example, be 1, 2 and 3. On receipt of the first train of impulses the first code selector will therefore rise to Level 1, 2 or 3. If to Level 1, one of the discriminating relays is operated, and the circuit is then prepared for *unit* fee registration. If to Level 2, the other discriminating relay is operated, and the circuit is then prepared for *double* fee registration. If to Level 3, both discriminating relays are operated, and the circuit is prepared for *triple* fee registration. Quadruple or quintuple fees could be arranged for, if necessary, by similar means. The multiple operation of the meters is produced by cams mounted on a special slow speed interrupter. At the end of the first train of impulses, the circuit for the release magnet is closed, and the first code selector restores to normal, but the circuit modifications are such that the closing of the rotary magnet circuit is delayed until the end of the second train of impulses. The second and succeeding trains of impulses (which represent the " routing " digits) are received by the code selectors, which then function in the normal manner. It will be appreciated that this scheme, with the Director system as at present designed, reduces from six to five the possible number of switchings for routing purposes. This however is not likely to be a disadvantage in the Manchester area, where the largest number of such switchings visualised at present is four. This scheme, whilst being simple and comparatively inexpensive for new exchanges, cannot be introduced very easily at large exchanges which have been brought into use already without the multiple fee registration facility, inasmuch as the accommodation of the special relays, the modification of the first code selector circuit, and the simultaneous rearrangement of all the director translations in such an exchange, would present practical difficulties of a serious character.

With a view to catering for such cases, another scheme has been devised. With the latter scheme (called for convenience the " 1st Code Selector Level " method) the special vertical bank is still required, and its wiper connects the meter wire direct to the appropriate multiple metering cams. No discriminating relay set is required, and no other change is necessary in the first code selector circuit. On the other hand, each class of fee must be allotted a separate first code selector level. The level to which the first code selector is raised by the first train of translated code digits will determine whether the subscriber's meter will receive one, two or three impulses when the registration of the call is effected.

With this scheme, calls routed *via* Tandem would require a maximum of three levels, one for 1d. calls, one for 2d., and one for 3d. The outlets from all levels allotted for Tandem traffic, however, would be graded in one common group, the segregation of levels being necessary for multiple metering purposes only. If sub-Tandem Centres should eventually be found economical it would, of course, be necessary to

allot a maximum of three levels for each such Centre. Multiple fees for calls to exchanges reached direct must also be given first code levels. The restriction in the trunking which results from the use of this scheme will be appreciated by a comparison of Figs. **10** and **11**, which

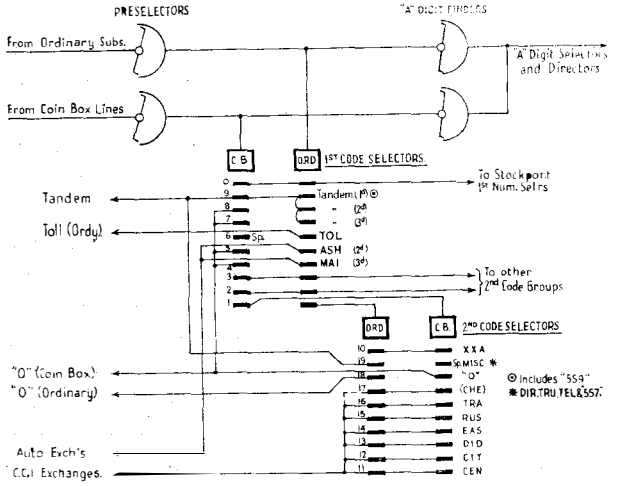


FIG. **10**.—DIAGRAM SHOWING STOCKPORT TRUNKING (WITH DIRECTOR TRANSLATION METHOD OF MULTIPLE FEE REGISTRATION).

show the trunking arrangements which would obtain at Stockport exchange. In Fig. **11** (the first code selector level scheme) the first code selector levels 4 and 5 are allotted to MAI and ASH, (multiple fee direct routes) respectively, and levels 7, 8 and 9 to Tandem traffic. The traffic for BLA, DEA, and CEN, however, which is individually heavier than for Tandem,

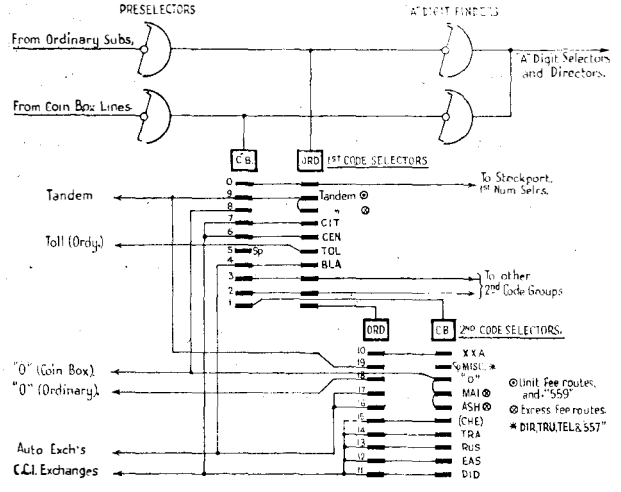


FIG. **11**.—DIAGRAM SHOWING STOCKPORT TRUNKING (WITH 1ST CODE SELECTOR LEVEL OF MULTIPLE FEE REGISTRATION).

MAI, and ASH, must all be routed *via* second code levels. More second code selectors will therefore be required than with the Director Translation scheme seen in Fig. **10**.

It will be appreciated that difficulties will be encountered in applying even this scheme at existing exchanges in some cases, and other schemes are under consideration to enable the facility to be provided under all circumstances without undue circuit complexity or expense.

The Director Translation scheme has been adopted for Manchester in view of the greater trunking facilities afforded thereby, the maximum of five switchings available for routing purposes being ample in this Area, as before mentioned.

Coin Box Multiple Fees.

Multiple fee calls from coin box subscribers, however, must still be routed to the manual board, to enable an operator to supervise the insertion of the appropriate fee in the coin box. This is the reason why in Fig. **10** two levels have been allotted for Tandem traffic, level 9 being for unit fee calls, whilst multiple fee calls will pass *via* level 8. Further, any calls over direct routes on which more than the unit fee is chargeable must be similarly segregated. MAI and ASH are the only direct multiple fee routes in this particular exchange.

The total number of multiple fee calls from coin box lines at any exchange is usually very small, and would not as a rule justify a separate group of junction circuits to the manual board. A separate group of Coin Box "O" circuits (terminating at the Toll positions) will, however, be provided for each exchange, and advantage is taken of that fact to pass the multiple fee calls from coin box lines to the Toll positions *via* the same group of circuits. In Fig. **10** therefore coin box levels 8, 17 and 16 are commoned with level 18. Similarly in Fig. **11** levels 4, 5, 7 and 8 are commoned with level 18.

Satellite Working.

The introduction of these schemes for auto-registration of multiple fees has limited considerably the field for satellite working in director areas.

In the first place a third wire is required on each junction outgoing from the satellite to the

parent exchange, and this of course modifies the financial aspect very materially.

In the second place, the junction fees will rarely be the same for any two exchanges in an area. Hence, if the economic advantage of a common group of directors for the parent and its satellites is to be retained, a difficulty at once arises, whichever of the two schemes of automatic registration is adopted. [If a common group of directors is not retained the economic advantage of satellite working would generally disappear and it would become cheaper to provide directors at each exchange, thus avoiding the heavy expense of the discriminating equipment at the satellites]. The difficulty will be appreciated more clearly by considering a particular case. For this purpose, assume that Prestwich exchange is to function as a parent exchange for two satellites, Radcliffe and Whitefield. In this case it so happens that there are no multiple fee calls which would be routed direct, all such calls being more economically passed *via* Tandem. An examination of the Tandem routes reveals five distinct combinations of fees for the three exchanges as follows:—

Group.	To Exchanges.	Fee for call from		
		PRE	RAD	WHI
1	ECC, MOS, RUS, WAL, WHI.	1d.	1d.	1d.
2	CHO, EAS, MID.	1d.	2d.	1d.
3	DID, DRO, FAI, HEA, LON, SAL, URM.	1d.	2d.	2d.
4	DEN.	2d.	3d.	2d.
5	ASH, GAT, MAI, STO, WOO.	2d.	3d.	3d.

Now, since the same translation must apply for any given exchange code, from whichever of the three exchanges the call originates, the first train of impulses must be different for each of these five groups. With the first code selector level method, this would require five separate first code levels for Tandem traffic (as shown in Fig. **12**). With the director translation method, five levels of the special marking bank would have to be allotted.

Further fee variations are obviously possible, and would have to be catered for if new exchanges were opened in the area, or if the area were enlarged to embrace 4d. and 5d. routes, in which case further levels would be required.

In view of this limitation it is unlikely that either scheme would be practicable for more than two or three satellites associated with any one parent exchange. The original Manchester proposals, for example, under which 12 satellites were to be dependent on Blackfriars as parent, would be clearly impracticable owing to the large number of fee variations which obtain at the 13 exchanges concerned.

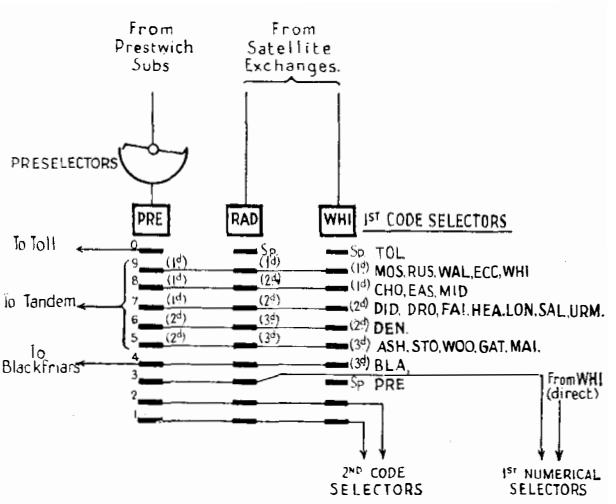


FIG. 12.—DIAGRAM SHOWING PRESTWICH AS PARENT EXCHANGE FOR TWO SATELLITES, RADCLIFFE AND WHITEFIELD.

Moreover, so far as Manchester is concerned, investigations have shown that, on the present lay-out of the area, there is no case where satellite working can be introduced with economy.

In the circumstances, therefore, it has been decided to provide directors at all exchanges in the Manchester area, as now planned. In some of the larger exchanges round the fringe of the seven mile radius, however, it might eventually be found desirable, if development proceeds more rapidly than is at present anticipated, to afford relief by serving a small portion of the area by a satellite exchange, with the existing exchange as its parent.

Speaking generally, however, it seems probable that, unless some other scheme for the auto-registration of multiple fee calls is devised, satellite working in director areas will not be

both practicable and economical for more than two or three satellites associated with any one parent exchange. A necessary condition will also be that the parent and its satellites must not be far apart, so that the number of fee combinations to be catered for will be a minimum.

The abolition of satellite working has resulted in a considerable reduction in the quantity of equipment required at the Blackfriars exchange.

It has also simplified the trunking arrangements at that exchange very considerably, since there is now no necessity for the large number of separate groups of second code switches, which would otherwise have been required in order to segregate the multiple fee traffic.

The restrictions in routing imposed by the discriminating satellite scheme are also avoided thereby, and greater flexibility in junction routing becomes practicable, with consequent economies in line plant costs.

Miscellaneous Traffic from Ordinary Subscribers.

The following codes are used for the types of calls mentioned below :—

DIR for calls to directory enquiry.
TRU for calls to trunk records and trunk enquiry.
TEL for calls to phonograms (for *inland* telegrams).
557 for calls to phonograms (for *foreign* telegrams).
559 for calls to phonograms (*Telephone-Telegram* traffic from Sub Post Offices).

The amount of traffic in each case is very small and does not, as a rule, justify a separate group of junctions to the service point. It is therefore economical to route all these calls *via* the Tandem group from the Sub Exchanges (*e.g.*, See level 19 on Fig. **10** for the Stockport Exchange), and split up the traffic at Blackfriars Exchange as shown in Fig. **13.**

Miscellaneous Traffic from Coin Box Lines.

As is now well known, the code letters of the exchange name shown in the directory for each subscriber's number are printed in capitals when the exchange concerned is automatic or has C.C.I. facilities. Coin box subscribers are instructed to dial " O " for all calls for other exchanges or services.

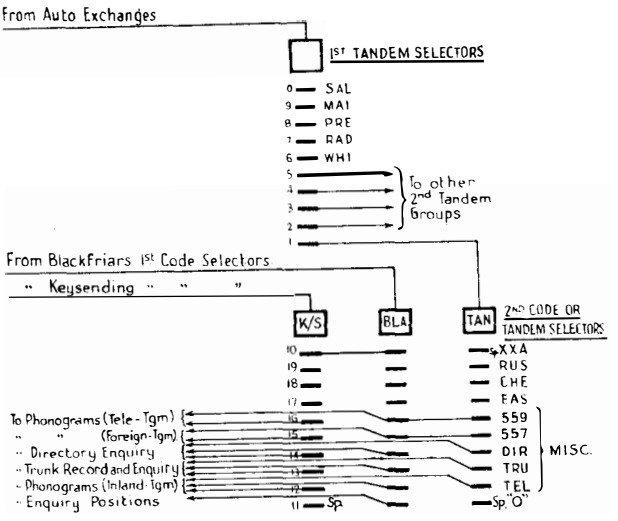


FIG. **13.**—DIAGRAM SHOWING ROUTING OF " MISCELLANEOUS " TRAFFIC FROM SUB-EXCHANGES VIA THE TANDEM SWITCHES AT BLACKFRIARS.

The Coin Box " O " circuits are terminated at the Toll positions, and the " A " operators at these positions have direct transfer circuits to the various service points for disposing of this miscellaneous coin box traffic. Hence, the coin box levels associated with the codes TOL, DIR, TRU, TEL and 557 are connected to the " number unobtainable " (NU) tone (vide levels 6 and 19 in Fig. **10**).

The level for 559 cannot be connected to NU tone, as the circuits for which this service is specially required are frequently from call offices, provided with coin boxes for the use of the general public.

Fig. **14** shows the various types of code level routings which are now necessary to provide the various facilities required in the Manchester Area.

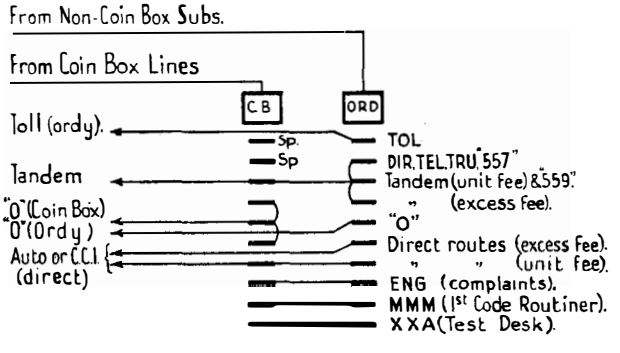


FIG. **14.**—DIAGRAM SHOWING TYPICAL ROUTINGS REQUIRED IN MANCHESTER EXCHANGES.

It might be added that the 3,921 subscribers' lines connected to the three new exchanges were transferred from no less than seven exchanges, and the conversion operation on June 7th was effected without a hitch, and resulted in only eight faults of a minor character. To those acquainted with the multitudinous details and complications inherent to a scheme of this character, it will be obvious that great credit is due to the enginering and traffic staffs concerned for the careful preparatory work necessary to achieve such a successful result.

In submitting these notes, I gladly acknowledge my indebtedness to Mr. A. S. A. Johnson for some suggestions, to Mr. W. E. Hudson for details in regard to the multiple fee registration schemes, and to Mr. W. A. Satchwell, of Manchester, for the photographs shown in Figs. **2-7**.

TELEGRAPH AND TELEPHONE PLANT IN THE UNITED KINGDOM.

TELEPHONES AND WIRE MILEAGES, THE PROPERTY OF AND MAINTAINED BY THE POST OFFICE IN EACH ENGINEERING DISTRICT AS AT 31ST MARCH, 1930.

No. of Telephones owned and maintained by the Post Office.	Overhead Wire Mileages.				Engineering District.	Underground Wire Mileages.			
	Telegraph.	Trunk.	Exchange.	Spare.		Telegraph.	Trunk.	Exchange.	Spare.
677,635	529	3,965	53,583	128	London	24,898	88,267	2,556,926	95,056
88,825	2,179	21,414	70,144	2,278	S. East	4,035	62,271	244,977	35,122
92,263	4,507	31,729	64,760	3,993	S. West	21,631	16,944	185,098	63,960
74,243	6,277	39,048	67,984	6,477	Eastern	24,529	47,904	156,949	62,731
106,605	8,462	45,229	64,205	4,739	N. Mid.	32,872	63,982	274,084	103,142
91,815	4,852	31,025	79,187	4,286	S. Mid.	12,992	30,162	217,438	81,002
62,383	4,685	29,951	57,404	3,573	S. Wales	6,734	29,306	139,329	69,851
116,140	7,885	26,934	54,771	4,245	N. Wales	13,723	43,655	314,392	60,661
170,122	1,471	15,993	45,156	3,162	S. Lancs.	14,527	84,461	540,287	49,892
101,293	6,098	30,715	49,729	3,344	N. East	14,018	49,329	269,595	72,724
68,926	3,949	24,252	40,660	2,469	N. West	7,754	37,074	177,931	29,427
51,819	2,552	15,998	27,174	2,972	Northern	7,553	21,598	144,866	38,487
23,646	4,490	8,927	14,202	585	Ireland N.	136	2,920	51,741	2,642
71,977	5,386	27,398	41,125	1,193	Scot. East	6,211	17,520	167,816	40,704
04,966	7,254	24,706	45,594	1,064	Scot. West	11,525	27,577	237,117	34,345
1,892,658	70,576	377,284	775,678	44,508	Total	203,138	622,970	5,678,546	839,746
1,854,083	70,779	375,457	762,329	44,696	Figures as at 31 Dec., 1929	202,804	606,348	5,558,868	866,093

AUTOMATIC ROUTINE TESTERS FOR AUTOMATIC EXCHANGES.

W. E. CHINN, A.M.I.E.E., and J. S. YOUNG.

THE opening articles of this series have already been printed in the preceding volume of this Journal, when a general outline of the common functions and operating procedure of Automatic Routiners were given, also the salient circuit features of the First Code Selector, Director and C.C.I. Relay Set Routiners were described.

In this article the functions of the C.C.I. Coder, 4-Digit Sender and Keysending " B " Position Apparatus Routiners will be outlined and points of particular interest will be indicated.

Coder Routiner.—The general design of this routiner is similar to that of the Director Routiner. In the earlier designs the Control Switch functioned entirely for the purpose of controlling the sending of the digits to the Coder under test, while the storage and display apparatus was a replica of the circuit used for the same purpose in the Decoding Relay Groups at C.C.I. Exchanges. In the course of development, however, this design has been altered and the Control Switch is now used for the purpose of both controlling the sending by the routiner and timing the pause between the digits sent to the Coder under test.

Access is obtained to the P, +, − and PU incoming leads to each Coder. The Access Switches are arranged for " Self Drive " over unequipped contacts and under these conditions a relay is operated to delay the commencement of the test cycle. In some of the early equipments no provision is made for the unequipped outlets of the Access Switches and hence should it be necessary to remove a Coder from its position it has to be replaced before routine testing commences, in order that the routiner may not be stopped unnecessarily.

A busy test is applied to the Coder by connecting a relay to the private and closing the operating circuit of a slow-to-operate relay at the same time. Should the private relay operate, it disconnects the circuit of the slow relay before the latter is energised sufficiently to operate and closes the circuit for a delayed alarm. If the private becomes free within a period of 30 to 60 secs. the tests are continued, but otherwise the alarm operates. In some of the later equipments slow-to-operate relays are dispensed with and the circuit is re-arranged in order that slow-to-release relays may be employed instead, while in other equipments the arrangements are the same as mentioned in connection with the C.C.I. Relay Set Routiner, where a double-coil relay is employed for the private test.

In the early types of Coders storage relays are used, but in the standard case these have been replaced by Rotary Switches. The routiners designed for testing the former are arranged to send predetermined digits in such an order that all of the storage relays are tested during each routine; this involves two complete operations of each Coder.

The digits employed were originally 8888 and 4444, but it was found that these allowed certain faults to pass undetected and, in consequence, it was considered desirable to change the order of the digits to 4848 and 8484.

In the standard Routiner, Digit Keys are fitted for the purpose of controlling the digits set up, since in this case it is necessary to be able to test the Coder with any digits.

Relay SS (Fig. **1**) operates when the Coder becomes free and causes 10 p.p.s. impulses to be connected to the Sending Switch DM, *via* the magnet impulsing springs. When the Sending Switch steps " off-normal," relay SA operates and removes the short-circuit from across the loop impulsing springs, thus impulsing the Coder *via* contacts of relay A. In the first test, relay SZ operates, after 4 impulses have been sent, and remains operated *via* level 2 of the Control Switch, thus preventing further impulses being sent by short-circuiting the loop impulsing springs. SZ also transfers the magnet impulses to the Control Switch. After 4 steps have been taken by the latter switch, relay SZ is released and the impulses are again directed to the Sending Switch in order that the remaining 3 digits may be sent to the Coder. Relay SC then operates and releases relay SG to prevent further digits being sent.

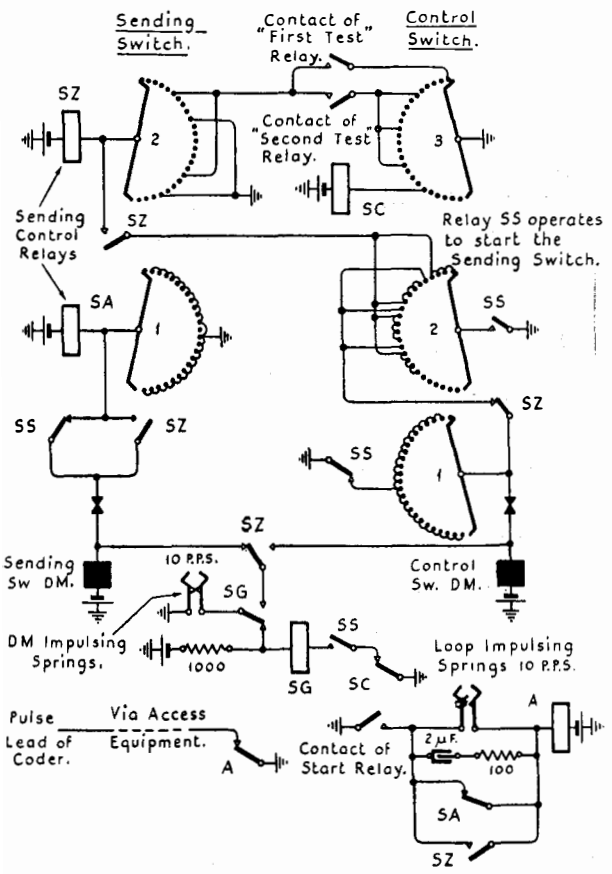


FIG. 1.

During the first test, after the digits have been transmitted, the " sending delay " feature of the Coder is tested by connecting battery and earth to the − and + leads, to hold relay LS for a given time before introducing the decoding loop. Should the Coder commence sending during this period, the routiner is stopped and an alarm is given.

When the decoding loop has been connected the Coder sends out the stored digits. In early routiners these are directed to the routiner display relays by means of two-step relays, and in later equipments by means of a Digit Distributor, the latter being stepped by the operation of a relief relay to the decoding relay LN.

The relief relay is necessary in order that the drive magnet current shall not pass *via* the contacts of the polarised relay, which normally have only 2 mils clearance.

The display lamp connections are taken *via* contacts of the digit keys in a similar manner to that previously described in connection with the Director Routiner. The display is maintained for 3-6 secs.

The private is guarded throughout the tests by connecting to it a low resistance earthed relay, as shown in Fig. **2**. It will be seen that earthing of the private by the Coder under test is detected by the release of this relay.

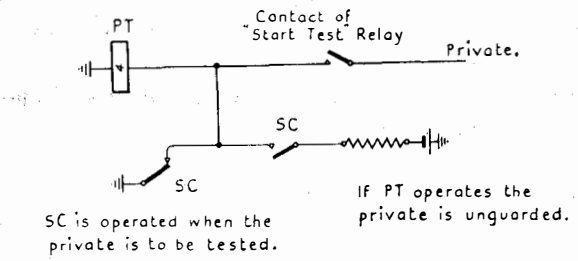


FIG. 2.

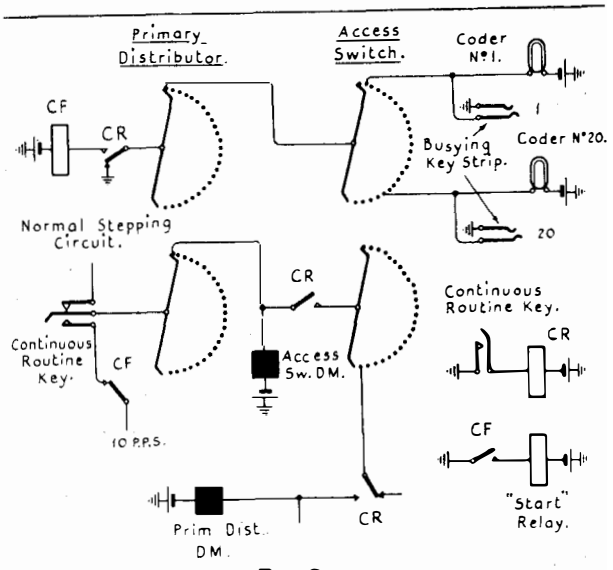


FIG. 3.

During normal routine when the tests on each Coder have been completed the access equipment is stepped to the next Coder.

A special feature has been incorporated in this routiner to facilitate continuous routine testing without the necessity for stepping the Access Switches to the particular Coder. The Coder required is marked by means of a peg inserted into a jack on a busying strip, one of which, together with an indicating lamp, is associated with each Coder, and then on the operation of the Continuous Routine Key, Fig. **3**, 10 p.p.s. impulses are connected to the Access Switch DM. The switch is thus stepped until it reaches the position on which the busying strip is earthed,

when relay CF operates and prevents further stepping and also operates the " Start " relay. When the required Coder is found the routiner commences testing without the necessity for any further operation of keys.

The various delay periods for the display, tests and alarms in the early equipments are provided by means of single time pulse leads and two-step relays. In the later equipments the S and Z alarm scheme is employed.

Fig. 4 shows a typical lay-out of the Coder Routiner equipment.

4-Digit Sender Routiner.—Unlike other apparatus for which auto routiners are provided, the 4-Digit Senders in most Exchanges work entirely in conjunction with local apparatus. The exceptions to this are those provided at the " Parent " Exchanges of " Satellite " areas, where it is general practice to centralise all manual operating positions, and in the Manchester and Birmingham Director areas where all manual boards are being concentrated in one building. In the general case, therefore, " Sender " routiners have been designed to apply functional tests only, there being no variable conditions such as junction resistance, insulation and voltage (other than the normal Exchange voltage variation of from 46-52 volts) to be met with.

The " Access " equipment is fitted on the routiner rack, as in the case of the Director and Coder routiners already described.

In most of the earlier Sender routiners, Test Switches have not been provided, the changes required to the testing conditions having been arranged for by means of relays. In the course of progress, however, it was realised that some economy in apparatus and simplification of the circuit could be made by employing a rotary line switch for measuring the alarm delay periods, which in this routiner are more numerous than in most of the others, and as the result a circuit was designed as shown in Fig. 5. The rotary line switch in this circuit is stepped with interrupted earth pulses, the alarm connections and starting conditions being connected by the relays which are used for applying the particular test in progress. In later circuits this Alarm Switch has been incorporated with the Sending Switch and this combination functions more in the nature of a Test Switch.

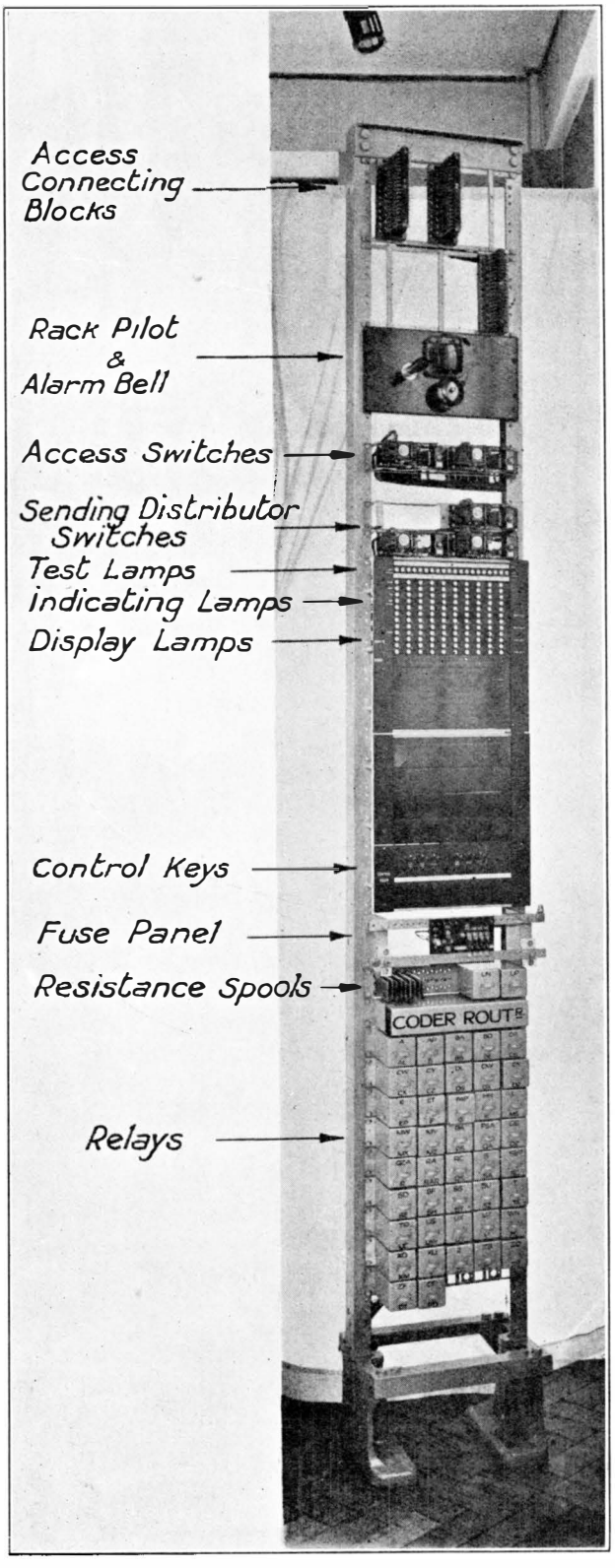


FIG. 4.—CODER ROUTINER.

Facilities are provided for testing the operation of each Sender under normal conditions but, in addition, all the extra features such as " Partial Call," " Manual Board " and " Cancel Condition " may be tested as and when required, these tests being controlled by means of keys.

The operation of the Start Key causes the routiner to step the Distributor and Access equipment to the first outlet associated with a Sender. On arrival of the Access Switch at this outlet the " Private " or " Busy Lead " of the Sender is tested, and, if engaged, the routiner waits until it becomes free or gives an alarm if it is continuously engaged for more than $37\frac{1}{2}$ secs.

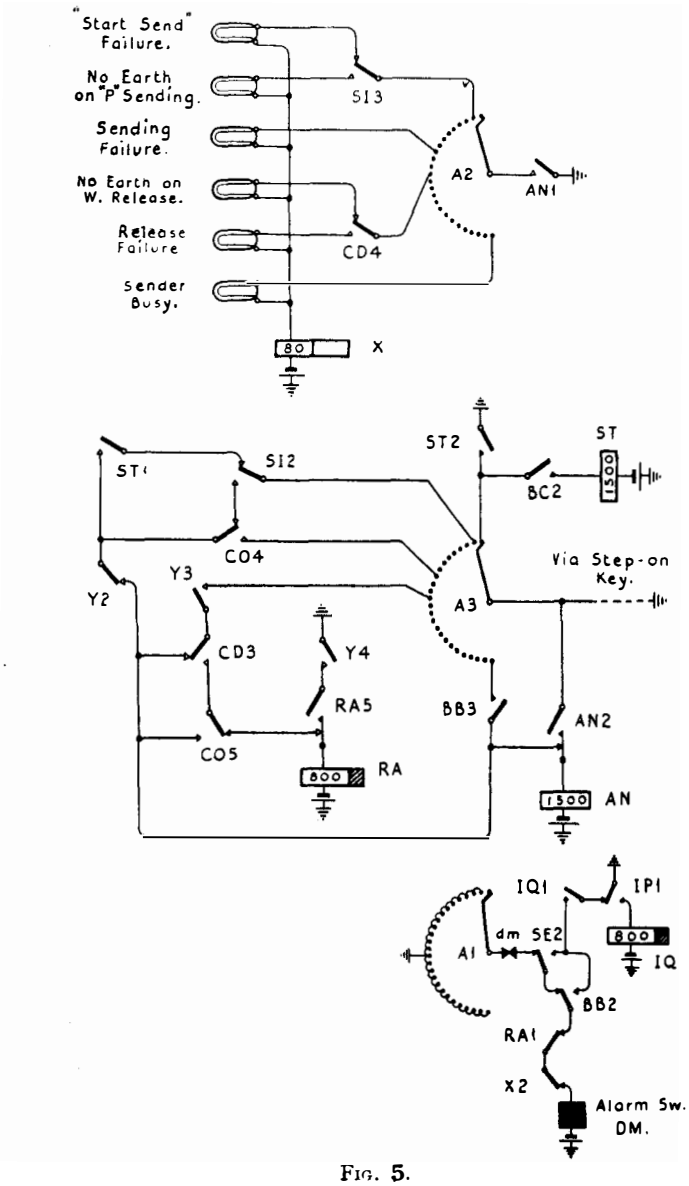


FIG. 5.

This alarm period is measured by the alarm switch. Referring to Fig. **5** relay BB, which tests the private for the engaged condition, starts the Alarm Switch stepping at 40 p.p.m. When the Sender becomes free relay BB releases and " homes " this switch. If, however, relay BB is still operated when the wipers arrive at the 25th contact, relay AN will operate and alarm conditions will be set up.

On the Sender becoming free it is seized in the usual manner by the routiner. The Sending Switch (PS), in the latter (see Fig. **6**) now commences to step under the control of two relays and as the wipers pass over the outlets, digit leads W, X, Y and Z are earthed momentarily in accordance with the code shown in Table I., the digits sent by the routiner being controlled by means of digit keys.

TABLE I.

SHOWING CODE PULSES FOR SENDERS.

Digit.	Storage Relays Operated.
1	W
2	X
3	WX
4	Y
5	Z
6	WZ
7	XZ
8	WXZ
9	YZ
0	XY

When all digits have been sent by the routiner, the " Z " lead is connected *via* contact 12 of bank 4 to the CO relay. The latter relay will only operate when the Sender connects earth to this lead. When CO operates, it closes its locking circuit to the private and, thereafter, depends upon earth being maintained by the Sender. The sending out leads are now connected by CO to the routiner A relay. The translated digits are received by this relay and directed to the relative storing switches. The pause between the receipt of the " Thousands " and the " Hundreds " digits is timed by means of the Pause Timing Switch in a similar manner to that described in connection with the Director routiner.

Should a wrong digit be received, relay XR

will operate in series with the corresponding lamp and normal key contacts and a " Wrong Number " alarm will be given.

When all digits have been correctly received, they are displayed for a period of 2-4 secs., commencing when relay Y operates after the receipt of the last digit. During the release of the

Facilities are provided for setting up 1 digit, then cancelling and subsequently setting up a complete number, these operations being performed in quick succession by the routiner and thereby testing the satisfactory functioning of Senders under cancel conditions. A key is provided in the earlier routiners whereby this feature

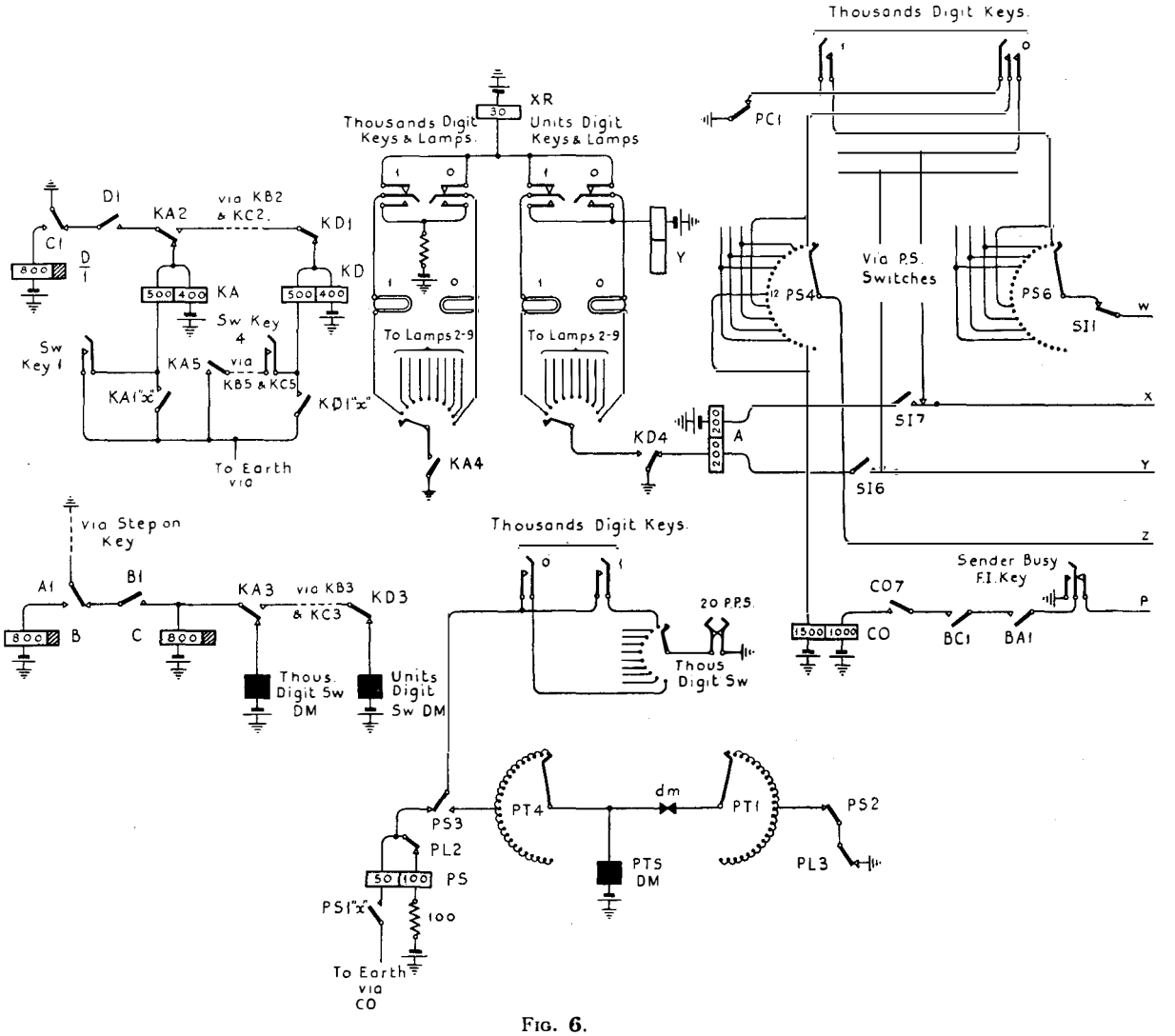


FIG. 6.

Sender, which occurs automatically when all digits have been sent, the private is disconnected and relay CO in the routiner is thereby released.

On satisfactory completion of all tests, the routiner apparatus is restored to normal, the Access Switch is stepped to the next Sender and tests on this proceed in the same manner.

may be omitted, but in later designs the test is included as part of the normal test cycle.

It is also possible to check all Senders for satisfactory operation under " Partial Call " or " Manual Board " set up conditions; for this test a key is operated which causes the routiner to send an incomplete number. Normally, under

this condition, a time pulse is operated in the Sender Finder circuit which applies the start condition to the Sender causing the latter to send digits for routing to the Manual Board. In the routiner, however, since no Sender Finder circuit is employed for the purpose of the test, this condition is simulated and earth is connected to the start lead immediately after the digits have been set up. The receipt of the correct Manual Board translation is then checked.

A typical lay-out of a Sender Routiner is shown in Fig. **7.**

Keysending " B " Position Apparatus Routiner.—The Keysending " B " Position apparatus, as far as this routiner is concerned, comprises all the apparatus, except Senders, which is involved in setting up calls from manual to automatic Exchanges, the items being " Junction Relay Sets," " Outlet Relay Sets " (or " Sender and Junction Finder Relay Sets ") and " Position Relay Sets."

The access equipment consists of two main portions (1) The position access equipment by which access is obtained to position leads, thereby enabling the " B " Operator's functions to be simulated and (2) the junction access equipment, by means of which access is obtained to the required leads on each Junction Relay Set. In most cases the equipment mentioned under (1) is mounted on the routiner rack and that under (2) is mounted in the positions.

The routiner provides for testing the Keysending " B " Position apparatus by selecting the unstaffed positions in cyclic order and then, on each Junction Relay Set associated with that position, simulating the normal conditions set up by " A " and " B " operators respectively. A spare subscriber's number is allocated for routine test purposes in order that a complete " through test " of the Junction Relay Sets may be made.

As position equipment is individual to normal traffic channels, it is necessary to arrange for routine testing by means of the Auto Routiner to be carried out during very slack periods. Testing is therefore carried out between 12.0 midnight and 6.0 a.m.

The routiner functions as follows:—

On operation of the Start Key the Position Distributor is stepped to the 1st position, when

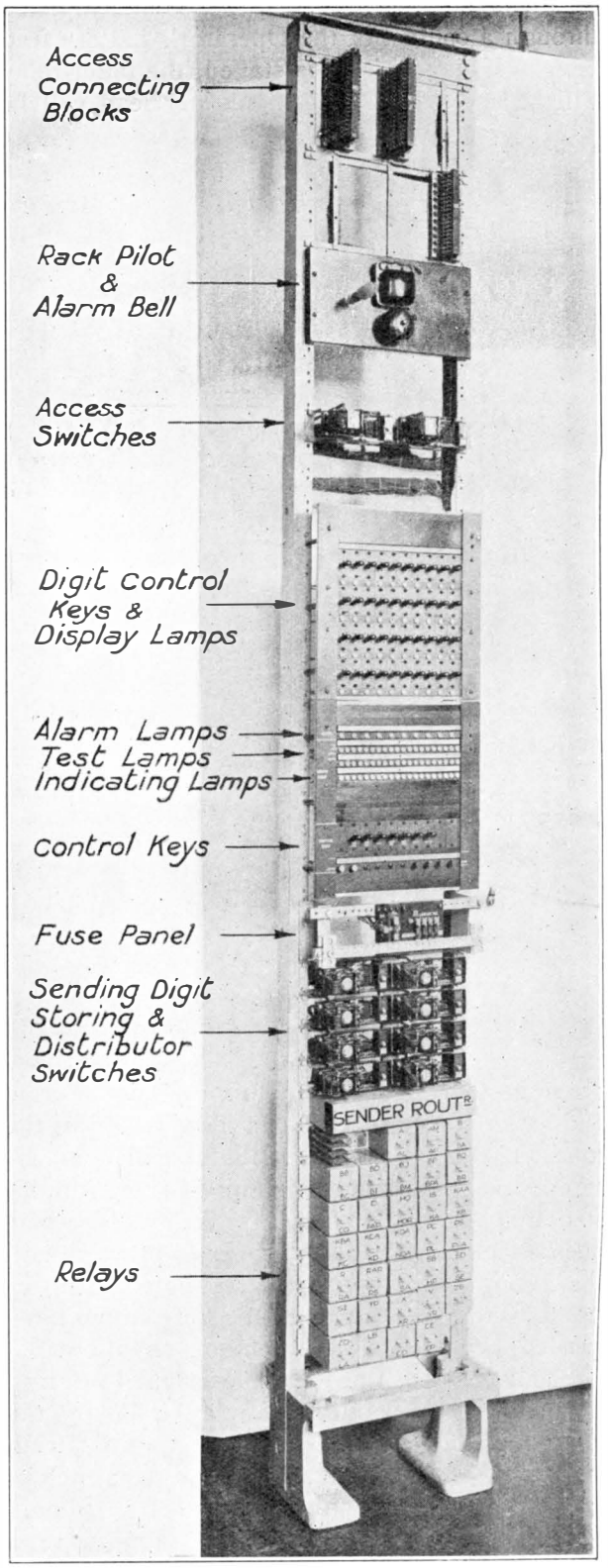


FIG. 7.—SENDER ROUTINER.

a circuit for relay PT (Fig. 8) is completed through a contact of the Operator's battery feed relay. If the position is staffed, the latter relay will be energised and the routiner lead will be

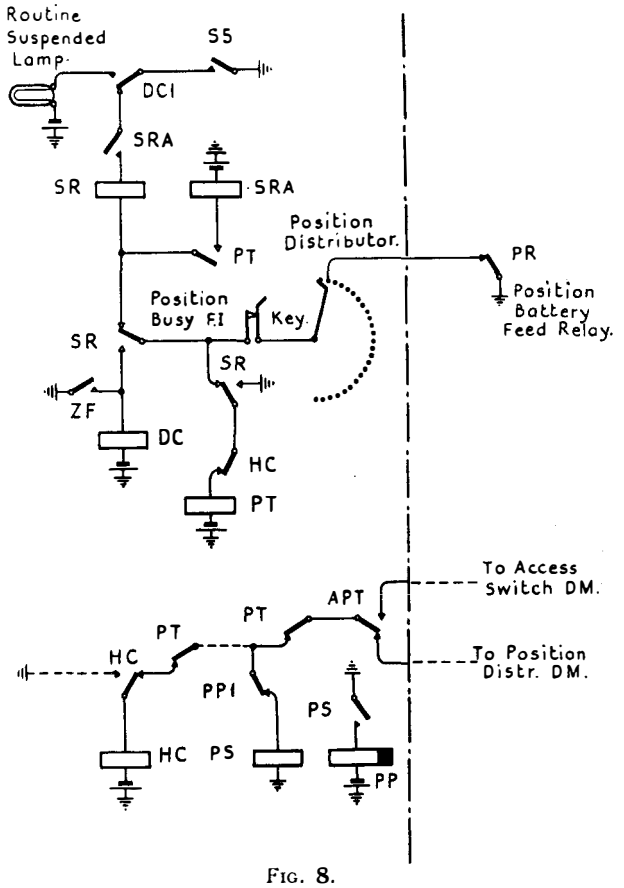


FIG. 8.

disconnected. PT will in this case not operate and, after the release of two slow relays in the routiner, the Position Distributor will again be stepped. This sequence is repeated until an unstaffed position is found. Relay PT now operates and causes the routiner to proceed with the testing of the apparatus associated with this position and also prepares the " Routiner Suspended " feature, which functions as follows :—

Should a position become staffed during routining, the operation of relay PR in the position removes earth from the routiner lead, allowing SR to operate. SR maintains the circuit for PT and starts the " delay set." Should the position be staffed for more than 3 to 6 minutes, relay ZF in the " delay set " operates and energises relay DC. DC lights the " Routine Suspended " lamp and releases relay SR, thereby releasing PT and allowing HC to operate. Relay PT is prevented from re-operation until the Position Distributor has been stepped to the next position. When relay PT released, the homing circuit of the Access Switches was completed. On arrival of the access switches at the home contact relay APT is released and the Position Distributor is stepped to the next unstaffed position.

The routiner having found a free position proceeds to test each Junction Relay Set associated with that position for busy condition, the Access Switch being stepped until the first free relay set is found.

Tests are now applied to the negative, positive and lamp leads of the relay set to prove that they are free from contacts, reversals and disconnections. The routiner then applies an operating condition for the relay set L relay. " Flicker " earth should now be connected to the lamp lead and this condition is checked by the routiner. Thus the supervisory circuit is checked for operation under conditions simulating an " A " Operator seizing the junction before assignment.

The relay set is then released by disconnection of the L relay circuit and then assigned in the normal manner by the routiner. The Sending Switch, which is arranged to transmit the test number (at present 0098), is now started and sets up this number by simulating the depression of the digit keys by a " B " Operator, access being obtained to the position digit leads *via* levels of the Position Distributor. When the number has been set up the supervisory lamp associated with the relay set should glow continuously and this causes a relay to operate and step the Test Switch.

On completion of the set-up of the test number by the routiner, the latter simulates the conditions of the " A " Operator seizing the junction and thus causes " start send " conditions to be transmitted to the Sender.

The Sender now transmits the translated digits which route the call to the test number *via* a final selector. From this point the connection is routed back to the routiner and the final selector applies ringing current, which is received on the routiner ringing relay. This indicates that the call has been routed correctly.

The routiner now trips the ringing in the final

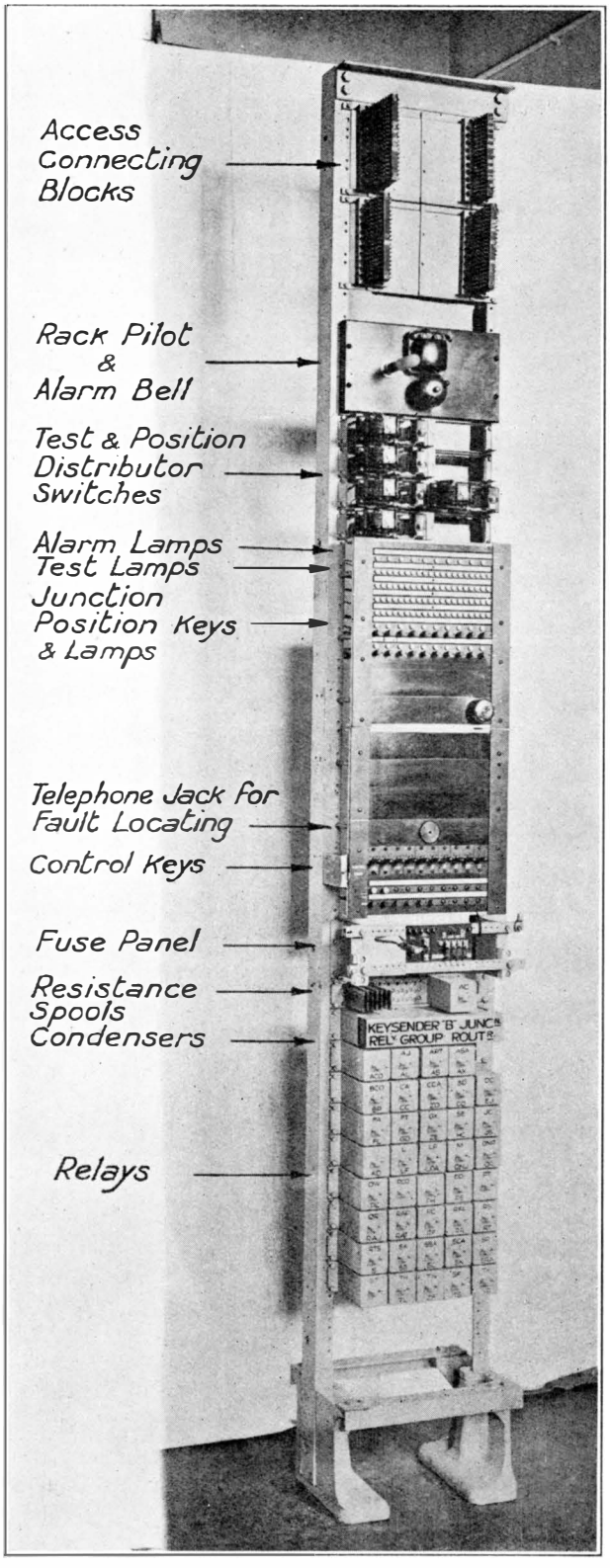


FIG. 9.—KEYSENDING 'B' POSITION ROUTINER.

selector and checks the receipt of the "Called Subscriber Answering" supervisory condition on the negative line of the Junction Relay Set.

The call is now cleared by the routiner and during release of the Junction Relay Set the period of guard on the private is measured by means of a rotary line switch stepping at 20 p.p.s. as described for other routiners.

The release timing is not included in the later equipments, except where the Junction Relay Sets are connected to outgoing junctions at parent Exchanges in Satellite Areas, as with the advent of the continuous private it becomes unnecessary in the general case.

On completion of the release timing test, the Junction Relay Set is again seized and assigned as previously described. The same test number is now set up in the Sender and a call is again routed to that number; this time, however, the line is busied by the routiner and the correct repetition of busy flash by the relay set is checked.

In addition to the above operation under general routine conditions the routiner is arranged so that it can be used for locating faults. In these circumstances arrangements are made by which the routiner simulates all the "A" Operator's conditions, but assignment and setting up of digits is carried out by a "B" Operator who acts under instructions from the Engineering Staff.

By means of keys the routiner can be connected with a certain position and routine test only the apparatus associated with that position, and by other key operations be connected to a particular Junction Relay Set and continuously test that one relay set.

Fig. **9** shows a "Keysending 'B' Position" Apparatus Routiner.

This is the last of the series of articles on Auto Routiners, and, in conclusion, it should be mentioned that although the Post Office and all Contractors have contributed greatly to the development of Auto Routiners, most of the original work of design was performed by Messrs. The Automatic Telephone Manufacturing Co., Ltd., in collaboration with the Department.

The Authors desire to express their thanks to Messrs. Siemens for supplying the photographs for publication in illustration of typical routiners.

THE A.T.M. ALL-ELECTRIC TOTALISATOR AT THE ROWLEY MILE COURSE, NEWMARKET.

FOLLOWING the successful demonstration of a 6-horse A.T.M. All-Electric Totalisator before members and officials of the Racecourse Betting Control Board at Thirsk Racecourse, Yorks, on January 8th last, the Automatic Telephone Manufacturing Company Ltd., Strowger Works, Liverpool, proceeded with the equipment of the famous Rowley Mile Course at Newmarket, the first installation of its kind.

The Newmarket Totalisator is designed for a total of 45 runners, the entire equipment, with the exception of certain ticket-issuing machines, located at other parts of the course, being housed in the building which constitutes the main Indicator, Fig. 1.

The Strowger electro-mechanism, which is identical with that comprising Strowger Automatic telephone exchanges all over the world, and daily serving some 6,000,000 telephone subscribers in 32 countries, is made up into detachable component groups, mounted on pressed steel shelves, carried by angle-iron frames as illustrated in Fig. 2.

Each of these component groups of Strowger switches and relays can be lifted from its shelf or replaced within a few seconds, and without disturbing the permanent wiring, a system of interlinked contacts resembling a double comb, one set fixed to the supporting rack, the other attached to the component group, ensuring perfect electrical continuity.

It is this feature which gives to the A.T.M. All-Electric Totalisator its transportable characteristic, and enables the entire equipment for a given race meeting, with a few minor exceptions, to be erected on site just prior to a meeting, and either removed to another racecourse, or stored, immediately following the conclusion of the meeting.

This is a particularly advantageous feature in a country like Great Britain, where the racing season is limited and certain courses have only one or two meetings during the year.

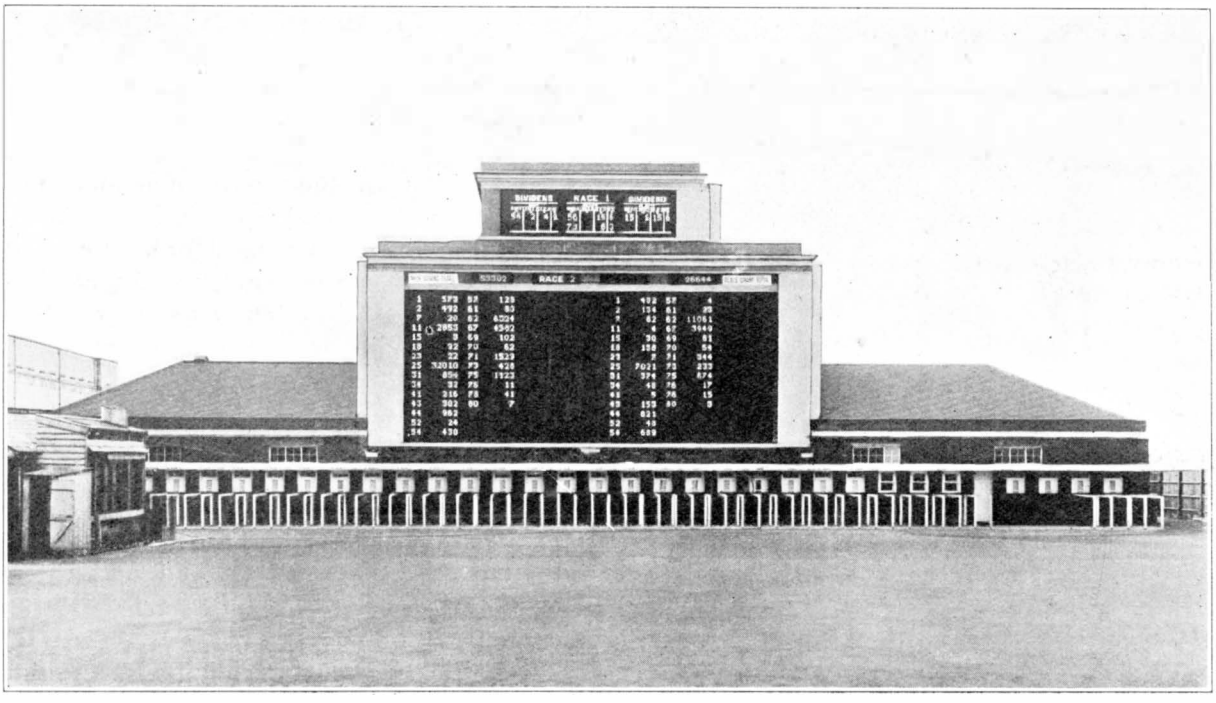


FIG. 1.—TOTALISATOR, NEWMARKET.

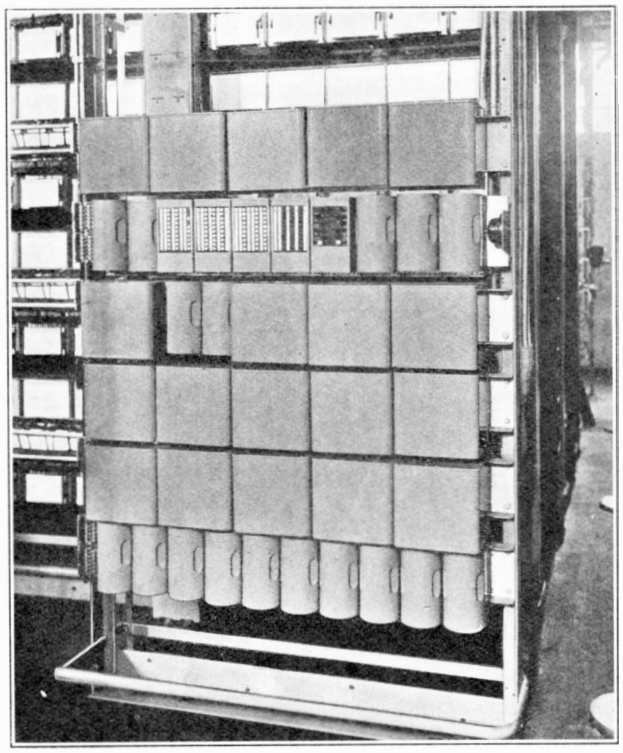


FIG. 2.—RACK MOUNTED APPARATUS.

In countries where racing is carried on continuously and meetings are frequent, the A.T.M. All-Electric Totalisator is equally adaptable to permanent erection, the detachability of the individual component groups remaining an asset on account of the facility it provides for inspection and adjustment.

To avoid delving too deeply into the technicalities of the A.T.M. All-Electric Totalisator, and yet make its operation reasonably clear to the reader, it is perhaps the simplest plan to follow the progress of a bet as staked at Newmarket.

The backer approaches the window of any ticket issuing booth on the course marked with the denomination or value of his stake, 10/- for example.

This is a decided advantage over the previous practice of allocating certain windows to certain horses, which caused congestion and queues due to unforeseen popularity of certain runners and the impracticability of a properly proportioned allocation of windows.

The backer nominates his horse, and the nature of the bet, " win " or " place," whereupon the ticket-issuing clerk depresses the corresponding " horse number " and discriminating keys on one of the two ticket issuing machines and a printed and dated ticket bearing a record of the stake is issued to the backer. The ticket issuing mechanism is so controlled that this does not take place until the bet has been accepted and recorded by the corresponding horse and total adding machines.

There are two ticket-issuing machines to each booth, the corresponding horse numbers dealt with being 1-40 and 41-80 respectively. The reason for the horse numbers being more than is provided for on the main indicator is of course that the numbers of the runners in any given event are not necessarily consecutive, due to withdrawals, scratchings, etc., on the eve of the race.

There are 100 pairs of Ticket-Issuing Machines on the Newmarket Course, 69 of which are accommodated along the sides and one end of the Indicator building, Fig. 1, whilst the remainder are distributed as follows :—

In the Main building, Tattersall's enclosure, eight 2/-; four 10/-; five £1; two £10; one £100; and for chits, four £1; four £10; and three £100.

In the Silver Ring, twenty-eight 2/-; six 10/- and four £1 pairs of machines, making 69 in all, in the main building.

There are two £1 sets in the Trainers' quarters; fourteen in the members' enclosure, comprising six 2/-; three 10/-; four £1; and one £10 pairs; together with four Chit machine pairs, viz., two £1; and two £10.

The total of 100 pairs of Ticket Issuing Machines on the Newmarket Course is made up by eleven in the Paddock Verandah; five 2/-; three 10/-; and three £1.

As will be seen, the machines are of five denominations, two machines to each value, commencing with the unit, (2/-). These values are clearly indicated on the booths and it is only necessary for a backer to select a booth corresponding to the value of his stake, irrespective of the number of his fancied runner.

The Ticket Issuing Machines for Newmarket were supplied by the Bell Punch & Printing Co., Ltd., Uxbridge, and incorporate a number of Strowger relays and a special coding feature which materially reduces the number of wires

between these machines and the main equipment. This portion of the equipment was designed and manufactured by Automatic Telephone Manufacturing Company, Ltd. The Bell Punch Totalisator Ticket Machine is essentially a miniature printing press, embodying in addition all the selectivity, impulse generation, and control necessary for its special purpose. Furthermore the machine is fool-proof, fraud-proof, and immune from deterioration, or the detrimental effects of varying atmospheric changes.

Depression of the keys of these several machines, in accordance with the requests of backers, closes electrical circuits and sets in motion the chain of Strowger electro-mechanism terminating in the registering and indicating devices which keep the public informed of the progress of betting preceding each race.

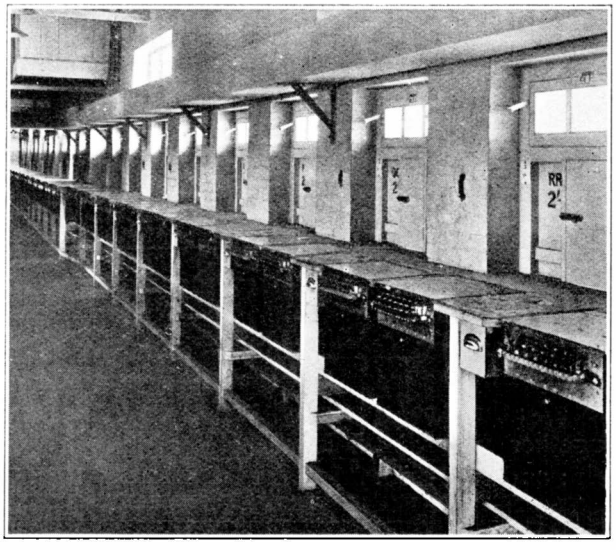


FIG. 3.—INSIDE FRONT, SHOWING TICKET-ISSUING MACHINES.

From the ticket issuing machines, Fig. **3**, which resemble a type-writer or cash register, the electrical circuits (ten wires per machine) pass to the main equipment, *via* a main distributing frame, Fig. **6**, on which the incoming cables to the Totalisator terminate and from which the interior wiring branches out, in orderly sequence, to the various component groups of apparatus.

The first sets of components to receive the electrical impulses initiated by the ticket issuing keys are the " Place Change-over " relay groups, whose function it is to discriminate between " win " and " place " bets and divert them into their respective channels.

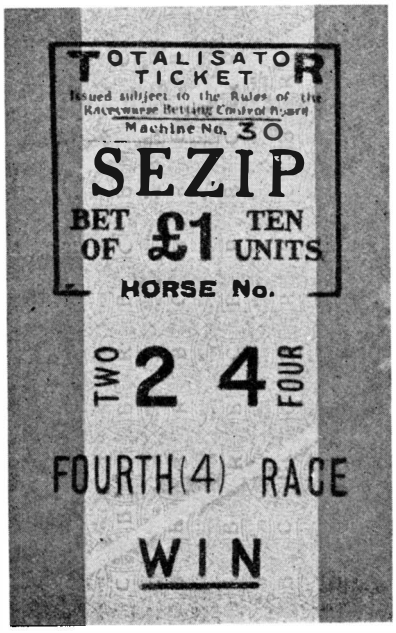


FIG. 4.—A " WIN " TICKET.

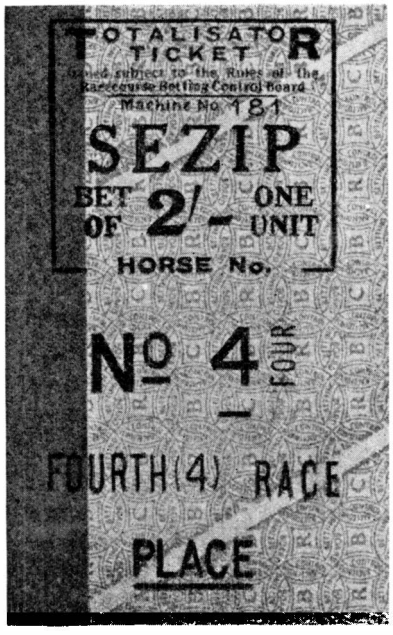


FIG. 5.—A " PLACE " TICKET.

Next in order come the Decoding Relay groups, Fig. **8**, which transform the key signals into their corresponding betting equivalents, and pass them on to the " Collecting Switches."

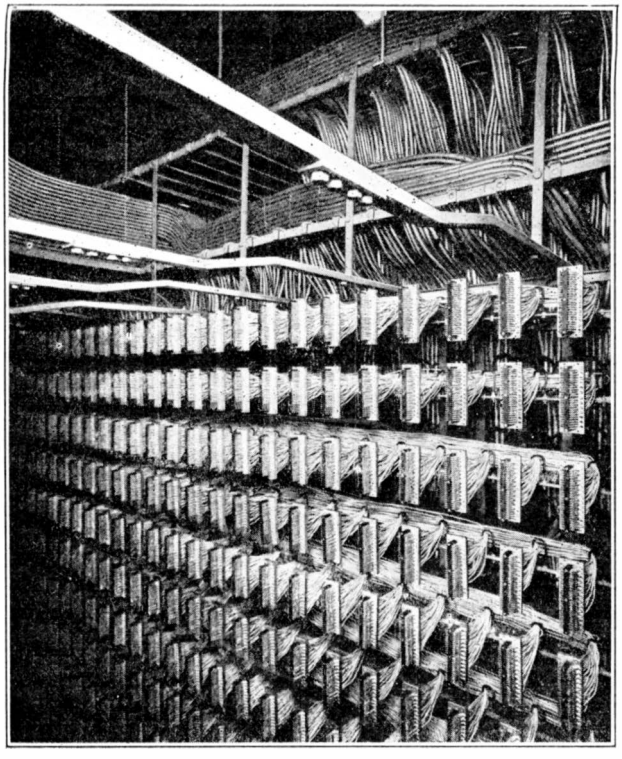


FIG. 6.—M.D.F.

These latter comprise Strowger heavy duty rotary line-switches, their function being to successively collect the bet signals from the various ticket issuing machines. Whilst betting is in progress, these switches are continuously rotating at a speed of about 50 r.p.m., the brushes traversing 2,400 contacts per minute, which provides an ample margin for the prompt acceptance of bets during the busiest pre-race period, when all Ticket Issuing Machines may be in use simultaneously.

The final equipment link in the chain of mechanism associated with each runner is the Horse Adding Machine, a combination of Strowger heavy duty rotary line-switches and relays, which aggregates the bets received from the collecting switches and transmits the resultant totals to the Indicator for visual display.

In addition to the Horse Adding Machines, of which there are two to each runner, adding " win " and " place " bets respectively, there are also two Total-Adding Machines, " win " and " place," which total up all bets and pass them to the " Total " display panels on the Indicator, where the ratio between these grand totals and those of the respective runners gives an indication to the public of the " odds " prevailing at any moment.

During the busiest period immediately prior to the start of a race the various totals change very rapidly, the several adding machines being in continuous operation. Due to the simplicity of the circuits, however, and the absence of any need for electrical synchronisation of the switches, the utmost accuracy is assured.

The whole of the component groups of apparatus so far described, together with the Ticket Issuing Machines, are inter-changeable within their respective classifications, facilitating immediate remedial measures in the improbable event of any temporary derangement, whilst a comprehensive system of supervisory lamp signals gives instantaneous visual indication of a hitch at any point in the system.

As will be seen in the illustration, each group of apparatus has an individual dust-proof metal cover, whilst slip-on covers also protect the wiring, terminals, etc.

Following our imaginary bet in its progress through the chain of mechanism, we have now reached the stage at which it is ready for adding to the corresponding horse and grand totals displayed on the main Indicator.

As will be noted, Fig. 1, the Newmarket Indicator is on the lamp monogram principle, each numeral being delineated by a selected group of lamps in a rectangular lamp-box containing 24

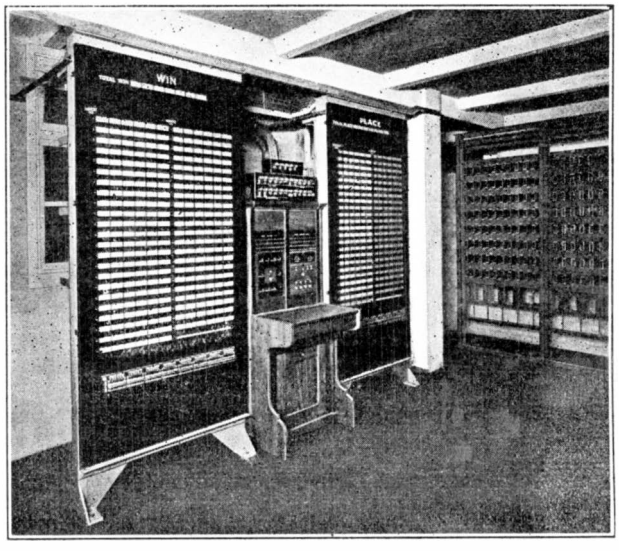


FIG. 7.—CONTROL SWITCHBOARD.

lamps. Each lamp is housed in a light-tight compartment insulated from its neighbours. The lamps are of the Mazda " sign " type, gas-filled, 100 volts, rated at 15 watts, and the effect of these displayed numerals is such that they are clearly visible, in direct sunlight, from a distance of 150 yards and at any angle up to 30 degrees.

There is thus ample notification to the assembled racegoers on the course of the state of the betting at any time.

At the back of each lamp-box is a Strowger relay control group, which selects the various sets of lamps to form the correct numerals according to the signals received from the several adding machines.

Each lamp-box and its associated mechanism is self-contained and interchangeable with any other, on the same principle as the main mechanism groups, and the removal and replacement of a box or boxes during betting does not affect the displayed totals or introduce errors into the automatic calculations in continuous progress.

The complete Indicator, shown in Fig. 1, is duplicated on the opposite side of the building, so as to be visible from both Tattersall's enclosure and the Silver Ring simultaneously.

There are 16 lamp boxes for each runner, two for the horse number and six for the totals, " win " and " place " respectively. The corresponding grand totals call for seven boxes each, or fourteen in all.

Forty boxes make up the Race Dividend display, there being two panels available for possible dead-heats in either " win " or " place " together with " Second " and " Third " horse display panels.

In all there are 1,418 of these lamp-boxes in the Newmarket Indicator, embracing a grand total of 33,798 Mazda lamps. The working voltage of the lamps is 100, and the load, on full display, *i.e.*, with a full complement of 45 runners, and evenly distributed betting, would be of the order of 1,200 amperes.

The Strowger Automatic switching equipment operates at 50 volts and the corresponding load represented by the mechanism in operation would approximate to 300-400 amperes.

The necessary current for operating the Newmarket Totalisator is derived from storage batteries mounted on motor-lorries and kept charged by petrol-engined generating sets, also mounted on lorries for transportability.

With the exception of the Ticket Issuing Machines, the location of which has already been referred to, the whole of the equipment of the A.T.M. All-Electric Totalisator at Newmarket, so far described, is accommodated on the first floor of the Indicator building, immediately behind the Indicator, in what is known as the Machinery Room, and is controlled from the floor below, which constitutes the Control Room.

The most important item of equipment in this room is the Central Control Switchboard from which the whole of the betting, including the issue of tickets at any point on the course and the horses running in each event, can be controlled. Betting can be started, stopped, or modified as necessary, from this central switchboard, and, once the control switches have been set for betting in accordance with the agreed procedure on any given race, the Control Board is locked to prevent accidental operation of the control keys, or unauthorised interference whilst the race is in progress. This facility is one of

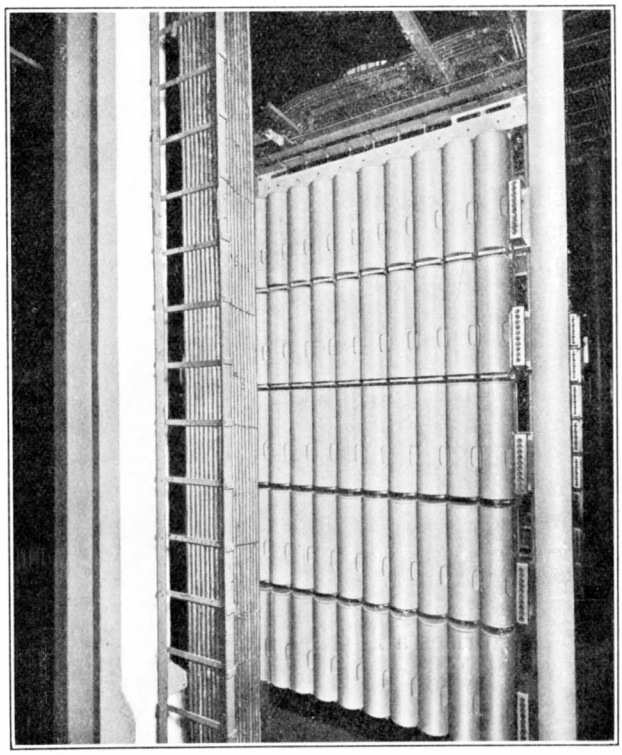


FIG. 8.—APPARATUS RACK AND CABLING. DECODING RELAY GROUPS.

several which effectually safeguard the racegoer against fraud.

The Control Board is equipped with a number of keys and corresponding signal lamps, one key representing each horse and each total adding machine, " win " and " place " respectively. Betting is started by manipulation of the corresponding keys at the control board. Thus, if both " win " and " place " betting are permitted, the total " win " and total " place " keys are operated, followed by the various horse " win " and " place " keys representing the actual runners. If there is no " place " betting these keys are left normal, and it is impossible for the ticket-issuing machines to accept " place " bets. Restoration of the horse and total keys to normal immediately stops all betting, inasmuch as the issue of tickets is controlled from the adding machines, and a horse-adding machine cannot continue in service unless the corresponding total-adding machine is also working. The signal lamp associated with each key glows as long as the key is in the operated position, and enables the controller to see at a glance what portion of the equipment is working and registering bets.

On each side of the Control Switchboard, Fig. **7**, are miniature Indicators, " win " and " place " respectively, which faithfully reproduce the indications on the main indicator and keep the Controller informed of the progress of betting.

Immediately above the Switchboard is a system of supervisory signal lamps of different colours which, by lighting, under distant control, keep the controller advised of the carrying out of miscellaneous instructions issued by him to the various points of the course.

Immediately to the right of the right-hand Miniature Indicator, Fig **7**, are the " Win " and " Place " Plugging-Down Racks, which enable the operators to display non-consecutive horse numbers in regular sequence on the Main Indicator and thus eliminate gaps which would otherwise occur in the case of non-runners.

The remaining equipment in the Control Room comprises a Dividend and Horse Number Display Rack for manual operation at the conclusion of a race; a miniature Dividend Display Indicator, a set of Supervisory and Control Panels and a Power Switchboard. All this is permanent equipment, as distinct from the transportable Strowger mechanism groups, Lamp Boxes, and Ticket Issuing Machines.

Similar permanent equipment in the Machinery Room above includes the Main Distribution Frame, Fig. **6**; three Intermediate Distribution Frames; eight Decoding Group Racks; four Collecting Switch Racks; four Horse Adding Machine Racks; one Horse Adding Supervisory Rack; one Total and Miscellaneous Rack; and a Routiner; together with all the associated permanent cable and wiring, of which there are upwards of 30 miles of all sizes and capacities. The complexity of the cabling will be noted in Figs. **2** and **6**, a large proportion being lead-covered overall.

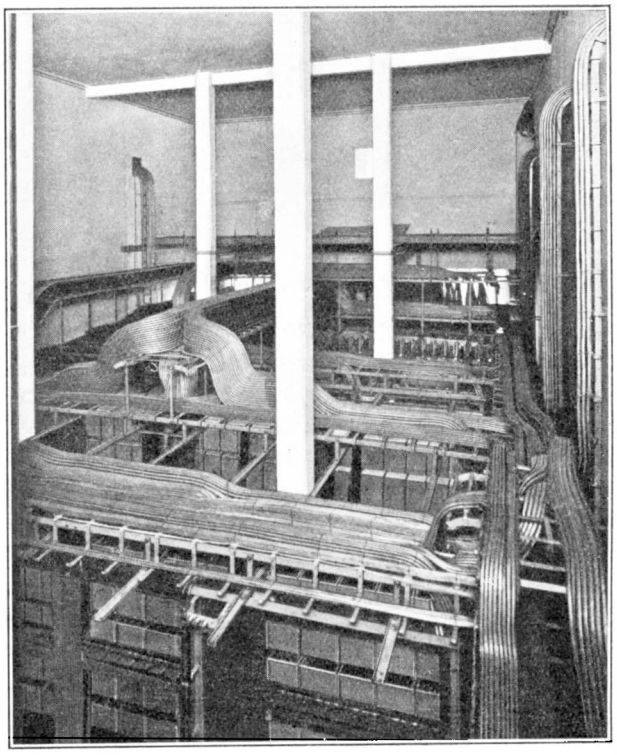


FIG. 9.—CABLING ABOVE RACKS IN MAIN INDICATOR BUILDING

Despite the proved reliability of Strowger Automatic switch mechanism such as is incorporated in the A.T.M. All-Electric Totalisator, it is highly desirable to test or prove out the correct functioning of the equipment following erection and prior to placing it in commission at any meeting.

It is the function of the Routiner, above referred to, to carry out this routine testing auto-

matically and within a minimum time. This most ingenious adaptation of Strowger mechanism to the duties of a maintenance electrician will effectually operate and test the whole of the Newmarket equipment, under actual working conditions, within the short space of 15 minutes, giving instant indication of an abnormal condition at any point.

An application of the Routiner, just prior to the commencement of betting, ensures that everything is in order and relieves the Staff of the tedious routine incidental to testing a large number of electrical circuits by hand.

The schedule of transportable equipment forming the major part of the Newmarket totalisator is as under:—

1418 Indicating Lamp-Boxes.
28 Change-Over Groups.
8 Decoding Supervisory Groups.
400 Decoding Groups.
162 Collecting Switches.
82 Horse Adding Machines.
82 Horse Adding Supervisory Groups.
1 Set of Miscellaneous Supervisory Groups.
200 Ticket Issuing Machines.

The whole of this equipment can be dismounted from its supporting shelves and racks without disturbing a single permanent electrical connection and transported for use elsewhere, or stored against future requirements.

Only the racks, cable, and wiring, and the Control Room equipment remain permanently *in situ*.

The All-Electric Totalisator equipment for Newmarket was designed, manufactured, and installed by Automatic Telephone Manufacturing Company, Ltd., Strowger Works, Liverpool, and supplied to the Racecourse Betting Control Board through the main contractors, the British Thomson Houston Co., Ltd., Rugby. The celerity with which the contract has been completed will be appreciated when it is realised that, following the placing of the order, on November 16th last year, installation of the racks and cabling on site commenced on the 8th of January, and was completed by the end of February, in readiness for the equipment, which was in process of manufacture concurrently.

This was placed in position on the racks and tested out by March 24th, being handed over to the Racecourse Betting Control Board on April 6th for the training of their staff.

A successful Demonstration was given to the Board and officials on the 14th of April, leaving all in readiness in ample time for the Craven Meeting on April 23rd, 24th, and 25th, truly a record achievement.

The advantages of the A.T.M. All-Electric Totalisator over existing mechanical types consist in the absence of inertia of the moving parts; the well-proved reliability of the Strowger automatic telephone exchange mechanisms of which it is comprised; the enhanced visibility of the luminous indicator; the flexibility and transportability of the component groups of apparatus; the compact nature of the equipment and consequent facility for its accommodation as contrasted with large groups of electric motors required for driving the mechanical type of Totalisator; a limited maintenance personnel; and minimum wiring between indicators, control equipment, and ticket issuing machines.

The A.T.M. All-Electric Totalisator can remain in operation up to the actual start of the race, thus securing the whole of the stake money, including the considerable sums deposited during the last few minutes.

The slower, hand-worked totalisators have to be closed down an appreciable time before the "off," in order to have the dividends ready as soon as possible after weighing in.

Precautions against fraud and forgery of tickets are absolute. Tickets are printed only as required by backers, the wastage caused by the use of pre-printed tickets being therefore eliminated. Immediately the "off" has been signalled the mechanism is locked, thus rendering it impossible to issue a ticket after the race has started.

The A.T.M. All-Electric Totalisator is covered by World Patents.

COMMISSION MIXTE INTERNATIONALE.

MEETING AT DOLLIS HILL RESEARCH STATION.

IN 1926 the Comité Consultatif International des Communications Téléphoniques à Grande Distance (C.C.I.) issued certain "Directives," or Guiding Principles, dealing with the protection of international telephone lines against interference by the operation of power circuits. In these Directives the C.C.I. tentatively defined the amount of power circuit interference noise that could be considered as tolerable on an international telephone line. A distinction was drawn between overhead and underground telephone circuits and the definitions are as follows:—

"Interference to telephone working occurs when a power line by electro-static influence develops between the conductors of the telephone circuit a voltage equivalent (as regards the intensity of noise in the telephone receivers) to an alternating voltage greater than 5 mV. at a frequency of 800 periods (5000 radians) per second."

"By reason of the small degree of cross-talk admissible for international telephone lines in cables, the permissible disturbing voltage on the circuits should not exceed the value equivalent (as regards the intensity of noise set up in the telephone receivers) to an alternating potential of 2 mV. at 800 periods per second."

These definitions were not accepted without question and when the Commission Mixte Internationale (C.M.I.) was set up, the subject of tolerable noise and how to measure it was one of the first questions put down for study. It should perhaps be explained that the C.M.I. is an offshoot from the C.C.I. and was set up to carry out actual investigations into problems of joint interest to the communication and power industries. It is composed of representatives from the C.C.I. (Telephones) and C.C.I.T. (Telegraphs), the International Union of Railways, the International Union of Producers and Distributors of Electric Eenergy, the International Union of Tramways, the Institutions of Electrical Engineers of different countries, the Syndical Union of Gas, France, and a number of electrical firms intimately concerned with electrical communications. Problems which are not matters of opinion but which can be settled by actual investigation are referred to a Comite D'Etude, formed from members who are definitely interested in the particular work, with a President Rapporteur in control. The individual members are expected to carry out investigations in their own countries and keep the other members informed of any progress made, and, depending upon the nature of the investigations, they are expected to invite the other members of the C.M.I. to attend the place where the tests are being made if the circumstances are favourable.

The question of tolerable power circuit noise and its measurement is being dealt with by Committee No. 6, with Mr. S. C. Bartholomew, of the British Post Office, as President Rapporteur. This Committee met at the British Post Office Research Station, Dollis Hill, London, from Monday, 17th March, 1930, to Wednesday, 19th March, 1930, to collaborate in comparative tests of different methods of noise measurement and to discuss the results and the question generally. In conformity with the rule previously mentioned, other members of the C.M.I. were invited to attend also, and those present included representatives from several Continental Telephone Administrations, international power interests, large electrical manufacturing companies, the Institution of Electrical Engineers and the Central Electricity Board.

There are two methods of noise measurement that have been used up to the present, one German (Geräuschspannungsmesser), the other American (Noise Measuring Set). The former is practically that laid down in the Directives, which, in effect, is a comparison between the noise it is desired to measure when heard on a special telephone receiver and that produced on the same receiver by a current of a single frequency of 800 per second passing through a certain network, the balance being expressed in millivolts measured across a potentiometer, which is adjusted to give what is considered a balance in volume. The American system is somewhat similar, except that a standard buzzer is used

instead of the 800 frequency generator, the test line is terminated with approximately its own impedance and the results are given in noise units which are millionths of the current output of the buzzer. Fig. 1 (figs. 2 & 3) illustrates in diagram-

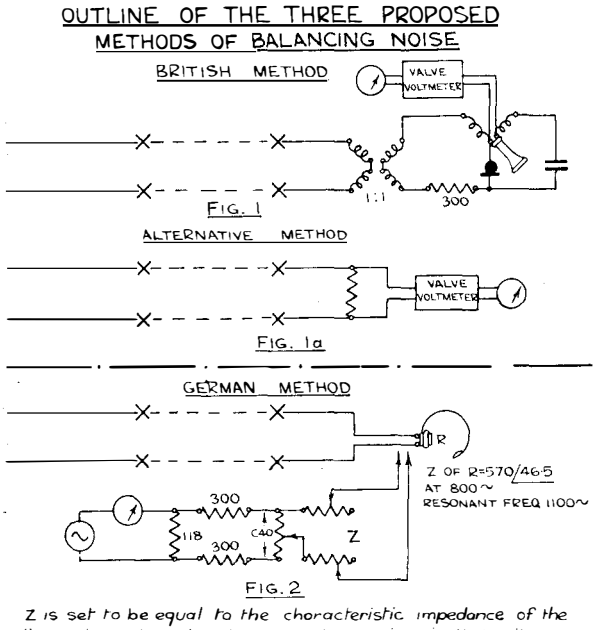


FIG. 1.

matic form these two sets of apparatus. Both these methods have certain admitted drawbacks, although good results are claimed for both types of apparatus when observers have had experience. The criticisms of the German apparatus are that the actual measurement is not easy to make and is heavily biassed by the personal opinion and aural peculiarities of the observer, and the results are based upon loudness of noise produced by the disturbance and have no direct relationship with the effect upon articulation. This last is important, as it has been shown that the articulation loss varies with frequency; for example, a given volume of 800 frequency disturbance produces much less effect upon articulation than the same volume of 1100 frequency, or telegraph type disturbance. Another criticism is that the tests are made under arbitrary conditions as regards line terminations, and the results depend largely upon the condition and characteristic of the receiver used. Unless the receiver is non-resonant, its characteristics may be such as to give misleading results if its natural frequency is the same as the power circuit interference note, or contains a similar frequency harmonic. Finally, reasonably silent conditions are required. Some of the above disadvantages hold good in the case of the American apparatus, although the conditions as regards line terminations are better and a composite note is considered preferable for comparative purposes by some observers. There is, however, an additional drawback in that the results depend very largely upon the condition of the buzzer and the cells.

In view of these difficulties, particularly the one of personal equation in judging noise, a suggestion had been put forward by the British Administration that a better way would be to measure the potential difference produced by the power interference, either at the receiver terminals or at the terminals of the international line, and correlate the voltage measured in that way with loss of articulation according to the frequency or frequencies of the interfering current. Curves illustrating the connection between loss of articulation, disturbing frequency and voltage are given in Fig. 2. To obtain these, the procedure consisted in terminating an artificial test line with a standard Post Office cord circuit and subscriber's instrument, on the receiver of which the listening was done and voltage measurements made. Numerous receivers and observers were used. The articulation tests were made under comfortable conditions by a considerable number of observers for various disturbing voltages.

In practical use the procedure, it was suggested, would be to measure the disturbing voltage on the receiver terminals or at the end of the

international line, and then on the appropriate curve to read the articulation loss or, of course, from the curves a definite figure for the allowable voltage of any kind of disturbance could be settled and worked to.

The valve voltmeter used has a lower cut-off of about 200 and an upper cut-off of about 3,500. It should be clearly understood that the relationship between millivolts disturbance and reduction in articulation is not in any way arbitrary. The relationship as given in the curves are the one and does not depend upon the aural impression of an individual. The reading can be taken quickly and an average effect based upon a large number of observers using a large number of receivers is obtained from the Laboratory results already made, once and for all. As is to be expected, opinions as to equality of volume of two sounds of different character vary widely and render any balances by ear of these sounds very unreliable unless a large number of observers are employed.

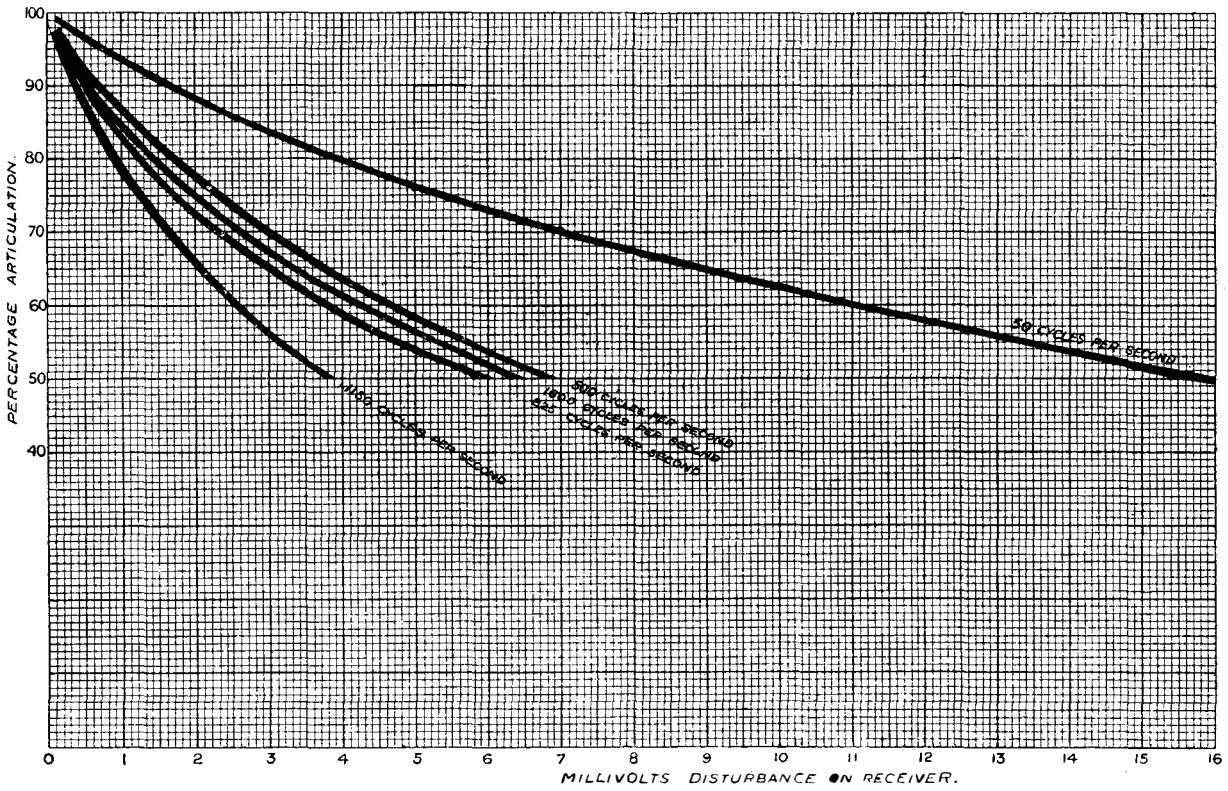


FIG. 2.—CURVES SHOWING RELATIONSHIP BETWEEN LOSS OF ARTICULATION, FREQUENCY OF DISTURBANCE AND VOLTAGE OF DISTURBANCE ON RECEIVER.

results of actual measurements and within the limits of experimental error may be accepted. These tests were made by ten observers with various line conditions, using six receivers and five transmitters. It is possible that with different languages and with the various receivers used in other countries some modification of the figures may be found to be desirable, but in no sense is the relationship arbitrary.

The great advantage of this method lies in the fact that the measurement is purely a physical

A criticism has been made that as the induction occurs on the line the measurement should be made there, but this objection does not seem to be very important as it is a simple matter to convert the potential difference measured on the receiver terminals into corresponding potential difference, either at the end of the Trunk line or at any point on the line if the conditions are known.

The first proposal was to measure the potential difference by means of a valve voltmeter and

from that deduce the loss in articulation according to the frequency of the power circuit note as shown on the curves. This would have meant a classification of the interfering note into different categories, and the evolving of some ready means of analysing approximately. This difficulty was got over, however, by devising a filter circuit to be associated with the valve voltmeter, the filter being so arranged that the readings would be weighted in accordance with the effects of the various frequencies in loss of articulation. If a reference is made to the curve it will be seen that with similar conditions the loss is greatest with a frequency of about 1100 per second, and that the loss falls off with frequencies lower and higher than that figure. H. S. Osborne, of the American Telephone and Telegraph Company, in a paper before the A.I.E.E. gave in 1919 results of investigations carried out by the A.T. and T. Co. which bear out this point, but probably owing to a different method being employed in assessing the loss, the Osborne curves do not exactly agree with those obtained at Dollis Hill. Osborne's work was concerned with ascertaining by means of a current measurement the comparative effects of different power generators in producing interference with telephones, and he designed a filter which had the effect of weighting the readings in accordance with the frequencies of the harmonics in the current and voltage waves of the power system. It will be seen, therefore, that the idea of using a measuring set having a net-work which has characteristics the inverse of the characteristic interference frequency curve is not new, except that it is applied to the telephone line instead of to electrical power machinery.

The above briefly indicates the position of affairs which the members of the C.M.I. present at Dollis Hill had to discuss and deal with. The different types of apparatus were installed and those present had an opportunity of making measurements with the German and American apparatus.

Comparative measurements were made by all members of the Commission by the three methods, four different types of disturbance being examined. The results by different observers showed wide discrepancies by both German and American procedure. It became evident during the course of the tests and discussion that there was general agreement, that an objective test as proposed was to be preferred to the subjective method of measuring by ear, and to that extent the problem was considerably simplified; the outstanding points then being (*a*) as to whether the British curves associating the voltage readings with loss of articulation could be taken as applying to all countries, and (*b*) the percentage loss of articulation that could be agreed as tolerable on an international line. As regards (*a*) it was suggested that the different languages and the different receivers might affect the shape of the curve, but the opinion was expressed that probably when the matter is tested out a curve will be found suitable for all countries, and from which a measuring instrument for universal use could be manufactured. As regards (*b*) Mr. Bartholomew pointed out that in this matter the last word must be with the Transmission Section of the C.C.I. (3rd C.R.). He contended that a mixed body of power and telephone engineers not directly concerned with telephone transmission problems was not in a position to come to a decision on such a question. It must be dealt with by experts. The committee in question (the 3rd C.R.) had tentatively suggested a maximum articulation loss of 5%, but further study was necessary before a decision could be expected, as the fixing of the figure must receive very serious consideration, taking into account the fact that it is now possible for 90% of the telephone subscribers in the world to be placed in communication with one another, and the effect on all the links in the chain must be borne in mind.

The work at Dollis Hill resulted in great progress being made by clarifying the problem, and indicated the steps necessary to arrive at an agreed solution.

A group photograph of the representatives appears on page 137. It does not show all those attending, however, as Dr. King, of the American Telephone and Telegraph Co., Mr. Grinsted, (Siemens), Mr. Dunsheath (Henleys), Mr. Marris (G.E.C.), Mr. Werren (G.E.C.), and Col. Carter were absent on this occasion. For the convenience of the visitors who stayed in London an auto-bus was used for conveyance each day between the Institution of Electrical Engineers and Dollis Hill. The new building at Dollis Hill was used for the first time

and proved in every way an admirable meeting place for such a gathering. The handsome Lecture Hall provided not only facilities for adequately carrying on the discussion, but enabled moving pictures to be shown illustrating work in connection with automatic apparatus and the jointing of underground cables. The there were no speeches and the cabaret show was decidedly good.

Complete satisfaction was expressed by the members of the Commission for the arrangements for the meetings and for their material welfare. Among letters of appreciation received, one was written to Mr. Bartholomew in English

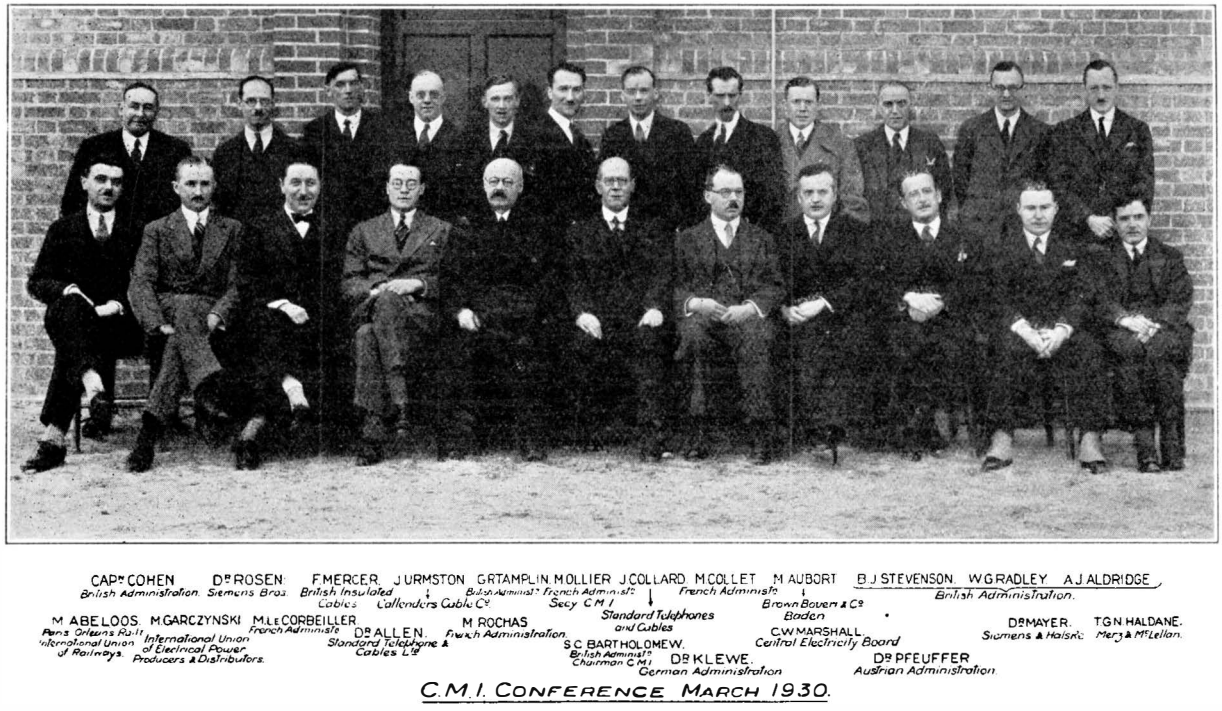
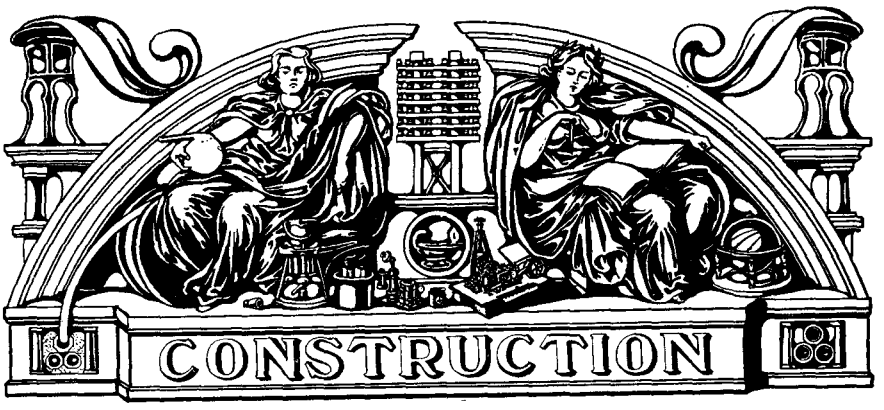


Fig. 3.

visitors were supplied each day with luncheon and tea in the building, the service being very satisfactory. On the Wednesday the Standard Telephones and Cables Co. invited the Commission to dinner at the Savoy Hotel. This was a most enjoyable affair. The dinner was very well chosen, the special orchestra was very pleasant, very feelingly, the final sentence reading "Thank you for all your kissness." The slight slip was no doubt due to the articulation loss being greater than 5%, but in order that there shall be no misunderstanding it is emphasised that no ladies were present!

S.C.B.



THE THEORY OF CORROSION.

C. E. Richards, A.I.C.

THE wastage due to metallic corrosion is nowadays assuming huge proportions. The annual loss from this cause has been estimated by Sir R. A. Hadfield to be about £500,000,000. This is an enormous amount, and it is only natural that strenuous efforts are being made at the present time to minimise the effects of this influence. Hitherto, most of the methods suggested for reducing corrosion have been somewhat empirical in nature, as investigators in this field were without a guiding principle. Early workers connected corrosion with the action of acids, notable carbonic acid, others suggested hydrogen peroxide, which is certainly formed when some metals corrode. The action of colloidal hydroxides has also been extensively studied.

Although the connection between the corrosion of metals and electrical phenomena was observed over one hundred years ago, and in fact Davy suggested an electrochemical method for the prevention of corrosion on the copper bottoms of the ships of those days, it was not until very recent years that an acceptable theory was evolved. This new electrochemical theory at first met with severe opposition, but is now almost universally accepted as giving the most reasonable explanation of the observed facts.

The following matter is an attempt to cover briefly the modern electrochemical theory of metallic corrosion in its most usual form.

Corrosive attack can conveniently be divided into two main classes—

(*a*) Corrosion which is accompanied by a visible evolution of gas and

(*b*) Corrosion unaccompanied by any visible evolution of gas.

It is with type (*b*) that we are here mainly concerned, and it has been descriptively called "differential aeration" attack, and "oxygen diffusion" corrosion, since the condition which is generally responsible is a difference in oxygen concentration at various parts of the metallic surface.

Experimental evidence points to the view that supposing it were possible to immerse an absolutely homogeneous metal, say lead, zinc or iron in a perfectly homogeneous aqueous solution, and maintain the solution homogeneous, no appreciable corrosion would occur, but since these conditions cannot be attained in practice, other methods of minimising corrosion must be sought.

The main feature to bear in mind is that any system in which there is heterogeneity in any phase is inherently liable to cause corrosion of the metal concerned, it does not matter whether this variation is in composition of the metal, concentration of the solution, temperature of the solution, etc., any difference from place to place is liable to set up corrosion. In actual practice the effect of electrolyte concentration is usually

small, but variations in oxygen concentration and heterogeneity of the metal surface have considerable effects.

Corrosive attack is always accompanied by variations in electrical potential over the metal surface, some parts becoming anodic and others cathodic whilst, in the normal manner, metal goes into solution at the anodic areas and tends to be deposited at the cathodes.

The fact that potential differences can occur at the junction of two electrolytes similar in composition and differing only in concentration has been proved by the study of cells, which are symmetrical except for the electrolyte. For instance, in a cell with an electrolytic system consisting of two halves, each of mercury in a saturated solution of mercurous chloride in 10% potassium chloride, written symbolically thus:—

$$Hg \;.\; Hg_2Cl_2 : K\,Cl_{10\%} :: K\,Cl_{10\%} : Hg_2Cl_2 : Hg,$$

The whole system being symmetrical, no P.D. can be expected between the two mercury electrodes; if, however, one half of the cell is replaced by another mercury half cell which is constructed with 1% potassium chloride,

$$Hg : Hg_2Cl_2 : K\,Cl_{10\%} :: K\,Cl_{1\%} : Hg_2Cl_2 : Hg,$$

a P.D. can be detected between the two mercury electrodes. Taking the investigation a stage further, Helmholtz studied the cell.

$$Zn : ZnCl_{2(1)} : Hg_2Cl_2 : Hg :: Hg : Hg_2Cl_2 : ZnCl_2 : ZnCl_{2(2)} : Zn,$$

and using concentration of (1) 1 part $ZnCl_2$ to 0.8 parts water and (2) 1 part $ZnCl_2$ to 9.1992 parts water he found that the system had an E.M.F. equal to 0.1154 of that of the Daniell cell used as a standard.

The above results cannot be applied directly to ordinary corrosion cases because the systems considered are theoretically reversible, whilst in corrosion cases this is not necessarily so. They serve to shew, however, that it is possible for differences in electrolyte concentration to cause varying potentials at the metal surface and thus commence corrosive attack.

Considering now the effect of a metal surface of varying composition it is easy to see that even in a homogeneous electrolyte, if there are portions of the metal plate which have different contact potentials to the liquid, local cells will be formed, *e.g.*, in the case of a flake of graphitic carbon embedded in the surface of a piece of iron, the graphite will form the positive pole of the cell, *i.e.*, current will flow from the iron through the solution to the graphite, and as usual, metal will go into solution; the current, taking the shortest path through the solution will leave the metal close to the graphite so there will be formed a corroded ring around it which may start a pit.

In the case where the impurity is in the form of a more electro positive element than the body of the metal, current will flow from the impurity through the solution to the main body, the impurity will be corroded away leaving a hole, again starting a pit.

Each method of corrosion so far described would, however, in practical cases speedily cease were it not for the presence of dissolved oxygen in the corroding medium. We do not, for example, generally deal with concentration cells of the type :

$$Zn : ZnCl_2 : \ldots\ldots\ldots : ZnCl_2 : Zn$$
$$\text{or } Hg : Hg_2Cl_2 : \ldots\ldots\ldots : Hg_2Cl_2 : Hg$$

where the electrodes are in contact with solutions containing abundance of their ions, so that when current flows from the liquid to the electrode, metal is deposited without seriously affecting the concentration of metallic ions in the liquid, but with systems which approximate to

$$Zn : NaCl_{(1)} :: NaCl_{(2)} : Zn$$

where the concentration of metallic ions in the liquid is almost nil. In this connection it is important to remember that when sodium chloride (which may be regarded as typical of any salt) is dissolved in water it does not remain in solution as molecular sodium chloride, but tends to split up into ions of sodium and ions of chlorine each of which carries a definite electric charge, the change being represented thus:—

$$NaCl \underset{aq}{\rightleftharpoons} Na^+ + Cl^-$$

Further, the water itself splits up into ions

$$H_2O \rightleftharpoons H^+ + OH^-,$$

so that in a simple solution of sodium chloride in water there are effectively six constituents in equilibrium with one another.

Reverting now to the case of the simple concentration cell

$$Zn : NaCl_{(1)} :: NaCl_{(2)} : Zn$$

When current is taken from this cell, one zinc pole being anodic tends to go into solution, but at the cathode there is a tendency to deposit metal. The only cations present in quantity in the solution are sodium and hydrogen, but sodium is a very active metal and if deposited on the cathode it would immediately react with the surrounding water giving hydrogen, which would replace it at the surface of the cathode; alternatively hydrogen ions might be discharged at the cathode, the final results being the same in either case. This discharge of hydrogen ions continues until the electrical charges liberated by them have raised the potential of the cathode to such an extent that no more can be discharged, *i.e.*, the potential difference between anode and cathode is equal and opposite to that of the electrolytes surrounding them, so that no current can flow in the circuit. The system is then "hydrogen polarised" like any polarised primary cell. No further current can flow and therefore no more corrosion can occur until the system is depolarised. This is done by the dissolved oxygen in the water and can of course only take place slowly. The rate of solution—or corrosion—of the anode is mainly dependent upon the rate of depolarisation of the cathode. A similar mechanism of reaction applies to the other case mentioned of "local cells" on the surface of a metal plate.

This brings us to a consideration of the role of oxygen in corrosion generally. In all ordinary cases it behaves as a depolarising agent. It is not necessary to assume any variation in composition of either electrolyte or metal at the commencement of the reaction, although these factors undoubtedly assist in establishing a rapidly corroding system. When a metal such as zinc, iron, lead, etc., is immersed in a homogeneous aqueous solution, it possesses a certain tendency (known as the solution pressure) to pass into solution, *i.e.*, to enter the ionic state. (The exact mechanism of the reactions at the surface of a metal plate immersed in a solution are at the moment a matter for speculation, but the following elementary theory gives a broad outline of the subject). It therefore throws off metallic ions into the layer of liquid next to the metal. These ions carrying positive charges leave the parent metal in a cathodic state and between the positively charged liquid and the negatively charged metal a strong electrostatic field exists, and we have an equilibrium achieved in which all the ions present in solution and also the cathodic metal are concerned. In the absence of dissolved oxygen or other depolarising agents the action then ceases, when an entirely negligible amount of metal has entered solution. Normally, however, the dissolved oxygen is free to combine with the cations near the cathode, giving water and metallic hydroxides. The effect of this is twofold; firstly, it reduces the P.D. between metal and liquid, thus allowing more metal to enter solution and, secondly, it depletes the solution of its available oxygen.

This supply can only be replenished by diffusion from (*a*) other parts of the liquid and (*b*) the surface of the liquid exposed to the air. The solubility of oxygen in water being small, the supply (*a*) is soon exhausted and further quantities must be obtained from the surface. This results in a variation of oxygen concentration throughout the liquid and therefore over the surface of the immersed metal. At the places where the oxygen concentration is greatest, *i.e.*, near the surface, the polarising hydrogen is removed most rapidly, and since hydrogen carries a positive charge these areas become cathodic, and the areas of least oxygen concentration anodic, so that a way is opened for the current to flow and, as usual at the anodic areas, metal goes into solution. This action can continue as long as there is a supply of oxygen from the surface.

The above example of a perfectly homogeneous metal in a uniform electrolyte is of course theoretical, but the action of oxygen is the same whether corrosion is started by lack of uniformity in the metal or the solution, and the main point which concerns us is that the metal goes into solution at the parts of the system to which oxygen has the least access. This is very important when the pitting of metal surfaces is under consideration. The original cause of a pit may be one of several, a scratch, an enclosed foreign body, such as a slag enclosure, segregation of some constituent of an alloy, etc. Once the pit is started, the bottom of the cavity being shielded from access of oxygen tends to become anodic whilst the mouth of the pit is cathodic. Metal goes into solution in the pit whilst at the

cathodic area alkaline hydroxide is formed. These two materials diffuse into one another and the usual result is the formation of a gelatinous mass of metallic hydroxide which clogs the mouth of the pit and still further restricts the supply of oxygen to the liquid within. Hence pitting, which is one of the most dangerous of all forms of corrosion, once started tends to become more and more vicious as time proceeds.

The above matter is not the whole story of corrosion; far from it. From the theory as described it could justly be argued that all metals should corrode. Yet we have around us to-day many examples of metallic objects which do not appear even to tarnish after years of service. Stainless steel is a familiar example. In all ordinary circumstances this alloy is uncorroded; it can remain for prolonged periods in contact with liquids of varying concentrations and oxygen content and remain bright. The explanation of this remarkable behaviour is that the metal does in fact corrode, but when it corrodes—or tarnishes—instead of giving a loose porous corrosion product such as generally forms, it gives a compact film which adheres tightly to the metal and effectually prevents the further access of corrosive materials to the surface. The surface is in what is known as a passive condition. Certain chemical combinations have distinct powers of destroying these films and in contact with solutions of this type even stainless steel has a tendency to corrode, *e.g.*, freshly cut surfaces are quite liable to be attacked by salt water (Evans: " The Corrosion of Metals ").

A case which is perhaps of more interest to telephone and telegraph engineers is that of lead and some of its alloys. Lead is a metal which is quite readily corroded, and in the laboratory rapid attack can be made by such reagents as distilled water, lime water and ammonium nitrate. The attack by distilled water on a freshly cut lead surface is so rapid that clouds of lead hydroxide can be seen to form in a matter of seconds. Yet lead and its alloys are almost universally used for such purposes as water pipes and cable sheaths, generally with entire satisfaction. Fortunately for chemical and electrical engineers certain compounds which form protective coatings on lead are very widely distributed. Very few natural waters are found which do not contain these " inhibitors," and even where they do not occur naturally in sufficient quantities it is an easy matter to add the necessary amounts. Calcium bicarbonate is present in the majority of waters and is one of these film-forming chemicals. Sulphates also occur frequently and also help to protect lead. It has recently been observed that silicates are very effective in preventing lead corrosion and in several cases the addition of silicate to a corrosive water has converted it to a harmless one.

In conclusion, it may be said that although corrosion may at first sight appear to be an entirely haphazard occurrence which cannot be foreseen, this is really not so. Corrosive attack follows certain well defined lines, and as more and more work is done on the subject so do the unknown factors concerned become fewer in number, and the chances of avoiding damage from this cause increase.

CABLE INSTRUCTIONAL COURSES HELD AT DOLLIS HILL.

W. T. Palmer, B.Sc.(Eng.), Wh. Ex., A.M.I.E.E., and G. W. Hodge, A.M.I.E.E.

For the first three months of this year a cable instructional course was held in the Research Section of the Engineer-in-Chief's Office, at which 46 officers of the Department attended. The syllabus for this particular course followed closely the general lines given in 1927-28, details of which are described in the Journal for April, 1928, and was divided as follows:—

1. Mathematical Introduction and Elementary A.C. Theory—daily lectures for two weeks.
2. Cable Balancing and Acceptance Tests—Lectures and Practical Work for five weeks.
3. Fault Localisation and Precision Testing—Lectures and Practical Work for five weeks.

in the second part, instruction was given regarding the application of systematic jointing schemes and the use of the 15-Position Testing Switch; and in the third part the application of alternating current for reliable fault localisation results was discussed. Also during the course, by the courtesy of the Standard Telephones and Cables Ltd., a visit was paid by the students to the North Woolwich Works of that firm and supplementary information in connection with modern telephone cables was obtained.

As in previous cases, the 46 members of the cable class were drawn from the ranks of the Department's Inspectors, Repeater Officers and Skilled Workmen, and one or more officers attended from almost all the Engineering Districts. The happy associations which are formed

CABLE INSTRUCTION CLASS AT DOLLIS HILL, 1930.

Some alterations and additions were made to bring the above course into line with the latest practice. In the first part, the Network Theorem was shown to be of more than academic interest; during such a three months course undoubtedly lead to a corporate spirit between all concerned, the psychological effect of which upon the co-operation between Districts and between Districts

and Headquarters is of immense value. The photograph reproduced on page 142 and the farewell dinner held at the Research Station upon the conclusion of the course give evidence of this spirit. A copy of the menu reproduced on this page shows that at least some of the lectures bore " fruit."

During the last ten years, more than 250 officers selected from all the Engineering Districts have attended Cable Classes held in the Research Section, *i.e.*, an average annual class of at least 25 officers has been required. In addition to such three monthly courses there have been many abridged courses for officers from Colonial Administrations, each lasting from one to three weeks. When it is remembered that since 1920 the capital value of the underground cable system has been increased by about £15,000,000 and is being added to at the rate of nearly £2,000,000 per annum, the need for the adequate training of a staff capable of maintaining such a system in an efficient manner is apparent. All the cable classes to date, however, have been held at irregular intervals, but from the foregoing figures it appears that the adequate maintenance of the cable system necessitates the training of suitable officers at regular intervals.

It is suggested that if this particular branch of training were carried out along the lines of the previous courses in suitable buildings (for which there is ample space in the grounds at Dollis Hill) in which training could be given in other branches of the Department's work, such as that of Automatic Telephony, Telephone Repeaters, Telegraph and Telephone Transmission, etc., the result would prove a sound investment. The station might also be provided with a Hostel for the accommodation of the young officers undergoing training, and might well then rank as an Engineering Training College on a par with the Naval Engineering Colleges and Military Training Colleges already in existence. Admission to the college could be made an incentive to the younger students of the P.O. Engineering Department at present attending Polytechnic Evening Classes.

A copy of the dinner menu is given below.

P.O. ENGINEERING RESEARCH STATION,
DOLLIS HILL.

1930 CABLE CLASS
DINNER,
HELD ON
THURSDAY, APRIL 3RD.

To celebrate the triumphant emergence from a terrifying ordeal.

MENU.

SOUP.

Crême de Moivre.

JOINT.

Roast Beef. Tan Sauce.
Potatoes (B. + B.).
Greens sans grit.

SWEETS.

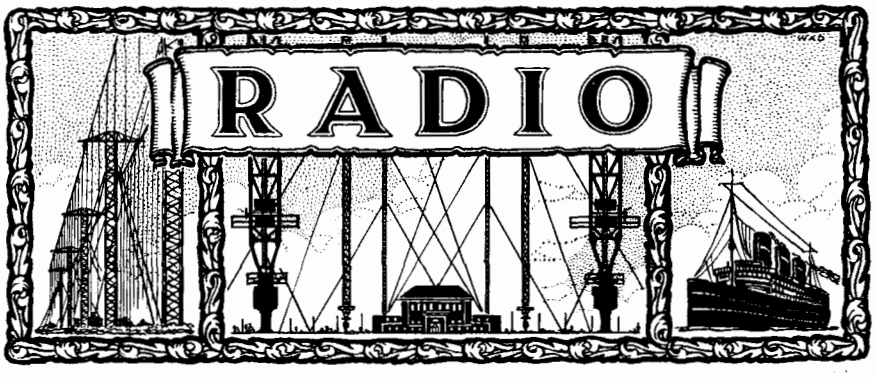
Determinant Puddings
(few).
Split Pears
(no cores).
Raspberries
(plenty).
Cross-whipped Cream.
Cheese and Celery. Café au — j.
Palmerian Oranges.

Joints supplied by Plumbers, of Dollis Hill, and guaranteed to be carefully selected and of best grade.

Catering by D.H. Refreshment Club to B.E.S.A. Specification for Density and Elasticity.

Hydrometers supplied free, but all disputes to be referred to the laboratory.

First Aid at Hut A. *Ambulances 10.15 p.m.*



CONSOLIDATED FUND (No. 3) BILL.

OVERSEA WIRELESS TELEPHONY.

26TH MARCH, 1930.

[*The Postmaster-General's reply to the discussion on the above. Extracted from Parliamentary Debates, House of Commons.*]

THE POSTMASTER-GENERAL *(Mr. Lees-Smith)*: I think it will be for the convenience of the House if I speak now, because the only explanation of the reasons for the Government action has been in answer to a few questions, and I think that probably this matter can be better debated if the full circumstances which the Government had to take into account are stated early in the Debate. I certainly have no complaint to make of the manner in which this subject has been introduced, and I hope to be able to show to the House that the decision of the Government has not been taken on account of any political doctrine, but has been reached on a consideration of national interests. If I can show that, I hope that this subject may become one of general acceptance, and that the Post Office can proceed with its work in the matter.

The late Government leased the beam stations for wireless telegraphy to the Communications Company under certain conditions and circumstances, but they reserved the future of wireless telephony, and I think I shall be able to show that the late Government and the Imperial Conference deliberately refused to give any undertaking that it would use the beam stations for future telephonic development.

That was the position which I found when I came into office, and, after I had been in office only a few weeks—I think it was in August—I received a letter from the Communications Company, from the chairman, followed up, I think, by other communications from Mr. Kellaway and Sir John Pender, suggesting that now the Government should discuss the question of using the beam stations, on payment of a rent, for the development of telephonic services to Canada, Australia, India and South Africa in the first instance, of course to be followed later by general development to the world as a whole. I think it may put the House in possession of the facts in the best way if I tell them what were the considerations which were before my mind at that time, as a layman, without any of the material which has since been accumulated, by which I had to try at any rate to come to some preliminary conclusions on the subject.

There were two alternatives. The first was to use the beam stations. They have the equipment, they have the receivers, they have the transmitters, they have the aerials, and therefore it seems obvious that by combining telegraphy and telephony in, so to speak, one set of apparatus, the most economical results can be achieved.

The other side was this—and it was not reached lightly or carelessly. I visited the great wireless station at Rugby—and I shall be very pleased if any Members of this House will themselves make such a visit—and there I found that there was a great wireless telephone service already in existence, the greatest commercial oversea telephone service in the world, which the Post Office engineers had added to the telegraphic service which was originally initiated there.

The question arises as to whether the advantage of combination in one instrument on the one side would not be outweighed by the advantage of concentration on one site at Rugby with its receiving station at Baldock. What do you find there? There, you have the aerial system pointing to the United States; walk a few yards, and there is the ground plotted out on which there will be an aerial system pointing to Canada; walk a few yards in the other direction, and you have your system pointing to South Africa, a few more yards to India, and a few more yards to Australia. You find already plotted out the whole system by which, in the course of a walk, you can cut across all the lines of conversation from Rugby to every part of the world.

The question, therefore, before us was whether, with the reductions in overhead charges and so on, what might be called rationalisation at Rugby did not give greater advantages than combination in a single instrument at the beam station. In deciding this issue, one had to decide which was the more efficient of the two alternatives offered to the Government, and which was the more economical. On the question of efficiency, an issue arose. The stations of the Marconi Communications Company have developed a system of aerials with very high masts running to about 280 feet in height. The Rugby engineers so far from duplicating the beam stations, have repudiated what is the main feature of the beam station. The Rugby engineers have, on the contrary, preferred the comparatively low masts, and have developed their telephonic aerials on masts of between 120 and 150 feet.

We were met with this claim. The Marchese Marconi and the representatives of the Communications Company argued that there was such an overwhelming superiority in the system of aerials with high masts that no other system would stand by its side. On the other hand, the Post Office engineers advised us that they had deliberately rejected the high mast system on the grounds of expense, and that the high mast aerial system costs roughly about £34,000, but the low mast aerial array costs about £3,500. Although there was a certain loss of power with the low aerial, they had made up for it by developing a very powerful transmitter, so that, taking transmitter and aerial together, the Rugby system gave as much power and, I think, more power than the Marconi aerial array. These were highly technical considerations, and the Government did what I think was the natural and proper thing to do.

We are asked to have yet another inquiry, but I say that no Government has ever inquired into a subject like this more carefully than we have done. There was, first, the Post Office inquiry by their own engineers, and the matter was referred at my request to a Cabinet Committee. The Government are greatly indebted to Lord Thomson, to my hon. Friend the Financial Secretary to the Treasury, and to my hon. Friend the Secretary to the Overseas Trade Department, who, with me, sat on that Cabinet Committee.

The matter, then, was referred to the Cabinet Committee, who decided to refer the matter to two experts, whose authority on this subject has not been challenged since their names were known, and has not been challenged and will not be challenged in this House to-day. We referred this matter separately to the two experts. We told each of them that we were referring it to the other, and, when they had given their independent reports, it was found that they were in such complete agreement, that they finally sent in a joint report to the Cabinet Committee. That gives their views even more weight than they otherwise would have had. The House has the report of the experts in their possession, but, in order to explain exactly the meaning of the questions put, perhaps I may tell the House what was the nature of the evidence and counter-evidence which was put before them. The Post Office engineers, first of all, argued that their system was cheaper; they then argued that, because their system was cheaper—because the aerial low mast system was about £30,000 cheaper than the other — it

possessed a greater degree of adaptability to new inventions than the Marconi system. As they pointed out, wireless telephony changes every month, and you must be ready to take advantage of new adaptations. If you have a cheap aerial system, you can scrap it as new developments occur. If you have an expensive aerial system, you have liabilities which tie you to the old methods.

They further pointed this out—and this is a point of very great importance in connection with the question of hours and guaranteed service for the different Dominions. The Post Office engineers argued that, if you are to guarantee hours of service, and if you are to get a reliable service all over the world, you must have more than one wave-length, because, owing to climatic and electrical disturbances, a wave-length which fades at one period of the day can have its place taken by another. Therefore, they argued, three wave-lengths are necessary for a reliable service. A new wave-length means a new aerial; with a cheap aerial you get a cheap wave-length, and for that reason the Post Office system would give three wave-lengths to each of the Dominions, whereas the Marconi system, with its expensive aerials and expensive wave-lengths, will give only two to most of the Dominions, and to Australia will give only one. These are the questions which were put to the experts. I will read three or four sentences which are most important from their Report:

> "A brief answer to the first question is, therefore, that apart from future development both systems are probably equally capable of providing satisfactory telephonic communication between two points for a given number of hours per day . . . . As regards future developments we think that the adoption of the more elastic aerial system, namely, that with the lower masts"

—

that is the Rugby system—

> "would be advantageous since equally satisfactory results could be attained with a smaller expenditure of money."

They also say:

> "There appears to be no reason for supposing that an effective aerial array would need masts over 180 feet in height, and there is no doubt that the cost of masts increases very rapidly when they are over 200 feet in height. The Marconi Company were pioneers in beam development and the Marconi beam stations already erected are handicapped somewhat by this fact. The Post Office system of aerial arrays being carried on lower masts could, therefore, probably be made more effective than the Marconi array at a lower capital cost."

Then, with regard to the question of the number of wave-lengths, they say:

> "A difficulty frequently arises from the varying attenuation of different wave-lengths, and to meet this it is often found desirable to change the wave-length in use according to the time of day. Provision for such choice of wave-lengths is likely to be more cheaply made with a relatively low mast system."

On that Report, the Government felt justified, and were justified, in concluding that there was no such overwhelming superiority on the part of the Marconi system as had been claimed, that, to use very moderate language, the Rugby system was at least as efficient, and that, therefore, we were entitled to proceed to base our conclusions upon other financial and general considerations.

I come to the question of economy. We come to the question of which has been the more economical system. It will perhaps be best if I give the House the pros and cons of that inquiry, in the same way that I did with regard to the inquiry into efficiency. The advanages of the Marconi system, and the economy arising from combination in one instrument I have already referred to and explained. On the other hand, the Rugby system gives great economies. There is economy in the overhead charges and in combining the new services with the service to America and others that may be created; there are economies where all the services are concentrated in one spot, due to our being able to economise in transmitters and to use one transmitter for more than one service. Transmitters are very expensive parts of the equipment.

Finally, the most striking economy comes from the system of land lines. In order to operate the wireless system there must be a system of land lines from a central trunk exchange in London to the wireless stations, in order that the

messages can be taken from London to the wireless stations and there switched into the air. Those land lines are very expensive. By concentrating all your services on one site you save a great many land lines, and, in addition, Rugby and Baldock are a great deal nearer to London than Grimsby, Skegness, Bodmin or Bridgwater, where the beam stations are situated. The beam stations require 4,192 miles of land line circuit, and Rugby and Baldock require 780.

Those are the broad advantages of the two systems. In order to test them by results, it was necessary, first of all, to make an estimate of what the Rugby system would cost, and then ask the Communications Company what rent they would charge, and compare the one with the other. The Rugby system costs, all told, both for the stations and for the land lines, £43,000 a year. The company made an offer containing three alternative proposals. The Post Office—for a reason which I will not enter into—thought the second was, on the whole, the best from their point of view. The second proposal by the company was that they would take a minimum rental of £40,000, plus 10 per cent. of the gross receipts in excess of a certain figure, but in addition to the rental which we were to pay to the Communications Company we had to provide our own land lines, and the annual cost of those would be £20,800. That would make a total of £61,000. If we compare that with the £43,000 which the Post Office system would need, there is a saving of £17,000 or £18,000. But there are greater savings than that, because if the gross receipts amounted to more than a certain figure the company asked for 10 per cent. of them. If the system belongs to Rugby, that comes back to ourselves.

I have said the cost would be £43,000 a year, but I have made no calculation as to savings on overhead charges. If we take into account that we share our site, our plant, much of our service and our labour, with the American service, the £43,000 is reduced to £39,000, giving another £4,000 advantage; and we must further take into account the fact that when we have developed the Canadian, Australian, and Argentine services, then, owing to the economy in transmitters to which I have referred, the saving will be increased by several more thousand pounds, and the average cost of each service will be about £36,000. Adding all these things together, the financial advantage of the Rugby system is somewhere between £20,000 and £30,000.

It was because our inquiries into the relative efficiency of the two systems and their comparative costs showed these results—those were the main considerations: there are others to which I am coming—that we came to the preliminary conclusion that we should be justified in declining the offer of the Communications Company and developing our system by concentration at Rugby and with the receiving station at Baldock. The right hon. Gentleman introduced a number of other considerations which I shall deal with, but I ask any hon. Member who has followed these calculations what other conclusion we could have reached it? If I had been standing at this Box and had asked the House to take into their hands the report of the experts, with its verdict as to the relative efficiency of the two systems; had told them, further, that the Rugby system would save between £20,000 and £30,000 of the taxpayers' money, and then had told them that it was the conclusion of the Government that they ought to allow these services to be leased by the Communications Company, I think I should have been open to the charge that I was sacrificing the national interest to the financial needs of a great commercial corporation.

I will come to the main arguments outside the sphere of economy and efficiency, to which the right hon. Gentleman appeared to pay very little attention. Most of his speech was concerned with other matters. He claimed that there is some sort of moral obligation on the part of the Post Office to use the beam stations, or to give them a trial. I refer to it because he quoted two passages from the Report of the Imperial Wireless and Cable Conference. He quoted Recommendation VIII. That recommendation gives a right, but it imposes no obligation on the Government, to use the beam stations. That recommendation, I may explain, was put in on the recommendation of the Post Office, in order that if we did wish to use the beam stations we should be saved from the danger of having to pay some monopolistic charge. As to the other quotation he gave, a general quotation, he will see if he reads it again that it refers merely to the telegraphic services which were to be handed

over, and has no reference to the telephonic services, which are now under debate. Beyond that I will say that if he will look at the Report of the Imperial Wireless and Cable Conference he will see that this matter was brought before them. It was reported to them that the Communications Company were asking for a guarantee that the beam stations should be used, and they said they were disappointed that the guarantee was being refused, but that they understood the position. That is actually in the Report of the Conference itself. I am very sorry that the late Postmaster-General is not here, owing to illness, because I am satisfied that if he were present he would not contradict what I say.

May I now come to another argument of the right hon. Gentleman? A good many of the facts with which he has been supplied are not correct. He said we refused to provide a service to Canada. The position of the Post Office in that matter has been perfectly frank. We have told the Canadian Government that we think that if they want a good commercial service—if that is all they are thinking of—they will get the best commercial service *via* New York. It has four alternative wave-lengths, and it gives communication to all parts. We have pointed out that if they have a direct service they will lose these four alternative wave-lengths, and will not be able to get to the west of Canada without going through American territory. But we have said that if, in spite of that, they would like a direct service, on account of Imperial reasons, or national reasons, that we are willing to provide that direct service. In the last few days we have received a reply which indicates they will ask for that direct service, and it will be provided by the Post Office, as it would be provided by the Marconi Company.

With regard to the Argentine, we are willing to open a service to the Argentine. We are accused of working through Berlin and Paris. The right hon. Gentleman does not understand that we are awaiting the authority of this House; when we have got the authority of this House, we will open a service to the Argentine within a few weeks. With regard to Egypt, the position there is that there are three companies wishing to obtain concessions in Egypt, and the Egyptian Marconi Company is one of them. We had a letter a few weeks ago saying they were hoping to come to terms, that they were making satisfactory progress with their negotiations with the Egyptian Government. Their managing director called upon us last week and we told him that, subject to the approval of the Egyptian Government, the Post Office would be very happy to open a service with them.

Now I come to the argument used by the right hon. Gentleman the Member for Sevenoaks with regard to America and the United States. I may say, in answer to the specific question which was put to me, that the suggestion that American engineers are employed at Baldock and Rugby is entirely incorrect, because there is not a single one of them employed at either of those stations.

Sir H. Young: My question was with regard to American engineers in the service of the Standard Cable and Telegraphs Company. I am sorry to interrupt the hon. Gentleman, but he has not got the question quite right.

Mr. Lees-Smith: I will now come to the question of American machinery, and ask what the House wishes the Government to do. This is the position. Every Government Department gives a preference to British goods, and the Post Office gives that preference as much as anybody else. British goods are deemed to mean goods produced in this country by British labour. In the contracts for the apparatus which the Post Office requires there are only two companies tendering, namely, the Marconi Company and the Standard Company, to which the right hon. Gentleman the Member for Sevenoaks has referred. The Standard Company is a company financed with American capital. Its works are at New Southgate, Hendon and Woolwich, and it employs several thousand British workmen. The practice of every Government Department and every Government has been not to exclude from their tenders any private company which has a factory in this country and which employs British workers. Is it the policy of the Opposition to exclude from our tenders all those companies which are financed by American capital? Must no orders be given to the Home Counties Electrical Trust?

I would point out that the Standard Company is one of our largest tenderers, and it does £1,000,000 worth of work for us every year in competition with companies like the General Electric Company, and Siemens and Ericsson.

What is the position? Why should not the Post Office follow the same practice as other Departments, and why, when the Standard Company get orders which might have gone to the General Electric Company, or Siemens, do they pass without comment, and when the Standard Company get an order for £20,000 which might have gone to the Marconi Company is made the subject of comment and questions in this House? The Noble Lord the Member for Aldershot (Viscount Wolmer) will remember that he put some questions to me about the Marconi Company. We have not given many orders recently, but there have been three orders during the last two years, and two were given to the Standard Company, and that seems to be what the main complaint is about.

VICOUNT WOLMER: That was before the Imperial and International Communications Company offered to provide the same service to the British Government.

MR. LEES-SMITH: Not at all. Those orders were given under circumstances in which the Marconi Company and the Standard Company both tendered together. At the time when the Noble Lord was at the Post Office either he or his superior officers deliberately, and rightly in my opinion, preferred to give the orders to the Standard Company, because their prices were lower and their quality was higher.

VISCOUNT WOLMER: The hon. Gentleman has not contradicted my statement. I say that those orders were placed by the right hon. Gentleman the Member for South Croydon (Sir W. Mitchell-Thomson) before the Imperial and International Communications Company were in a position to offer the services which they are now offering to the Government, and that cannot be denied.

MR. LEES-SMITH: Those orders were placed at a time when the Marconi Company were in a position to offer those services, and, in fact, did offer them. Since I have been at the Post Office, I have only had one small order to give, and I gave that to the Marconi Company. In order to make the matter clear, I would like to say that I am prepared, in fact I have made arrangements by which, in the future, before these orders are given, the specification for them shall be discussed with the Marconi Company, and any other company that tenders, in order that the difficulties of the past may not occur again in the future. That being so, I hope that we shall cease to have this pressure put upon us, because it is not in the interests of economy or efficiency, and the only result is that articles appear in the newspapers.

What would be the result if the Government gave way to a Press agitation? There are only two tenderers for this particular class of work, and if, as a result of agitation, we cut out the Standard Company, we should give a monopoly to the Marconi Company, and the oversea services would have no alternative source of supply. The right hon. Gentleman the Member for Sevenoaks has told us that the Communications Company has undertaken special obligations. An advisory committee has been dealing with this question, and has drawn up certain specifications, and it is said that for these reasons, among others, we ought to hand over this service to the beam stations. I would like to point out that the Communications Company accepted those obligations at the time in return for most valuable financial rights, which indeed turned out to be so valuable that when it was known that they were to have these obligations there was a boom in their shares on the Stock Exchange. Now that the contract has been made, I entirely repudiate that it is my duty to hand over other financial rights which formed no part of the original arrangement and which can only be handed over at the expense of the nation as a whole.

The right hon. Gentleman the Member for Sevenoaks made a good many remarks about the Post Office, and he re-echoed what has happened in the Press during the last nine months. Ever since I have been Postmaster-General there has been a steady stream of attacks and criticisms of the Post Office, in which the Marconi Company has taken a very considerable share. Now this great issue has been brought before the House and we find that the same interests and the same newspapers that have been attacking the Post Office for the last nine months are urging that the Post Office should hand over these great national services to this company, and they are leading the way in this attack. Let the House remember the task which the Post Office has to perform. The Post Office is a great State Department, and I repudiate the notion that it should be placed on an equality with the

Communications Company, because that is a most improper and unconstitutional doctrine.

SIR H. YOUNG: I did not put the Company on an equality with the Post Office, but I pointed out matters of similarity.

MR. LEES-SMITH: The right hon. Gentleman dealt with it as a public utility company, but there are many kinds of companies. The Communications Company is not like the British Broadcasting Corporation or the Port of London Authority which make no profit at all. It is not that sort of public utility; it is a company in which profits play a very important part, and its shares are dealt with on the Stock Exchange. The Post Office is a great State Department which is represented in this House, and, as the faithful representative of this House, it has to enter into negotiation with great and powerful financial interests, and consequently it is bound to create hostilities and antagonism if it faithfully discharges its duty. I do not ask for any favours, but I think the hands of the Post Office are weakened in defence of the public interest if when it creates those hostilities its action is to be received with hostile criticism in the Press. The Post Office cannot defend the public interest unless it gets some sympathy and understanding, if not from the Press at any rate as a last resort in this House.

During the last three or four days there was put into my private door a letter written by Sir Ambrose Fleming, long associated with the Marconi Company, and that letter which was supported by a leading article in the *Times* contained abuse of Post Office engineers, and stated that the Post Office engineers suffered from ineptitude, sterility, and stagnation. Stagnation indeed, when the very reason that we are holding this Debate is that the Post Office engineers have developed at Rugby the greatest commercial telephone service in the world, a service which carries 100 messages per day, a service which carries more commercial messages than all the other oversea telephone services put together, a service which makes thousands of pounds a year profit, and which, by linking America to Europe, enables the subscribers to get into communication with 90 per cent. of the telephone users in the world. Stagnation indeed! The Post Office engineers have built at Rugby a service which independent experts pronounce to be the equal to-day of their competitors, and likely in the future to drive their rivals off the field. I should like to take this opportunity—it is not very often that I get the opportunity—of expressing my thanks to and my appreciation of the staff of the Post Office for the inventiveness and initiative that they have shown; and I ask the House, by authorising this new development this afternoon, to show their appreciation by now giving them the power to go forward with the ordered and full development of this great new national service which their patriotism and their enterprise has provided for the State.

MR. PYBUS: I intervene in this Debate with considerable diffidence, because if it is based on the subject on which it was ostensibly to be based, the question is far too technical to discuss in this House. If there is no other consideration than the technical question, I cannot understand the wisdom of raising the matter here. I have spent most of my life as an electrical engineer, and I am bound to confess that the subject in its higher reaches is certainly too profound for me. I admired the courage and determination of the right hon. Gentleman the Member for Sparkbrook (Mr. Amery) in putting over so much technical information with so much emphasis. Hon. Members will be well-advised to keep off the technical side of this subject until they are quite sure that it is on a technical question that this Motion has been put forward. Hon. Members should not worry themselves about high aerials or low aerials. I cannot understand why, when one department takes a departmental decision to place a contract in a certain direction, it is the subject of half a day's debate in this House, while when nearly every other Department makes a decision as to where a contract shall be placed such decision is accepted by the contractors and nothing more is heard of it.

What is the real issue? The right hon. Gentleman the Member for Sevenoaks (Sir H. Young) in his speech maintained a very high note. I felt a little nervous about following him as he laid down the dangers for the Empire in the course which the Postmaster-General proposed to take. I consider that the Postmaster-General very kindly and equally courteously demolished those arguments, and reassured the right hon. Member for Sevenoaks that now we

can treat this matter as a matter of business. What has really happened? Somebody wanted to sell something to the Postmaster-General, and he replied, " I thank you, but I think that I can do it better myself." That is an answer which I have often heard in business. My only regret is that when, in the old days, I lost a contract from the Government, I was unable to secure such excellent publicity and such persuasive advocacy. The truth is that the Debate is not a technical Debate at all. There are always two ways of doing everything. What the technical report of the experts says is, that of the two ways offered to the Government, and of which the Postmaster-General has the choice of alternative, both, or either, of them will do the job. I think that those who have brought the name of Marconi into the discussion do him an injustice. It would be a very grudging House of Commons which did not accord to that great scientist a full meed of gratitude for what he has done in developing this great science from its very beginning. He ranks alongside Stevenson and James Watt. But in the days of Stevenson and James Watt inventions were not floated for millions of money, and consequently the Postmaster-General, or whoever would be placing a contract before Parliament at that time, would not find himself confronted with the difficulty of having to give up all development on his own account because he had handed that development over to somebody else.

I am not attacking the Marconi Company or the International Communications. I am sorry in a way that it has not been possible for this business to have gone to the Marconi Company, but I refuse to allow questions of Empire, introduced quite illogically, to intrude in what is nothing more than a straight business proposition. I consider that the Postmaster-General acted with unusual care. I cannot see the First Lord of the Admiralty acting with the same care when he decides to adopt a gun-mounting or a fuse and refuses to have it developed by Vickers-Armstrong. The Postmaster-General appointed two experts. Their report is as clear to the ordinary man-in-the-street as any report of so highly technical a nature could be. He then put that report before the Cabinet. The Cabinet approved that report. I cannot imagine how the placing of any contract or any concession, after assessing it in that manner and after it has received the full support of the Government, can be questioned, unless you wish to question the entire integrity of the Government.

Why should not the Post Office develop this system? The Post Office engineers in the past have had a great record of service of invention and of enterprise. Those of us who know anything of the Post Office realise that many devices which are, in the first instance, invented by somebody outside, are improved by somebody inside the Post Office, and it is very difficult to assess what is done by the Post Office and what is done by somebody else. I should be very sorry if there was a feeling in this House that the Post Office were not entitled to a research staff equal to the work which they would have to undertake. I consider the mere fact that there are masts erected in one part of the counrty by the Marconi Company and other masts erected by somebody else really does not matter one bit. In ten years' time, possibly, there will not be one mast of either type. The fact is that the whole business, the whole art, is in the same stage of development as the Rocket and the subsequent steam engines were. Having supported the Government in their view that they should carry out telephonic communication with wireless in this manner, I should like to plead that if they intend to set up a Department under the Government they should develop alongside Marconi interests and other progressive interests in order to get the best for the country. I hope that in asking for the best brains for Government service they will, at any rate, reward them reasonably and at a fair rate. The greatest weakness of the present Government is in securing for the State proper research for that Department. The chief engineer of the Post Office is rated, I think, at a basic salary of £1,500 a year and his Department hand over £8,000,000 to the State. This sort of thing will not help in the proper development of research by the Government.

I hope that the Postmaster-General will proceed calmly and serenely on his way to do what he feels is best for the country, and that he will not allow himself to be disturbed or his staff diverted from their object by attacks from one side or the other. I trust that if that chance is given to them, the quarrel between the opposing interests may yet die down, and that we shall find

the British Government marching side by side with the Marconi Company, as they should do, and everybody getting the best out of research. I have pleasure in supporting the Postmaster-General.

MAJOR CHURCH: I would like to support the hon. Member for Harwich (Mr. Pybus) in the claim which he has made on behalf of the Post Office to try to put an end to this somewhat distressing quarrel between two great corporations, one possessing the whole backing of the State, and the other a private corporation, which had the support of the State through the late Postmaster-General ending in an agreement finally arrived at between the company and the present Postmaster-General. I deplore, as I expect most Members of this House deplore, the curious way in which the Communications Company advanced their claim to submit this matter of telephonic rights in trans-oceanic telephonic communication to an impartial inquiry. I can imagine no impartial inquiry into such a matter which does not contain experts on its committee, and I can imagine no experts appointed to such a committee who would not either be in the employ of the Communications Company or in the employ, directly or indirectly, of the State. I am not impugning for a moment their good faith in the matter. I am only pointing out how difficult it would be to convince anybody among the general public of the complete impartiality of the experts on either side. I should also like to point out the difficulty which any of us laymen, or any laymen sitting on such a committee, would have in coming to a common opinion with regard to the rival claims, or the rival opinions, if there were rival opinions, of the so called impartial experts.

If you take the development of the wireless transmission services in this country, it is obvious that a certain amount of work has been done by the Marchese Marconi and other scientists. In recent years the whole of the developments have been in the hands of the Marconi Company, or two or three departments of the State. I refer to the Post Office, the Admiralty and the Air Force. The experts of these various services, including the Marconi Company, have been gathered together on a Radio Research Board. It has been suggested in the Press during the past few weeks that the Post Office and the Government as a whole have not at their command the services of men such as are at the command of the Marconi Company, or, shall I say, of the Imperial Communications Company. If hon. Members make any reference to any work on wireless or to recent research work, they will find that the Government experts are in the van of progress. It is true, as the hon. Member for Harwich said, that they are not remunerated in proportion to their intrinsic worth to the State. That is a matter which he and his fellow commissioners on the Royal Commission will probably be able to put right. One has only to refer to the work of the Post Office in recent years to realise how great a prejudice there must be in the minds of certain outside interests which may, rightly or wrongly, be in opposition to the Post Office experts. For example, there was a letter in the Press the other day from Sir Ambrose Fleming, a great inventor. One does not accuse him of prejudice and one is not imputing motives to him, but it is a fact worth recording that the prolongation of his patent for the thermionic valve was successfully opposed by the Post Office, and one always regards as suspect letters from people who regard themselves as penalised by the advice given by Government experts on such matters.

Right hon. and hon. Members opposite who have taken the trouble to visit Rugby—I am one of them—have probably been surprised at the amazing progress that has been made in a very few years with regard to wireless telephony. I am credibly informed, shall I say authoritatively informed, that when the possibility of wireless telephony was before the Inter-Departmental Committee eight or nine years ago, the experts from the Marconi Company expressed the opinion that there was not the slightest possibility of that service ever being developed. It is true that experts change their opinions, but here is the fact that eight or nine years ago the opinion of the Marconi experts was that there was no future for wireless telephony, based on the knowledge existing at that time. The Post Office showed a considerable degree of foresight in the matter, and we cannot blame our Post Office engineers for not being given that full glare of publicity which almost invariably attaches to experts employed, and not always employed for the best of motives by private com-

panies. Eight or nine years ago the Marconi Company's experts definitely said that there was no future for long distance wireless telephony, but the Post Office went forward. It is true that when the Imperial Communications Committee were considering the future of imperial communications, they reserved to the nation, through the Post Office, the right to develop these services, and it is equally true that the Imperial Communications Company wished to have the privilege of working the services, but at that time they were not in operation; they were in a purely experimental stage. What is the position at the present time? We have a receiving station at Cupar and another receiving station at Baldock, the station at Cupar being used for long-wave reception and that at Baldock for short-wave reception. With the two stations we are able to maintain wireless telephone communication with America for the whole 24 hours of every day in the year. It is not claimed—certainly I have not heard that it is claimed—by the Imperial Communications Company that they can operate their system for 24 hours in the day. That is one very essential factor, and that is done by a combination of the long-wave system and the short-wave system. As the Postmaster-General has said, the short-wave system has this advantage, as operated by the Post Office, that there is the choice of three wave-lengths, 15, 24 and 32 which can be operated. One wave-length may be better for one period during the day, during a certain state of the atmosphere, and another wave-length may be more suitable for another period of the day. The fact remains that we have a 24 hours' service, and it happens to be a very lucrative business.

I was informed, and I believe that it is an under-estimate, that the number of messages per month, according to the average for the last three or four months, has been 1,200, with an average duration of six minutes for each message. In other words, we have a revenue, assuming that that average can be maintained throughout the year, and apparently it is on the increase, based upon £9 for six minutes—that is half the total revenue, because the total revenue will be £18, half of which will have to go to the company on the other side—of something approaching £130,000 for a capital expenditure on the station—and this is worth remembering—of £500,000. It is quite conceivable that in the not very distant future when we have developed the beam service to Australia—and that is in the immediate realm of probability—and to India and other countries, indeed, it is fairly obvious, that with a very small additional expenditure the State will derive a very considerable revenue from its wireless telephony services.

I am reminded that when the wireless telegraph services were handed over to the Imperial Communications Company, a system which cost the Post Office £160,000 to develop was actually receiving each year £160,000 in revenue; in other words, the revenue from the system was practically equal to the capital expenditure, not because the Post Office wished to keep up their prices but because of an agreement arrived at between the Post Office and certain cable companies not unduly to lower their prices for overseas transmission. As a going concern that has been handed over to the merger company. It is sometimes suggested that the Post Office is very much behindhand. The charge was made by Sir Ambrose Fleming in his letter to the *Times* that the Post Office when they had the cables, or certain portions of the cable system, under their control, did not introduce the new permalloy system. That system had not been in existence very long then. If that system is what it claims to be, and I understand that you can send messages over it at about ten times the rate, and even more, than over the existing Atlantic cables or over any ocean submarine cable, one wonders what the merger company, the Imperial Communications Company, has been doing all this time in continuing to use cables which are completely obsolescent. We need more cables.

I would like to ask the Postmaster-General in regard to the development of international wireless telephonic services, whether the agreement with the Imperial Communications Company in regard to telephonic services gives to that company the right in respect of all messages transmitted over submarine cables, or is that right still reserved to the nation? If not, I can see a tremendous future for the Imperial Communications Company if they will only take a bold step and lay some of the new cables, which can be manufactured in this country and certainly would

be manufactured in this country. The Permalloy has its counterpart in a new alloy discovered in this country possessing the same properties. Permalloy was an American invention. It is within the realm of possibility that we shall be able over these new cables to send seven or more messages simultaneously—not telegraphic messages but telephonic messages. We shall be able to use one cable for transmitting seven telephone communications at the same time. That would conceivably make a tremendous difference to the development of wireless telephonic services.

The advance of science, as the hon. Member for Harwich said, in this particular field of research cannot be gauged to any degree of nicety at the present time. We are discovering new things every day. Our Government scientists, under-paid though they are, apply themselves with tremendous energy and enthusiasm to the task of keeping alight the lamp of research. They have made a number of remarkable contributions to the growth of this particular science. Some of them are employed by the Post Office. No Government scientist gets the same amount of publicity as the scientists outside, and there is a tendency on the part of the general public, because there is not constant advertisement by the State of these services, to get the impression that the Government scientist is somewhat inferior to the scientist employed outside. That is an entire misconception. We have men in the Government telephone service who stand high among their fellows, and the State has every reason to be proud of the service it maintains, whether by the Post Office, the Admiralty or any other Department. One need not enumerate the many contributions made by Post Office engineers to the advancement, particularly of the technical side, of wireless telephony in the past few years. The results they have achieved are well known throughout the technical and scientific world. But I want to say this in regard to the Post Office Engineering Department: it is not a scientific Department.

Under the Haldane Report a definite line of demarcation was laid down between what is fundamental and applied research. It is the business of the Post Office engineers to apply the researches made in universities and laboratories throughout the world; to keep abreast of all modern achievements in science and to apply them. Their primary function is not to make discoveries for themselves, and any sneer or suggestion that they are lacking in competence is entirely unfair. They are performing their functions only too well for some of the outside interests. They are keeping themselves so well abreast of modern developments, that, apparently, this country is leading the world in the question of trans-continental telephonic service. Anyone who has been to Rugby or has taken the trouble to realise how delicate a machine there is in being, how complicated is the machinery, and how easily it can be put out of order, not only by faulty operation but by faulty research work, will realise the tremendous strides forward that have been made by the Post Office in comparatively few years.

There is another point with regard to telegraphs. When you hand a telegram over the counter for overseas or this country, there is no question of getting in touch immediately with someone at the other end of the wire. In dealing with telephones you have a different proposition, and one of the reasons why I wish the Imperial wireless telephone service and cable telephone service to be kept in the hands of the Post Office is that such a policy would ensure an absence of friction. If you have two entirely different concerns, one an outside concern existing in the interests of its shareholders and operating through the Post Office, as is suggested, and anything goes wrong with the service, the blame will be put on the Communications Company by the Post Office and by the Communications Company on the Post Office. It is much better, when you are dealing with telephones and the possibility of a breakdown due to the personal factor—and we know that breakdowns of that kind are not infrequent—that you should have control centralised in one institution, which has built upon a somewhat unskilled foundation a great telephone service not only for this country but for the whole world.

NOTES & COMMENTS

WE publish elsewhere in this issue reports from Hansard, which state the Post Office case in the debate in the House of Commons on the recent proposed acquisition by a public company of the Inter-Dominion telephone service. Much could be said on the subject, but it is considered that our readers should have at least a verbatim report of the Government's point of view. We are not concerned with the political aspect of the situation, but as engineers we are deeply interested in the technical and economic side, and it is gratifying to be able to announce the complete success of the section whose job it was to install and bring the service into operation. On the 30th April a public telephone service was opened between this country and Australia. Communication was available at the opening between telephone subscribers here and in Melbourne and Sydney, but the facility has now been extended to Brisbane on the other side and to western European countries generally. Transmission is effected from Rugby on a short-wave system of some 25/32 metres and received at La Perouse near Sydney; the corresponding points in the other direction being Tennants Hill, Sydney and Baldock, the main short-wave receiving station on the Baldock-Royston road. The opening talk between the British and Australian Premiers on the 30th April was broadcast by the B.B.C., and was very successful, barring a short failure of the broadcast transmitter. The difference in time between this country and Australia militates against the growth of traffic, but in spite of this the service is being taken up remarkably well. Conditions for operating telephone service to South Africa are much better and it is to be hoped that the authorities there will take steps to come into line.

A service has also been opened to the principal cities in the Argentine, Uruguay and Chili *via* Madrid and Buenos Aires radio, a limited service to Rio de Janeiro *via* Paris and one to Java *via* Amsterdam. Ship and Shore services are also in operation between certain large transatlantic liners and Rugby-Baldock.

TELEPHONE RATES COMPARISON:

New York and London.

While Britain has a lower telephone density than the U.S.A., she enjoys cheaper calls. Noteworthy statistics prepared by the Engineering Department of the British Post Office show that, contrary to the opinion very generally held in this country, both business and domestic telephone rates are considerably higher in New York than in London. Rates throughout America tend to vary more than in this country, as the local services are in the hands of many independent companies. British rates are, as nearly as may be, uniform.

In the inner areas the business rates are:—

No. of Calls.	New York.	London.
	£ s. d.	£ s. d.
180	14 7 6	8 15 0
900	14 7 6	11 15 0
1800	22 16 3	15 10 0

In the outer areas the domestic rates are:—

No. of Calls.	New York. £ s. d.	London. £ s. d.
180	10 10 0	6 5 0
792	10 10 0	8 16 0
1692	18 10 9	12 1 0

It should be understood that the New York rentals of £14 7s. 6d. and £10 10s. 0d. include, respectively, 900 and 792 free calls, the subscriber subsequently paying per call at a decreasing rate as the number increases. The London local rate is, of course, 1d. per call, and its advantage therefore, while considerable at the lower calling rate, becomes even more marked as the calling rate becomes really high, for each additional call adds nearly twice as much to the New York bill as to the London bill.—*Electrical Review*, 2nd May, 1930.

STATES OF GUERNSEY TELEPHONE DEPARTMENT.

Mr. E. H. Bennett, Manager-Engineer of the Department, has sent us a copy of the Balance Sheet for the year ended 31st December, 1929. The number of subscribers' lines shows an increase for the year of 104, being now 3,740. The gross revenue for the year was £20,597, an increase of £1,378, but the net profit is down by £36. The department offers subscribers four tariffs—A, private houses, £2 10s. per annum with 120 free calls, afterwards 1d. per call; A, business premises, £3 0s. 0d. per annum with 240 free calls, afterwards 1d. per call; B, £3 per annum and ½d. per call; and C, £6 10s. 0d. per annum and 3,200 calls without further payment. The number of subscribers paying these tariffs is as follows, the figures for the preceding year being given in brackets: A, private houses, 1,011 (955); A, business premises, 1,883 (1839); B 445 (437) and C 401 (405). The metallic circuit wire mileage, overhead, amounts to 2,385 miles, a decrease of 43, while the underground reaches 4,908½ miles, an increase of 22¾.

LARGE EXPENDITURE ON TELEPHONES PLANNED IN BRITISH COLUMBIA.

Large capital expenditures on telephone system in the Province of British Columbia this year are indicated in the announcement that the British Columbia Telephone Company, Inc., is planning the expenditure of $5,000,000, made up as follows:—Buildings, $690,000; central office equipment about $1,500,000; subscribers' station equipment, $180,000; outside exchange plant, $1,560,000, and toll line construction, $1,070,000.

MR. DANE SINCLAIR.

Mr. Dane Sinclair passed away at his residence, "Oakwood," Weybridge, on May 6th, at the age of 78 years. He had been in failing health for some time past. He leaves a widow, four daughters and a son, Mr. D. Johnstone Sinclair, who is a director of British Insulated Cables, Ltd., of which company his father had been chairman since 1927.

Mr. Dane Sinclair was born in 1852 at Caithness, and the whole of his life was spent in connection with telegraph, telephone, cable manufacturing, and other associated interests. His electrical career commenced in 1872 in the telegraph department of the North British Railway, and three years later he was sent with several other men to Japan for work in the erection of telegraph lines. He was appointed Inspector of Telegraphs by the Japanese Government, and in recognition of his valuable services the Mikado conferred upon him the Distinguished Order of the Rising Sun, Third Class. When he returned to this country after five years in Japan he was appointed engineer to the National Telephone Company for the Glasgow district. Shortly afterwards the three principal telephone companies in Great Britain were amalgamated into the large concern which retained the name of the National Telephone Company, and Mr. Sinclair was asked by the directors of that company to furnish a comprehensive report on the equipment and working of the whole enlarged system. His report formed the basis upon which a complete reorganisation was carried out, and it laid down the lines of policy on which the operations of that company were successfully conducted. Mr. Sinclair became London manager of the company in 1892 and from that year until 1902 he was engineer-in-chief of the entire system. That position he vacated in order to take up the post of general manager of the

British Insulated and Helsby Cables, Ltd., at the invitation of the late Mr. James Taylor. From the year 1902 down to the day of his death Mr. Sinclair was associated with the British Insulated Cables, Ltd., first as general manager, later as general manager and director, and the great growth made by the company is a matter of general knowledge in the industry at home and in the markets abroad. Its record during the past few years include important railway electrification work in India and Australia, the Mid-Scottish Grid, and other undertakings. He became chairman of the company in 1927 on the death of Mr. James Taylor, J.P., and combined the post of managing director with the chairmanship until July, 1928, when in view of his many years of strenuous work he relinquished the more active duties of managing director in favour of Mr. G. H. Nisbett. In the development of the Automatic Telephone Manufacturing Company, which was originally a subsidiary of British Insulated Cables, Mr. Sinclair displayed great experience and skill. On his recommendation the Strowger patents were acquired, and he was active in promoting the use of this system for automatic telephone equipment in many towns in Great Britain and in various foreign countries.

A correspondent writing to the *Times* pays him a high tribute for his kindly disposition, integrity and genuine character, which endeared him to a large circle of friends. " His," says the writer, " was a nature unspoiled by prosperity, and he proved a ready friend to all in adversity." We are sure therefore that we shall be expressing the feelings of the whole electrical industry when we offer our sincere sympathy to his widow and family in their bereavement. The funeral took place at Wick, Caithness. A silent and touching tribute was paid to Mr. Sinclair's memory when the cars conveying the remains and the mourners halted for a short time outside the company's offices, Surrey House, the Embankment, on the way from Weybridge to Euston Station.—*Electrical Review*, 16th May, 1930.

Everybody in the world to-day thinks he can build a wireless set and each builder is convinced that the results of his combination of receiver and loud speaker are the best ever produced, although many an able radio engineer has had his pride humbled by his wife blandly asking him if she should not get young Johnny across the road, who has built such a fine set, to come and assist him out of his difficulties. The number of experts is legion, but they are not always disinterested, so-and-so's coils, such-and-such a condenser are necessary to complete the ideal set. One of the Radio Section engineers, who has been directly engaged in the construction of receiving sets, will in our next issue discuss the present position of the reception of broadcast music, talks, etc., and point out the advantages and disadvantages of the several systems of high frequency amplification, rectification and audio amplification now in use by the best manufacturers. The general public is not aware of the part played by the Department in this broadcasting business, beyond the fact that wireless licences are issued at post offices. Much of the S.B. work is carried on line circuits, and our latest cables are being fitted with screened pairs or quads for broadcast operations, to secure a minimum of interference and with high cut-off points for music transmission.

We have been charged sometimes with making the Journal too mathematical, too highbrow in character for the ordinary working man, be he engineer, inspector, skilled workman or youth-in-training. This may be true at times, but the fact remains that certain aspects of the subject of electrical communications cannot be properly treated except by the use of mathematics, and it has been our constant aim to maintain the high standard of the magazine and to render it as useful as possible to our readers. The introduction of a Telephone Transmission examination by the City and Guilds authorities has created a demand for teaching courses on the subject, which is being catered for at many of the technical institutes. Mr. W. T. Palmer, of the Research Section and a lecturer at the Northampton Polytechnic Institute, Clerkenwell, has agreed to contribute a series of articles on a " Guide to Telephone Transmission Theory " which will begin in our October issue. Mr. Palmer will start from first principles and will lead up to and cover the syllabus of the above examination, and perhaps farther. The series will of course be

mathematical, but we need not fear criticism of our contents bill on this score—the material will be useful to most of us and especially to the younger men with ambitions to go higher.

We have to thank all ranks of the Engineering Department, from the Superintending Engineers down to Youths-in-training, for the hearty support they have given to our appeal for increased support. The result is most gratifying, since the appeal brought in some 1,600 additional subscribers and has brought our circulation well over 6,000 copies per quarter. We are not content, however, even with this increase; a staff of 30,000 men should do better, as one journal among six men does not go very far. To explain this ratio it should be mentioned that over 1,000 copies go overseas quarterly. Next year, when we hope to reduce the price to one shilling, the number of subscribers should show another twenty-five per cent. increase, at least.

HEADQUARTER'S NOTES.

EXCHANGE EQUIPMENT.

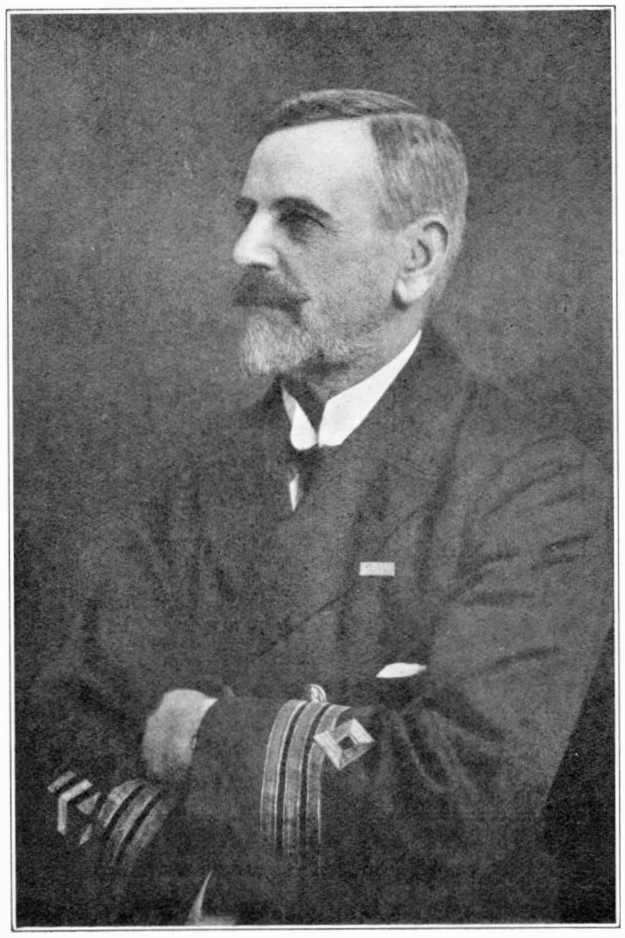
The following works have been completed:—

Exchange.	Type.	No. of Lines.
Moss Side	New Auto.	1780
Middlesbrough Area (4) ...	,,	4200
Fulham	,,	7500
Portobello	,,	700
Temple Bar	,,	8000
Amherst	,,	3600
Primrose Hill	,,	7000
Collyhurst	,,	1950
Terminus	,,	M.F. only
Maidstone Area (8)	,,	3200
Granton	,,	1220
Oxford	Auto Extn.	Re-arrangements
Cowley	,,	200
Headington	,,	200
Arkwright Notts.)	,,	760
Grimsby	,,	550
Sherwood (Notts.)	,,	200
Castleton	,,	100
Whitworth	,,	100
Bishopgate	,,	100
Maida Vale	,,	Re-arrangements
Bath	,,	Obsn. Equipt.
Great Moor	New Manual	900
Loughton	,,	1020
Bradbury Agnew	P.A.B.X.	40
Lewis Berger	,,	30
Colgate Palm Olive	,,	30
Kiaer & Co.	,,	20
Lighting Trades	,,	30
Shell Mex	,	30
French & Sons	,,	30

Orders have been placed for the following works:—

Exchange.	Type.	No. of Lines
Southall	New Auto.	1700
Ayr	,,	1780
Prestwick	,,	520
London Operators' School ...		—
Temple Bar	Auto Extn.	100
Bishopgate	,,	100
Edgware	,,	1500
Ipswich	,,	300
Rochdale	,,	300
Crawley	,,	Re-arrangements
Sanderstead	New Manual	620
Gof Stores	,,	1650
M.G. Cars	P.A.B.X.	200
Reading University	,,	30
Kiaer & Co.	,,	20
Ipswich	,,	20
Strachan & Co.	,	20
British Tube Mills	,,	30
B'ham Corpn. (Mental) ...	,,	20
Constructors, Ltd.	,,	20
Crowe & Co.	,,	20
C. Lloyd	,,	20
Emmanel College	,,	30

CAPT. HENRY FRANK BOURDEAUX, O.B.E.



CAPTAIN HENRY FRANK BOURDEAUX, O.B.E.

THE retirement of Captain Bourdeaux on April 30th, 1930, breaks an association of this name with the Submarine Branch which has been continuous since the transfer to the State of the Submarine Telegraph Company in 1889. Captain H. F. Bourdeaux's father was the first Post Office Submarine Superintendent, and his brother was his immediate predecessor in that position.

His early life at Dover undoubtedly gave him a predilection for the sea, and the hardships of old sailing ship days did not alter his determination to be, if not a "sailor bold," then a competent experienced navigator. In fact Captain Bourdeaux, when relating those early experiences had little to say of the hardships, but much of the wonders of the life and the good fellowship which existed. He did not enter the Post Office service until he was 27 years of age, when, with junior rank, he joined the old cable ship "Monarch" which, incidentally, it will be remembered, was lost by enemy action off Dover in September, 1915. Fortunately our friend was not then on board. His war services around our coasts were, however, sufficiently vivid, exciting and dangerous. Indeed, it is not known generally, even in our own Department, what a risky job it was during the war to be engaged on a Post Office cable ship. Overseas communications were of course vital and these were maintained with a disregard for mines and torpedoes and with a high sense of duty which perhaps it may be said received less than due recognition when honours were distributed. Captain Bourdeaux, however, was fortunate to receive the honour of the O.B.E. and special commendation for his good work.

After the Armistice, Captain Bourdeaux took over the arduous duties of Commander of the new "Alert," combining the duties of Navigating Commander, Cable Engineer and Electrician. This was, at that time, a tough proposition, as the original officers and permanent crew of the old "Monarch" and "Alert" were dispersed and divided between four or five auxiliary ships temporarily fitted up as cable ships, leaving Captain Bourdeaux with only a skeleton trained crew to assist him to do his part in overtaking the heavy arrears in submarine cable work.

On the retirement of his brother, Mr. John Bourdeaux, he became Submarine Superintendent in April, 1922, being the first officer of that rank to be placed on the Headquarters Staff under the Submarine Reorganization.

One might have thought that under these circumstances, Captain Bourdeaux must have felt at times like a "fish out of water," but by his qualities of tact, unfailing courtesy and cheerful disposition, he soon endeared himself to his colleagues at Headquarters and at the same time retained the respect and affection of the Submarine Staff for whose work and welfare he remained responsible.

As head of the Submarine Branch of the

British Post Office, Captain Bourdeaux was, of course, well known to submarine cable engineers in many countries and his expert advice was frequently sought.

On May 27th, colleagues and friends gathered together to say farewell and Godspeed. Mr. Shaughnessy in happy vein, supported by other members of the Staff, expressed kindly thought and appreciation of Captain Bourdeaux's many fine qualities and subsequently handed to him a gold repeater watch and an illuminated autograph album as a tangible expression of this appreciation. To Mrs. Bourdeaux was sent a beautiful inlaid Indian tray.

We regret our friend's departure, we shall miss his outstanding characteristics of friendliness and cheery optimism, but that he will be happy in his retirement we can have no doubt.

ENGINEERING DISTRICT NOTES.

LONDON DISTRICT.

Exchanges, Exchange Lines and Stations.

At March 31st, 1930, there were 391,359 direct exchange lines in the London area and 659,318 stations, an increase during the quarter of 8,003 exchange lines and 13,379 stations. At the same date the total number of exchanges in the area was 136, of which 23 were automatic.

Eight automatic exchanges are now being installed, the total initial equipment of these exchanges being 30,500 lines. The ultimate capacity of these exchanges is, of course, very much greater. In addition there are thirteen buildings being erected to accommodate automatic exchanges.

In connection with the issue of the March telephone directory, 17,000 lines were transferred from one exchange to another. These transfers are necessary on account of the establishment of new exchanges which necessarily serve areas which were previously served by other exchanges. A similar number of transfers is necessary every six months, but although a certain amount of inconvenience to subscribers is unavoidable, the transfers give rise to very few complaints. This is due to the systematic preparatory work and the care which is taken by the Traffic and Engineering Departments to reduce the inconvenience to a minimum and to deal promptly with enquiries regarding changed numbers, etc.

Reconstruction of Toll Exchange "B."

Some years ago it became necessary to establish a separate exchange to deal with the traffic on short trunk or "Toll" circuits in order to allow room for the expansion of the traffic on long trunk circuits. The exchange thus established is situated in Norwich Street, Holborn, about three-quarters of a mile from the main trunk exchange. After the transfer the growth of traffic on the Toll circuits was very rapid and it subsequently became necessary to divide it so that only the traffic incoming from towns in the Toll area was dealt with at Norwich Street, which was renamed Toll "B," while traffic outgoing to towns in the Toll area was dealt with at a new exchange established at G.P.O. South and named Toll "A."

It has now been necessary to convert the positions at Norwich Street which were formerly used for outgoing traffic so that they can be utilised to deal with the ever increasing volume of incoming traffic. This work is being carried out by the Sectional Staff and comprises the following items:—

- Recovery of wiring on 68 operators' positions and provision of new wiring. Of this number, 29 will be provided with jack-ended circuits and the remainder with plug-ended order wire circuits. All positions will be provided with additional cord circuits.
- Outgoing multiple extended by 980 jacks over all positions.
- Provide 40 additional order wires on all positions, including those which are at present working.
- Extend the test jack field on the test desk by 500 jacks.

The work is well advanced and some of the

rewired positions will shortly be brought into use.

Radio Channels.

The number of channels for radio service continues to increase. In addition to the four channels for which equipment was installed in the new radio room on the 1st Floor, G.P.O. South, equipment has now been provided for two further channels and the preliminary work in connection with the installation of equipment for four additional channels is now proceeding. When this is completed, a total of 10 channels will be available.

This work is also being carried out by the Sectional Staff.

Removal of Record Distribution Positions at G.P.O. South.

The above mentioned positions, at which requests from London subscribers for Trunk connections are switched to Record tables on another floor, were originally accommodated on the main suite of positions in the Trunk exchange, but their removal to the same floor as that on which the Record tables were accommodated became necessary in order to provide accommodation for additional radio channels owing to the rapid expansion in the radio traffic.

The circuits are of a special character and standard switchboards were not suitable. Three No. 10 stripped sections were used and wired on the spot. Each section is provided with 33 lines to " Record " operators and is wired for 40. The suite will accommodate 600 " Incoming " record circuits.

The work had to be carried out by the local staff at high speed and to proceed continuously owing to the necessity to provide the additional Radio Channels at short notice. The transfer was effected at 6 o'clock p.m. on an ordinary week-day without trouble.

Teleprinters for Race Meetings.

The teleprinters which have been installed at race courses in the vicinity of London have proved fully capable of dealing with the volume of work during the peak period and appear to have practically eliminated the necessity to resort to Wheatstone working.

Presentation to Mr. H. C. Stone.

On March 31st, Mr. H. C. Stone, Executive Engineer of the City External Section, retired from the Engineering Department after a long service, during which he had earned the esteem of all those who came into contact with him. The exceptionally large gathering to witness the presentation must have been very gratifying to Mr. Stone, as it furnished evidence that although he set a high standard of efficiency, and sought by every means to obtain this standard, he had been able to carry his staff with him. Mr. Stone will be missed in many ways, and not least on account of the excellent relations he established with the officials of the local authorities and of the various undertakings which carried out underground operations or building construction works in the City of London. It is not possible to express in monetary terms the value to the Department of the ability to co-operate in this way and thus obtain, in a few minutes of friendly discussion, facilities which might otherwise take many months to obtain by correspondence, and, in some cases, only after legal proceedings.

Several of those present spoke of Mr. Stone's calmness in periods of emergency, coupled with energy and initiative, and one expressed it in the following verses, which although not the highest type of poetry, might well be learnt and applied by younger men :—

" Somebody said that it couldn't be done,
But he with a smile replied,
That maybe it couldn't but he was one,
Who wouldn't say so till he'd tried.

So he buckled right in with a trace of a grin,
On his face. If he worried he hid it,
And he began to sing as he tackled the thing,
That couldn't be done, and he did it."

Mr. Gomersall made the presentation, and spoke in very high terms of the services rendered by Mr. Stone to the Department, and of the high regard in which he was held by the higher officials as well as those who worked under him.

Staff Changes.

Mr. Harvey Smith has been transferred to the City External Section, and his position in charge of the West External Section has been taken by Mr. W. F. Boryer, formerly Assistant Engineer in that Section.

A Novel Reconstruction Job.

W. A. Sullivan.

Building reconstruction work of an uncommon character has recently been carried out at one of the Exchanges in the London Engineering District.

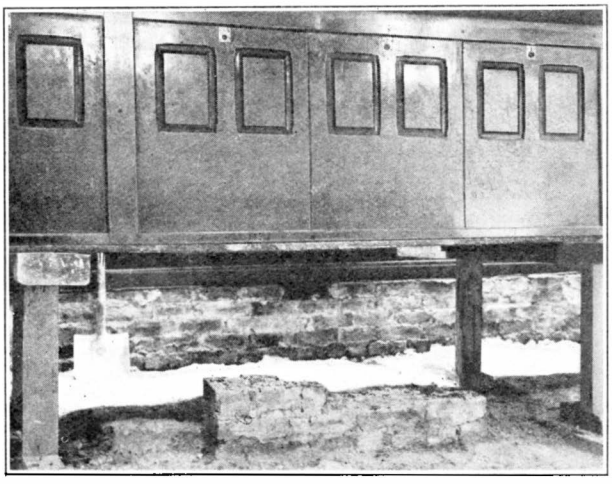


Fig. 1.

Upon the transfer of the subscribers from Primrose Manual Exchange to the Automatic Exchange, it was decided that the former equipment, which is situated in what was formerly a church, should be reconditioned and re-opened at a later date as Cunningham Manual Exchange. The first step in this direction was an inspection of the flooring and joists of the switchroom by the Office of Works, owing to dampness having been encountered in parts of the floor, when it was found that dry rot was very prevalent and it was decided that the whole of the joists and floor boards should be renewed.

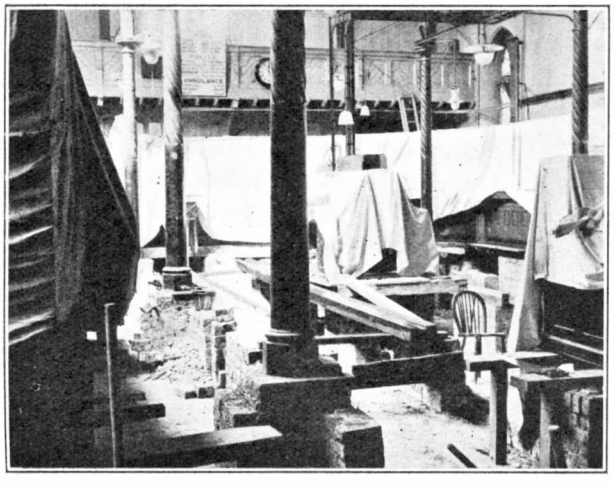


Fig. 2.

During the process of the work the switchboards were, in the case of the "B" Boards, temporarily supported by quartering as shown in Fig. 1, while the new woodwork was placed in position. From the experience gained, it was then decided to abandon this method, as far as the "A" Boards were concerned, and they were supported on jacks, a section at a time, while the old joists and floor boards were removed, new joists treated with solignum, and floor boards placed in position.

Fig. 2 shows a general view of the switchroom with the brick piers for supporting joists in the process of renewal, the "B" Board being on the left, Information Desk in the centre, and the "A" Board in the background.

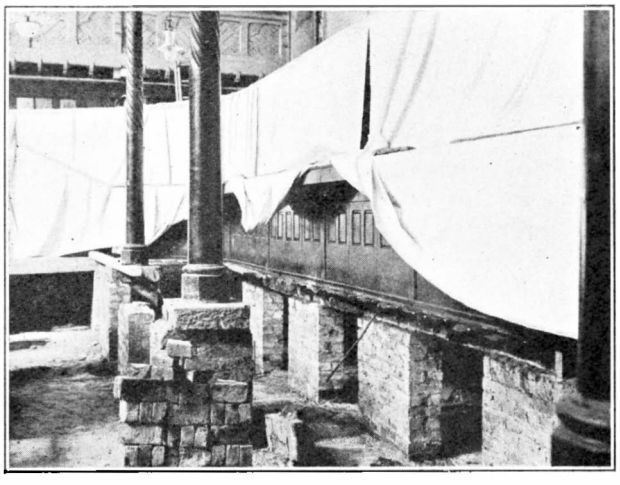


Fig. 3.

Fig. 3 shows the "A" Boards with the old brick piers, cut away portions of joists and floor boards, prior to the switchboard being raised on jacks.

S. LANCS. DISTRICT.

Manchester Automatic Scheme.

Progress on the Manchester Automatic Scheme proceeds apace. Installation work on the new Director Automatic Exchanges, namely, Ardwick, Collyhurst, and Moss Side, is now completed, together with their associated Auto-Manual Boards, centralised at Telephone House,

Chapel Street, Salford. The Exchanges were brought into service at 2 p.m. on June 7th, 1930. The transfer is of some interest, as the Exchanges are the first Director Exchanges to be brought into operation in the provinces, and are the first step in the scheme for the conversion of Manchester Auto area to Director working. Only a portion of the complete Auto-Manual Board was brought into service at first, as indicated hereunder:—

33 "A" positions.
10 Enquiry positions.
10 "4-digit" key sender positions (for dealing with traffic from City and Central Manual Exchanges to the Automatic Exchanges).
1 Supervisor's desk.

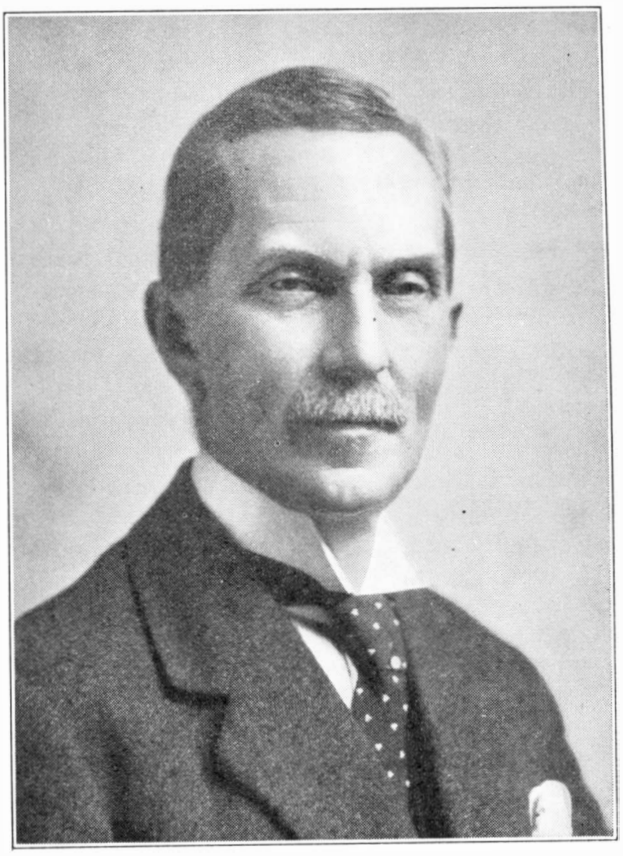
An interesting innovation in connection with the Auto-Manual Board is that this is the first time the system of straightforward junction working has been introduced in a Director area.

Ardwick Exchange is of the Siemens type, Collyhurst the S.T. & C. type, and Moss Side is of the G.E.C. type. The first opened with approximately 1,700 lines, the second 1,000 lines, and the last 1,400 lines. In addition to the installation of the equipments previously referred to, C.C.I. equipments have been installed at the Manchester City and Central Exchanges for the receipt of calls direct from the Automatic Exchanges. Other Manual Exchanges in the Auto area will not be equipped with C.C.I. positions during the initial period of Automatic working, *i.e.*, until 1931. Automatic subscribers requiring these Exchanges will obtain connections *via* the Automatic Manual Board.

In order to prepare the subscribers for the transfer from Manual to Automatic working an automatic demonstration set has been installed at H.P.O., Manchester, and has done good work in demonstrating to subscribers how the new system works.

Retirement of Mr. W. J. Medlyn, O.B.E., M.I.E.E.

Mr. W. J. Medlyn, M.I.E.E., has had a long and distinguished career in the Post Office Engineering Department, and his retirement leaves a gap which will indeed be difficult to fill.



Mr. W. J. Medlyn, O.B.E., M.I.E.E.

Born in a remote part of West Cornwall, he first entered the Service as a "Learner" at Falmouth. After a short interlude with the Direct Spanish Telegraph Company he rejoined the Post Office at Cardiff. His theoretical electrical training was obtained at the University College of South Wales and Monmouthshire and in 1891 his engineering experience commenced under the late Sir John Gavey. In due course Mr. Medlyn became Sectional Engineer at Leeds, and it was during this period that he devised the superposing plan which did so much to extend the telephone service to remote villages. In the late nineties Mr. Medlyn devised a plan which did for telephone trunk signalling what the Secondary Cell system of working had done for telegraphs, thereby replacing the hordes of primary cells by a power installation.

In 1901 Mr. Medlyn was called to London, and there ensued a period of strenuous effort during which he redesigned the Post Office trunk switchboards and the signalling system.

This new system was applied to the London Trunk Exchange, opened in 1904, and was followed by the installation of similar equipment at all the more important provincial centres, such as Manchester, Liverpool, Birmingham, etc. These equipments were manufactured and installed by The British Insulated Cables, Ltd., of Prescot and Helsby, and they constituted the beginnings of the extensive telephone works which are now carried on by The Automatic Telephone Manufacturing Co., at Liverpool. The designs embodied many apparatus devices which facilitated the handling of long distance traffic and included the invention of a three-minute time check to assist the operating staff to deal with the timing of trunk calls.

Mr. Medlyn's administrative abilities were very speedily recognised. His really deep knowledge of accountancy, his ever-living interest in costing, and his flair for statistics, distinguished him from his fellows in the days when such sordid subjects were anything but popular. And he has remained in the Service long enough to see the basic principles which he has preached in season, and out of season, definitely established as an essential part of the scheme of things. Whilst always aiming at the highest efficiency, he has consistently recognised that the cost of absolute perfection may be prohibitive, and therefore uncommercial. He has certainly instilled these ideas in the minds of his staff—a staff which has ever been happy in his leadership.

In 1908 Mr. Medlyn came to Manchester as Assistant Superintending Engineer, and in 1913 became Superintending Engineer of the South Lancashire District. Practically the whole of the arrangements in connection with the transfer of the late National Telephone Company's plant to the State and the organisation of the staff fell upon his shoulders, and the success of this work was no doubt due to his native grit, bred in a bit of old England, where the ideal of duty has never been dimmed by questions about the magnitude of the resulting rewards. But, be this as it may, there can be no doubt that the burden thrown on to Mr. Medlyn was indeed onerous; the work was, however, so efficiently and so thoroughly executed that the prestige of the South Lancashire District rose ever higher and higher. The number of telephone stations increased from 67,856 to its present figure of close on 170,000, but even more significant was the continual fall in the cost of every item of maintenance and construction work. This latter result was no doubt in large measure due to the statistical methods which Mr. Medlyn devised, and used so effectively, to raise the efficiency of the multitudinous operations which represent the output of the South Lancashire District.

The subject of this sketch, if he were asked for the form in which the memory of his life's work should be perpetuated, might well reply as Sir Christopher Wren replied, when asked the same question, in the single word " Circumspice! " And, when we do look around us we observe the entire disappearance of beds of open wires and roof-standards in the cities and towns of South Lancashire. The network of underground cables which connects all the Lancashire towns and villages disposed around Manchester is unequalled in magnitude and comprehensiveness in other parts of the world. Modern exchanges have replaced those of earlier days and the new era of automatic telephony in the Manchester area will commence on June 7th—just a week after Mr. Medlyn's retirement.

Perhaps one of the most valuable features of Mr. Medlyn's work has been the close personal attention which he has given to the establishment of cordial relations with local authorities. This has been accomplished by unremitting vigilance in promptly seeking to satisfy local requirements. The manifestation of a sincere desire to understand another's point of view, coupled with an ambition to help, and if possible to find an acceptable solution to every difficulty, has naturally reacted in producing a friendly atmosphere. This is particularly noticeable in the attitude of the various Chambers of Commerce, and it is difficult indeed to over-estimate the value of this phase of Mr. Medlyn's work.

After the conclusion of the Agenda of the last meeting of the Whitley Committee at which Mr. Medlyn presided, the Chairman of the Staff Side expressed his appreciation of the sympathetic consideration and careful thought bestowed upon every question raised on the Committee. After similar remarks by Mr. C. H. P. Kent and Mr. Hepplestone, Mr. Whittaker presented a little token of esteem and regard to Mr. Medlyn, from present and former Staff Side members of the

Committee. This little ceremony was indeed a striking testimony to the ability with which the principles of Whitleyism had been applied in the South Lancashire District. The main feature has certainly been Mr. Medlyn's keen and obvious desire to secure absolute justice and the Staff Side members fully appreciate that always and in every possible circumstance they have had a square deal. What more can one desire?

So much for the purely official work. There are, however, yet other important directions in which he has served his day and generation. As Chairman of the South Lancashire Centre of the Institution of Post Office Electrical Engineers he has each year delivered a Presidential address of very great value in crystallising the developments of the past year.

He has, for many years, been a member of the Manchester Geographical Society, and has for some time served on the Council of that Society. He has taken an active part in promoting the interests of the Institution of Electrical Engineers, and became Chairman of the North Western Centre during the 1926-27 Session. To him we owe the inauguration of the joint meetings between the Institution of Electrical Engineers and the Institution of Post Office Electrical Engineers. In fact, it is only just here to observe that no opportunity of advancing the prestige of his Department, and of his Officers, has ever been neglected, no matter what the pressure of his ordinary duties may have been.

The final note must necessarily deal with the man rather than the Official. It has been said that the Official oft decays the man, but it has not been so in this case, at least. Mr. Medlyn has won the kindly regard of everyone. At heart personal advertisement is distasteful to him, and consequently the performance of public duties involves a comparatively severe strain. Nevertheless, whenever the circumstances have imposed this necessity, he has invariably performed the required ceremony with distinction and efficiency. The result of these efforts has been that to-day it can justly be said that Mr. Medlyn makes speeches which may be described as admirable cameos; depicting precisely what he wishes to convey in a direct and attractive manner.

So far as his relations with his Staff are concerned, it is only in accordance with truth to say that he demanded from everyone the best that was in him, just as he himself was utterly unsparing in his own efforts. It may be that the discipline in the South Lancashire District is stricter and sterner than in any other, but it has this advantage, that deviation from the straight and narrow path of duty is checked long before the offender can form habits which will seriously affect his future career. On the other hand, every man, from top to bottom, could rely on careful and sympathetic consideration, with absolute justice, but inspired by an earnest desire to help the individual and thus to advance the best interests of the Service he loves so well, and the well-being of the man concerned.

The writer of this little memoir has had the honour to serve Mr. Medlyn as his Assistant for ten years, and the passage of time has only increased his appreciation of a remarkable brain directed by a kindly heart.

T.E.H.

Presentation to Mr. Medlyn.

There was a remarkable gathering at the Manchester Limited Restaurant on the 31st May, the last day of Mr. Medlyn's service. The guests were received by the Chairman (Mr. T. E. Herbert), Mr. Medlyn and Sir Thomas Purves. A simple little meal was then admirably served.

After this, Mr. Medlyn performed his last official duty by investing Mr. W. H. Martin, S.W.2, with the Imperial Service Medal.

A musical interlude followed and then speeches in honour of the guest of the evening were made by Col. Sir T. F. Purves, President, I.E.E., Engineer-in-Chief to the Post Office, Mr. J. W. Atkinson, Superintending Engineer, N.E. District, Mr. H. Downes, Mr. J. G. Maddan (Postmaster Surveyor of Manchester), Messrs. T. McLeod, F. N. Harrop, C. H. Smith (General Secretary of the Post Office Engineering Union), G. H. A. Wildgoose, H. Broadhead, H. Hepplestone and Sir William Noble. The speeches were, without exception, brilliant and the large audience followed them with eager interest. The duration of the speeches was strictly limited and was controlled by the lighting of green, orange, and red lamps; it was amusing to observe the Chairman timing each speaker with an official

stop watch. He was quite impartial and at the end of 2½ minutes the speaker got the orange light, followed half a minute later by a red light. Sir Thomas and Sir William, however, both outwitted the Chairman by signalling their own conclusion lights.

The presentation, which comprised a portable wireless set, a gramophone, camera and a handbag for Mrs. Medlyn, was then made by the Chairman (Mr. T. E. Herbert) in a few brief but well-chosen sentences—incidentally, he remarked that the earlier speeches were not merely a case of *de pensionis nil nisi bonum*. Anyone who denied Mr. Medlyn's high qualities was either a follower of Ananias or a direct lineal descendant of Balaam's Ass.

Mr. Medlyn in reply expressed his appreciation of the magnificent tribute which had been paid to him not only by the personal gifts, but even more by the character of the gathering. It would be a happy memory which would remain with him to the closing hour of his existence.

The company numbered some four hundred and the gathering may well be described as unique. Not merely in point of size, but in the warmth of the atmosphere and in the sincere cordiality of the proceedings. Many messages of goodwill were received from those unable to be present and if one of them may be selected for special remark it is the message to Mr. C. H. Smith from the President and Executive Committee of the P.O.E.U. charging him to convey their good wishes to Mr. Medlyn.

The speeches were all perfectly audible in all parts of the large banqueting hall and for this the Chairman expressed his thanks to Mr. Storey, of the Standard Telephones & Cables, for the installation of a microphone and loud speakers.

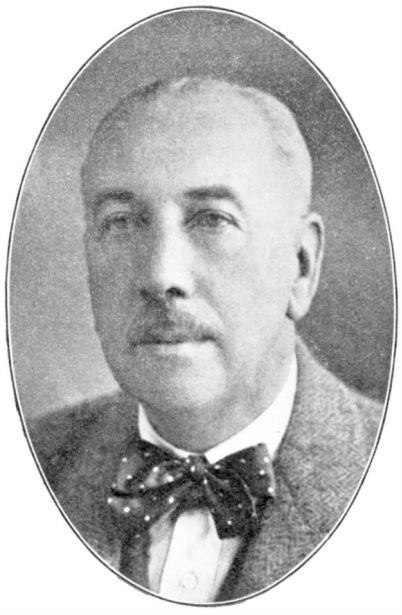
An unforgettable evening concluded with a vote of thanks to the Chairman, despite his frenzied operation of the red light!

W.C.

Honours.

The Birthday Honours List contains the name of William John Medlyn as an Officer of the Order of the British Empire. We congratulate Mr. Medlyn very cordially and would add that this honour has never been more worthily bestowed.

Mr. T. E. Herbert, M.I.E.E.,
Superintending Engineer, South Lancs.



Mr. T. E. Herbert, M.I.E.E.

Mr. T. E. Herbert was appointed as Superintending Engineer of the South Lancashire District on the 1st June. He is at present Chairman of the North Western Centre of the Institution of Electrical Engineers. He has for the past ten years occupied the position of Assistant Superintending Engineer to Mr. W. J. Medlyn, O.B.E., M.I.E.E., who has just retired.

In his younger days, Mr. Herbert was well-known as a lecturer on Telegraphy and Telephony and he is the author of various works on these subjects. The 5th edition of his "Telegraphy" was published recently and has met with a most favourable reception.

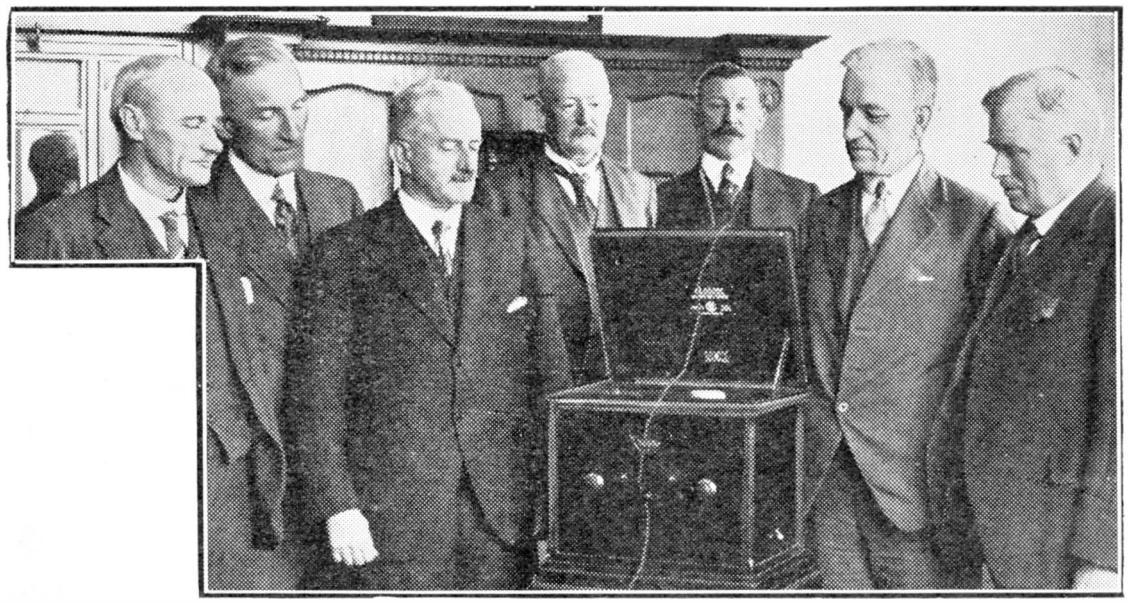
SCOTLAND WEST DISTRICT.

A distinguished statesman referring the other day to the Government Telephone Service, said they had men on their staff who might be said to have followed the telephone from its cradle, and were still ahead with all the latest marvels of wireless telephony. He might well have been describing the life of Mr. Robert Aitken, M.I.E.E., Superintending Engineer, Scotland West District, who has just retired from the Service after a distinguished career.

In connection with his severance of office, Mr. Aitken, at a large and representative gathering of the staff, presided over by Mr. R. Cunningham, was presented with a handsome 3-valve Madrigal Wireless Set and Loud Speaker in recognition of his long service and also as an appreciation of the staff's esteem and affection. The presentation was made by Major John Cameron, O.B.E., M.I.E.E., Assistant Superintending Engineer.

and Sir John Gavey in connection with the valuation of the trunk telephone circuits prior to their transference to the Government.

Mr. Aitken was also responsible for the preparation of all the early traffic and underground schemes carried out by the National Telephone Company. When the Post Office entered into an agreement to rent the underground plant to the company in London, all the arrangements on the Company's side were made by him. Prior



PRESENTATION TO MR. R. AITKEN.

A. Scott. G. Morrison. Major Cameron. R. Cunningham. J. C. Witherby. R. Aitken. G. W. Crawford.

Looking back at the milestones of life Mr. Aitken has passed—and it may be recalled that he has given many young men heartening to make some of their milestones in times of stress—it can be said that this gentleman from the "Capital of Golfland" has helped to build up and extend the British telephone system.

He has links with the old service, and many interesting recollections of these far off days when a telephone in some country villages was looked upon as something just a little uncanny. He joined in 1891 the National Telephone Company and two years later he was transferred to its engineering department.

He was what is known as "a young man o' pairts," and by 1896 he was chosen to go on a tour of the country with Mr. Dane Sinclair, the Manager of the National Telephone Company,

to the transfer of the National Telephone Company's local lines to the Post Office in 1912, he was in charge of the Company's headquarters staff in London engaged in the inventory and valuation of the plant.

When the transference to the Government took place Mr. Aitken joined the staff of the Post Office Engineer-in-Chief in London as Assistant Staff Engineer and was promoted in 1926 Superintending Engineer to the West District of Scotland.

In Mr. Aitken's early days in London he was an enthusiastic Rugby Football player and also a great pedestrian. His hobbies at the present time are Wireless and Walking — the two "W's." While a non-smoker, he has been known as a cautious Fifer to take a little whisky with his haggis, but never known to drown it.

In Caledonian circles in London and at Clan gatherings and concerts, Mr. Aitken was well-known, but, unless to his intimates, he was regarded as a typical Scot who heard everything but said very little.

Mr. Aitken will be missed in Glasgow, but he has the best wishes of many in his retirement. It is not known if he ever intends to go back to St. Andrews, his native town, in order to qualify for some of the big prizes in golf, but in the meantime he will continue to reside in Helensburgh.

MR. CHARLES WHILLIS, M.I.E.E.,

Superintending Engineer, Scotland West.

MR. CHARLES WHILLIS, M.I.E.E.

MR. WHILLIS entered the Post Office service in 1889 as a telegraphist at Newcastle-on-Tyne, but like many more Tynesiders he was not content to remain so and in 1896 he was transferred to the Engineering Department as Junior Clerk at Newcastle. He was made Sub-Engineer in 1899 and was engaged in the installation and maintenance of the old NEN system under Mr. A. W. Heaviside. Three years later Mr. Whillis came to London as 2nd Class Engineer and served in the District and in the Telephone Section at headquarters for seven years. He then returned to his old District as Executive Engineer, first at Carlisle and then in NT South and the Technical Section. He was promoted Assistant Staff Engineer in March, 1926, and was attached to the Construction Section for two years and to the Lines Section for the last two years before going to Glasgow. Mr. Whillis served on the Comprehensive Railway Agreement Committee and on the E.-in-C's Office Staff Reorganisation Committee with much acceptance. In his earlier days Mr. Whillis was a keen technical student and was C. and G. Medallist in both Honours Telegraphy and Telephony.

SOUTH WALES DISTRICT.

RETIREMENT OF MR. JOHN BLEADEN RYALL.

MR. JOHN BLEADEN RYALL.

The retirement in March of Mr. Ryall, Sectional Engineer, Gloucester, has left a gap in the now very small band of men still in the service who were associated with the development of the telephone in this country in the early eighties. Mr. Ryall entered the service of the old United Telephone Company as far back as 1883 and for thirty years he was stationed in London, his experience during that period covering practically all sides of both engineering and traffic work. In 1914 he was promoted Executive Engineer and was given charge of one of the Cardiff Sections. In 1919, on the combination of the two Cardiff Sections, Mr. Ryall went to Gloucester in charge of that Section. During

his regime of eleven years in Gloucester, there has been a very large expansion of the telephone system in the Section, 40 new exchanges having been opened in rural areas alone, while the conversion of the Gloucester and Cheltenham exchanges to Automatic working a few years ago was carried out to a successful conclusion under Mr. Ryall's direction. The installation of the Gloucester Repeater Station was another important piece of work.

Enthusiastic and keen about his work, Mr. Ryall was himself a hard worker and by precept and example encouraged all members of his staff to follow his lead in that respect. He was held in high esteem by all ranks, who appreciated the care Mr. Ryall took to be scrupulously fair to everyone, while his generous and sympathetic nature was always responsive to a case in which a man was in any kind of trouble. In the exercise of his official duties, Mr. Ryall added to his thorough knowledge and long experience a habit of applying what may perhaps be described as a common-sense test to the various problems with which he had to deal. To this quality of mind and to his genial disposition, much of the considerable success which Mr. Ryall achieved in the Gloucester Section is undoubtedly due. He is widely-known and popular in Gloucester, where he was a member of the Rotary Club. It is understood that he intends to continue living in Gloucester, for the immediate future at any rate. Mr. Ryall is an enthusiastic motorist and, now that he has plenty of time at his disposal, he will no doubt spend part of it in seeing the country more thoroughly than he has had an opportunity of doing before.

On 27th May Mr. Ryall was presented by Mr. Terras with a gold watch subscribed for by the members of the Gloucester Section Staff and by his colleagues in other parts of the South Wales Engineering District and on the District Manager's and Postmasters' staffs. All his old friends hope he may be long spared to enjoy his years of retirement.

NORTH WALES DISTRICT.

Mr. George William Billingham.

On the 18th January last, Mr. G. W. Billingham retired from the position of Executive Engineer of the Birmingham External Section, having completed 46 years in the Department's service.

Mr. G. W. Billingham.

Mr. Billingham entered the Telegraph Service in January, 1884, and was appointed S.C. & T. in August of that year at Birmingham.

Being studiously inclined, he applied himself to technical studies, and was transferred to the Superintending Engineer's Office of the then South Midland District at Birmingham, in July, 1897, as Junior Clerk. The engineering side of the service presenting the greater appeal, he became a Sub-Engineer in August of the following year, taking up duty in the Chester Section. Four years later he was promoted to Second Class Engineer at Bolton, where he remained until 1908. In that year he was attached to the Survey Staff of the Engineer-in-Chief's office, spending three years on valuation work preparatory to the transfer of the National Telephone Company's plant to Post Office control.

He was promoted to the rank of Executive Engineer in December, 1911, and was posted to the Bangor Section. He was transferred to Chester in 1915, and in August, 1917, took over control of the Birmingham External Section, where he spent a strenuous time for nearly thirteen years.

At the time of the transfer the Birmingham

and Black Country areas were left with a very inadequate underground plant system, and the restrictions on expenditure imposed during the War period rendered the position worse. For many years the Section Staff were busily engaged in laying large quantities of duct and cable in the endeavour to overtake arrears, and in preparation for the change-over to automatic working. Mr. Billingham only saw the beginning of the change-over, but the work of his successor in completing the extensive programme will be greatly facilitated by the preparatory work carried out under his control.

As an administrator, Mr. Billingham inspired his staff with confidence and gained their loyalty and respect. He was ever willing to take up the cudgels in their interests, and was always ready to assist any member of the staff, to whom he was always accessible for consultation. His close relationship with the staff was also extended to their recreation; he was a keen participator in numerous billiard handicaps, and devoted much time to the Cricket Club of which he was President. In the latter he was ably supported bv Mrs. Billingham.

At a Smoking Concert held recently, which was attended by about 200 members of the Engineering, Traffic and Telegraph Staff and other friends, Mr. Billingham was presented with a quantity of pewter ware, a travelling case and a loud speaker, and Mrs. Billingham was also asked to accept a valuable gold bangle. The presentation was made by Mr. R. A. Weaver, M.I.E.E., the Superintending Engineer of the District, who, speaking in high terms of Mr. Billingham's ability and personal attributes, expressed the view that his outstanding characteristic was his absolute dependability on all occasions. He was supported by Major H. Brown, O.B.E., R.E., Asst. Engineer-in-Chief, Mr. F. H. Horner and Mr. G. Richardson, old friends of many years' standing, all of whom spoke in glowing terms of their colleague and expressed their good wishes for his future. Many members of the staff voiced their appreciation of their late chief, and Mr. R. P. Collins, in a humorous speech, asked his acceptance of a framed photograph of the Cricket Team.

An excellent musical programme was arranged, the whole of the items being provided by members of the Department's Staff, and a thoroughly enjoyable evening was closed by the singing of Auld Lang Syne.

SOUTH EASTERN DISTRICT.

Automatic Telephones.—The transfer of the Maidstone Area to Automatic working was very successfully carried out on the 26th April, 1930.

The work in connection with the transfer of the Folkestone Area is progressing satisfactorily, with April, 1931, as the prospective date for transfer. The area includes the following Exchanges: — Folkestone, Cheriton, Hythe, Lyminge and Sandgate.

Main Cables.—The following main cables are in course of construction:—

Anglo-Belgian Cable. 7 Quad continuously loaded, Canterbury *via* Dumpton Gap to La Panne.

Anglo-French Cable. 104 pr/20 P.C. Quad cable with 56 prs. pot loaded Canterbury to Seabrook, 7 Quad continuously loaded cable Seabrook to Le Portel.

Brighton-Hastings. 38 pr/70 P.C. Quad cable. Hastings to Bexhill Section.

Dover-Folkestone. 38 pr/40 P.C. Quad cable.

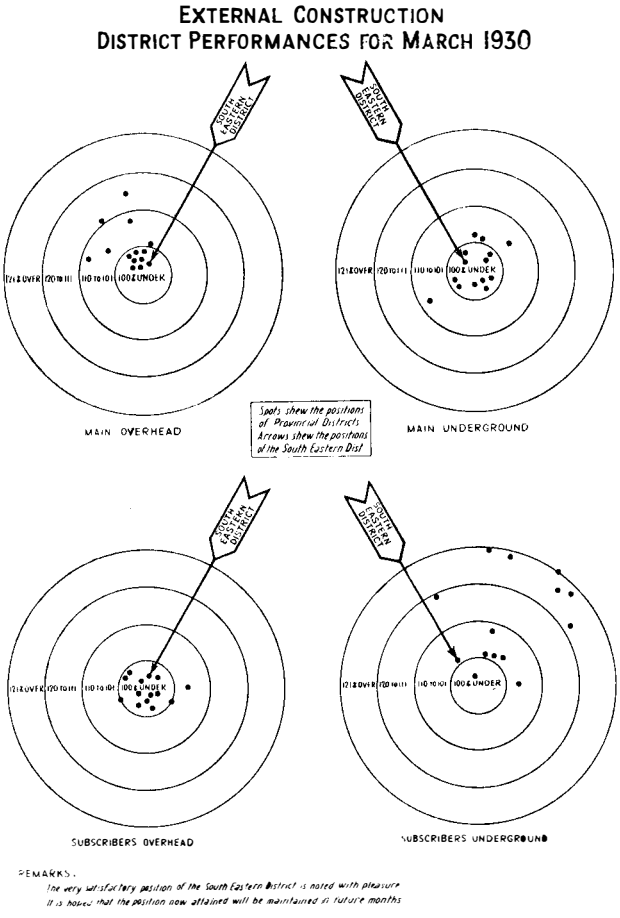
Polegate-Hailsham. 38 pr/70 P.C. Quad cable, Polegate to Horeham Road. 28/70 P.C. Quad, Horeham Road to Hailsham.

Pitts Head—Haywards Heath. 28 pr/70 P.C. Quad cable.

External Construction Costs.—The problem of getting external work performed at the rates considered by the Engineer-in-Chief to be reasonable has exercised the minds of all supervising officers in the District since the Performance Rating Scheme was initiated. At the outset arrangements were made to circulate to foremen in each Inspector's area a list of their own and their colleagues' performances. This, though in some respects effective, led to a certain amount of discouragement on the part of foremen whose high percentages were due to causes beyond their control. A way was sought to maintain the men's interest in the matter without confusing them with references to graphs or schedules. The treatment of the Section as a team for comparison with other Sections in the

District and the District as a whole for comparison with other Districts was thought to be the fairest method and the one most likely to attain the desired result. By treating the Sections as teams the difficulty arising from inequalities in the grade of work is overcome. So far as the means for presenting the results to the men are concerned it was thought that the most easily understood and the most striking arrangement would be to record the results in target form with arrows to indicate the position of each team as shown in the Fig.

There is ample evidence to prove that the men are keenly interested in securing a satisfactory position for their Section on the diagrams issued monthly, and since the first issue of targets the performance ratings have materially improved throughout the District.



Arrows show the position of the S.E. District on the work targets.

SOUTH MIDLAND DISTRICT.

The outstanding feature of the opening months of this year was the great wind storm of the 12th January from a W.S.W. direction. Its effects on the overhead plant in the South Midland District were worse than any experienced in late years. Throughout the area routes were brought down by falling trees and every main overhead line was affected. In many cases successive breaks occurred for long stretches, miles in extent. The damage was spread over the whole of the District and the work of repair presented a difficult problem of organization.

Blocked roads and the continuance of the stormy conditions rendered the work of preliminary clearing very difficult, but by the end of a week communication was established on most of the main line routes. Special attention was given to the lines carrying B.B.C. circuits, so as to ensure that the arrangements for broadcasting His Majesty's speech at the Naval Conference on the 21st January should be satisfactory. All circuits of the Leafield W.T.S. were broken down, but by the evening of the 15th service was given on one line and restoration of the remaining circuits followed quickly.

The permanent repairs have thrown a heavy burden on the District. The extent of the damage called for the best efforts of the Staff and this was given without stint by all ranks.

THE INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS.

THE Annual General Meeting of the Institution was held at the Institution of Electrical Engineers, London, on Tuesday, May 13th, 1930. The Chair was taken at 5 p.m. by the President, Colonel Sir Thomas Fortune Purves, M.I.E.E.

The following Agenda was then carried through :—

Presentation of Annual Report of Council.

Presentation of Statement of Accounts for Year 1929-30.

Resolution that Annual Report and Statement of Accounts be accepted.

Vote of thanks to retiring Members of Council.

Presentation by the President of the Medals for Session 1928-29.

AWARD OF MEDALS FOR SESSION 1928-29.

Senior Silver Medal to Mr. W. G. Radley, B.Sc. (Hons.), A.M.I.E.E., for his Paper No. 121 on " X-rays and the Structure of some Engineering Materials."

Senior Bronze Medal to Mr. A. J. Aldridge, A.C.G.I., A.M.I.E.E., for his Paper No. 124 on " The Measurement of Sound and its Application to Telephony."

PRINTED PAPERS.

The following is a list of the printed papers issued to the Membership during the year :—

No. 121. " X-rays and the Structure of some Engineering Materials," W. G. Radley, B.Sc.(Hons.), A.M.I.E.E.

No. 122. " The Measurements of Relay Times," R. W. Palmer, A.M.I.E.E.

No. 123. " Modern Electrical Illumination," J. J. Edwards, B.Sc.(Eng.), A.C.G.I., D.I.C.

No. 124. " The Measurement of Sound and its Application to Telephony," A. J. Aldridge, A.C.G.I., A.M.I.E.E.

ESSAY COMPETITION.

The prize winners in the recent Essay Competition, arranged in order of merit, are as follows :—

1. W. A. Stripp, Testing Branch, Birmingham. " Phototelegraphy."
2. W. H. B. Cooper, Repeater Station, Marlborough. " The Thermionic Valve as a Speech Frequency Amplifier."
3. R. J. S. Tuddenham, Radio Section, E.-in-C.O. " The Thermionic Valve."
4. A. F. Street, Bedford. " The Nature of Electricity."
5. H. W. Jarvis, Brighton. " The Siemens No. 16 Key Sending " B " Position."

The Council has decided to award Certificates of Merit to the following three competitors who were next in order of merit :—

6. W. H. Maddison, London District. " The Physics of the Thermionic Valve."
7. R. N. Renton, Circuit Laboratory, E.-in-C.O. " Interconnection of Automatic and Manual Exchanges."
8. T. A. Marks, Petersfield, Hants. " Notes on Exchange Construction by Contractors."

The number of essays submitted was 42 and although the number is somewhat smaller than in previous years the Judges reported that the average standard of the essays submitted is high.

COUNCIL FOR THE YEAR 1930-31.

The constitution of the Council for the year 1930-31 will be as follows :—

Chairman—Mr. E. H. Shaughnessy.

Honorary Treasurer—Mr. C. J. Mercer.

Representing Staff of the Engineer-in-Chief's Office—
Mr. B. O. Anson and Mr. C. W. Brown.

,, Executive Engineers—
London : Mr. W. C. Burbridge.
Provinces : Capt. N. F. Cave-Browne-Cave.

,, Asst. & Second Class Engineers—
London : Mr. J. Prescott.
Provinces : Mr. G. Bailey.

,, Chief Inspectors—
London : Mr. A. Miller.
Provinces : Mr. W. Weightman.

Representing Clerical Staff—
London: Mr. E. H. M. Slattery.
Provinces: Mr. J. Mawson and Mr. A. C. Smith.
,, Inspectors—
London: Mr. N. Layton.
Provinces: Mr. R. P. Collins.
,, Draughtsmen—
London and Provinces: Mr. R. J. Stewart.
Secretary—Mr. P. G. Hay.

LONDON CENTRE.

The Annual Meeting of the Institution held on the 13th May was followed by a meeting of the London Centre, at which a paper by Messrs. J. M. Owen and J. A. S. Martin, on "Composited Telephone and Telegraph Working," was read before a large audience. Mr. Owen read the paper and Mr. Martin replied to the discussion, which was taken part in by a number of well-known telegraph and transmission experts. The paper was illustrated by lantern slides.

LOCAL CENTRE NOTES.

SOUTH LANCS. CENTRE.

The Sixth Meeting of the Session was held on Monday, March 10th, 1930, when a paper on "Composite Telegraph and Telephone Working" was presented by Messrs. J. M. Owen, A.M.I.E.E., and J. A. S. Martin, of the Engineer-in-Chief's Research Section. The paper proved to be of considerable interest and a very useful discussion resulted.

The seventh and final meeting of the Session was held on Monday, April 7th, 1930, when a paper on "The Manchester Repeater Station" was read by Mr. S. Jackson. The paper dealt very fully with the lay-out of the Station, the circuit and cabling arrangements for 2-wire, 4-wire, and cord circuit repeaters, and the routine work necessary in the lining up and bringing the repeater units into use. On account of its length the paper had to be somewhat abbreviated, but with the aid of a series of lantern slides the author was able to present adequately the main features of the paper. A good discussion followed.

Before the meeting closed a vote of thanks was passed to Mr. W. J. Medlyn for his services as Chairman of the South Lancashire Centre over a long and memorable period. Several speakers paid tribute to the excellent manner in which he had undertaken the work and emphasised how the prestige of the Institution had been raised largely through his unsparing efforts.

NORTH WESTERN CENTRE.

The closing meeting of the 1929-30 Session was held in the Lancaster Road Institute, Preston, on the 17th March, 1930, when a paper entitled "Cells" was read by Mr. T. Woodhouse, A.M.I.E.E.

The Chairman of the Centre (Mr. J. M. Shackleton) presided.

Mr. Woodhouse first dealt with Primary Cells, their construction and maintenance. He then proceeded to deal at length with the subject of Secondary Cells and covered construction, installation, charging and maintenance. The lecture was illustrated by lantern slides and was followed by a lengthy discussion.

D.B.

SESSION 1930-31.

LOCAL ORGANIZATION.

Chairman—Mr. J. M. Shackleton, M.I.E.E.

Vice-Chairman—Mr. S. Upton, M.I.E.E.

Committee—Messrs. H. Butterworth, A. S. Carr, B.A., A.M.I.E.E., E. Hopper, A.M.I.E.E., W. H. Lane, W. G. Morris and H. F. Perry.

Librarian—Mr. H. Howarth.

Secretary—Mr. D. Barratt, Office of the Superintending Engineer, G.P.O., Cross Street, Preston.

THE INSTITUTION OF P.O. ELECTRICAL ENGINEERS.

Officers of Colonial and Foreign Telegraph Administrations who are engaged in Electrical Engineering Works may be admitted as Colonial and Foreign Corresponding Members respectively, after application.

Subscription payable annually in advance on 1st April in each year:

Colonial Members	... ...	£1 0 0
Foreign ,,	... ...	£1 10 0

These sums include Annual Subscription to the Journal of P.O. Electrical Engineers and the supply of all Professional Papers issued during the period covered by subscription.

Forms of application for Colonial and Foreign Membership can be obtained on application to

The Secretary,
Institution of P.O.E. Engineers,
G.P.O. (Alder House), E.C.1,

or the undermentioned gentlemen who have kindly agreed to act as representatives of the Institution in their respective countries:—

R. Badenach, Esq., B.Sc. (Melb.),
Chief Engineer's Office,
Postmaster-General's Department,
Treasury Gardens,
Melbourne, C.2,
Australia.

H. C. Brent, Esq.,
District Telegraph Engineer's Office,
Wellington, N.Z.

N. N. Banerjee, Esq., A.M.I.E.E. (Ind.),
Divisional Engineer, Telegraphs,
Calcutta West Division,
8, Wellesley Place,
Calcutta,
India.

A. T. Kingston, Esq., M.B.E., A.M.I.E.E.,
Office of the Chief Engineer,
Telegraphs & Telephones,
C.T.O.,
Colombo,
Ceylon.

A. J. Kellaway, Esq.,
Department of Posts and Telegraphs,
P.O. Box 366,
Pietermaritzburg,
South Africa.

F. L. Jephcott, Esq., A.M.I.E.E.,
Chief Engineer's Department,
G.P.O. Box 91,
Salisbury,
South Rhodesia.

BOOK REVIEWS.

"Telegraphy." By T. E. Herbert, M.I.E.E. Fifth Edition. 1199 pp., 750 illustrations. Price 20/- net. Published by Sir Isaac Pitman & Sons, Ltd.

The new edition of this well known text-book covers a wider range than previous editions and embraces the recent machine telegraphy developments in the United Kingdom. The Creed Teleprinters are described at some length with numerous illustrations, and other similar apparatus has not been overlooked.

The Baudot system, including the Mendonça governor, is adequately dealt with in 95 pages.

Voice Frequency telegraph systems, such as the Siemens, Halske, General Electric, S.E.L.T., Western Electric and Wald, are succinctly explained and the achievements of a single channel high speed voice frequency circuit are briefly recorded.

A chapter is devoted to multichannel circuits for double superposed and subaudio methods of working telephones and telegraphs simultaneously, and some of the latest developments are portrayed.

Other new and useful matter is contained in Appendix A, which deals with the recent investigations into the speed of working on loaded and unloaded cables.

The book caters specially for the needs of students, and in this respect fulfils the requirements admirably. As a reference book it can be recommended to all who are interested in the science of telegraphy.

H.K.

"The Theory of Electrical Artificial Lines and Filters." By A. C. Bartlett, B.A. Chapman & Hall, Ltd. 13/6 net.

This book gives a well balanced and comprehensive survey of the theory of lumped networks. The first chapter deals with the mathematics of T and π section artificial lines. The equations are derived from the difference equation which is obtained by an application of Kirchhoff's Law to the r'th section of a ladder network. At the end of this chapter the author gives a few examples showing how the theory can be applied to particular cases. The second chapter deals

with the theory of the general artificial line. The author in order to make his mathematical analysis as general as possible deals with a repeated network which is not electrically symmetrical, and then, by adding the condition for symmetry, he deduces the general artificial line theory as a particular case. The original analysis contained in this chapter will enable the reader to construct and discuss artificial lines of any degree of complexity. The algebra involved, however, except in simple cases, is very heavy. In the third chapter considerable use has been made of the theory of continued fractions in order to discuss the generalised ladder network in which all the elements have arbitrary values. The author then gives a number of practical and interesting examples. The fourth chapter deals with a class of equivalent networks related to artificial lines and discusses the intimate relations that exists between these lines and hyperbolic functions. The fifth chapter discusses the networks related to the uniform transmission line. In the sixth chapter the determination of the constants of a coil loaded line are given as an example of the artificial line theory. The seventh chapter deals briefly with the theory of non-dissipative wave filters and phase correctors and concludes with a description of Boucherot's constant current networks. The next chapter discusses the geometrical aspects of the homographic transformation and its bearing on electrical networks in general. The final chapter gives a general theory of the multistage amplifier.

The book can be thoroughly recommended to readers. The mathematical treatment is brief, clear and original. The diagrams are excellently drawn and reproduced. A very fine work on an important subject.

"The Electric Wiring of Buildings." By F. Charles Raphael, M.I.E.E. 252 pp. Sir Isaac Pitman & Sons, Ltd. Price 10/6 net.

This book is written in a simple and straightforward manner so as to be equally of use to foremen and wiremen, as well as to electrical contractors and others interested in the wiring of buildings for lighting, power, and allied services such as bells, etc.

In addition to dealing with the various systems of wiring, chapters are included dealing with the necessary calculations for the sizes of cables and the provision of adequate illumination.

A statement on page 11 requires alteration in a future edition. This is to the effect that doubling the voltage of supply causes four times the current to pass through the lamp. It is obviously intended to refer to the heating effect of the current, but as written it tends to cause confusion of ideas.

J. McG.

"The Elecric and Magnetic Circuits, Alternating Current and Direct Current." By E. N. Pink, B.Sc., A.M.I.E.E. 122 pp. Sir Isaac Pitman & Sons, Ltd. Price 3/6 net.

This book has been written with the intention of helping the electrical engineering student who, having some knowledge of electricity and magnetism, wishes to study more particularly the subjects of the flow of electricity in simple and complex circuits and also magnetic circuits.

It is based on the theory of electronic flow and being pleasantly written will serve as an introduction to the study of, and calculations in connection with, electrical and magnetic circuits generally, including the use of vectors for A.C. problems.

The book is amply illustrated with diagrams and explanatory examples and is good value for the published price.

J. McG.

"Transmission Networks and Wave Filters." By T. E. Shea, M.S. Messrs. Chapman & Hall. Price 32/- net.

Mr. Shea, a member of the Bell Telephone Laboratories Technical staff, has in this book consolidated the work of a number of men in the fields of transmission networks and wave filters. In particular must be mentioned that of O. J. Zobel, in connection with the theory of wave filters, A. E. Kennelly on transmission theory, and G. A. Campbell on Fourier integral methods.

After an introductory chapter concerned with the functions that networks and filters are called upon to perform, the book is divided into three sections, the first dealing with the principles of transmission networks, the second with electric wave filters themselves and the third with the resolution of transient waves into frequency components by Fourier integral analysis.

The second section is in all probability the one of greatest general interest and develops fully the theory of " constant k " and derived " m " and double " m " sections for low pass, high pass and band filters. From the point of view of design the treatment of the effects of energy dissipation in filters is especially valuable.

The somewhat complicated theory is very well presented throughout the book and, above all, the numerous curves and diagrams are very clear.

J.G.S.

" Installations Téléphoniques." By M. R. Parésy. 6th Edition.

This work deals with the elementary principles of telephony, makes detailed reference to the apparatus employed in subscribers' installations in France, and gives a brief sketch of exchange installations, and the methods of line construction and testing of the French Administration. The book covers a field very similar to that covered by the " Workmen's Pamphlets " of the British Engineering Department and is designed suitably to meet a similar requirement.

For British engineers it is quite a pleasant exercise in Technical French.

The work is published—Bound, 53 francs; Paper covered, 43 francs—by M. Dunod, 92, Rue Buonaparte, Paris, VI.

P.J.R.

" Radio Data Charts." By R. T. Beatty, M.A., B.E., D.Sc. London. Iliffe & Sons, Ltd. Price 4/6 net.

This book is a collection of 76 alignment charts originally published as a series in the *Wireless World* and now revised and amplified for publication in book form.

The charts cover a wide range of subjects from the multiplication of volts and amperes to give watts down to the more intricate computation required for the design of inductances and transformers.

Although a few of the charts such as the volts, amperes and watts abac are of a simple type the great majority will be found to be extremely useful and labour saving. Each chart is accompanied by a page of letterpress giving instructions regarding its use and in the more intricate cases by worked out examples.

No person working on the design of radio apparatus should fail to provide himself with a set of these charts, as by their use calculations which would normally take hours can be carried out in a few minutes. A.J.G.

CURRENT LITERATURE.

The Journal of the Institution of Electrical Engineers, Vol. 68, No. 399, March, 1930.

Alternating-Current Potentiometers. C. V. Drysdale. An historical account of the evolution of the apparatus, with descriptions of the author's and other types of the instrument. Theory and accuracy are discussed and examples given of the application of the instruments for various tests.

The Impedance and Power Losses of 3-Phase Overhead Lines. P. D. Morgan and S. Whitehead. An important item, as far as communication lines are concerned, deals with the impedance of a line conductor and earth return when one phase is accidentally earthed.

Vol. 68, No. 400, April, 1930.

Water Penetration Effects in Lead Sheathed Power Cables. E. A. Beavis.

The Pressures on the Diaphragm of a Condenser Transmitter in a Simple Sound Field. W. West. Free air pressures of a sound wave may be increased at the diaghragm of a microphone in a ratio greater than 2 : 1 at certain frequencies when there is concavity in the face of the microphone. A method of calculating the magnitude of this increase is applied to the Wente type.

Alternating-Current Tests on High Speed Telegraph Cables. E. W. Smith. Paper is concerned with A.C. characteristics of loaded

telegraph cables and their relation to transmission capacity. General principles of transmission are reviewed and performances may be estimated from A.C. characteristics. Methods of testing and apparatus are discussed; departure and arrival curves constructed from theory are compared with records obtained by test. The assumed criteria for satisfactory working expressed in terms of attenuation are verified by transmission tests.

A Method of Measuring the Overall Performance of Radio Receivers. H. A. Thomas.

Address to the Sheffield Sub-Centre. Col. Sir T. F. Purves, President, I.E.E.

Measurements on Long Telephone Lines by the " Open and Closed " Method. A. Rosen. Simplified approximate formulæ are given for calculating attenuation, wave-length constant and characteristic impedance. Limits of error are ascertained and the accuracy in the measurements is determined.

Vol. 68, No. 401, May, 1930.

Surges and Over-Voltage Phenomena on Transmission Lines due to Lightning. Dr. H. Norinder.

A Direct Reading Photo-Electric Photometer for the Commercial Measurement of Incandescent Electric Lamps. G. T. Winch.

The Development of a Precision Ammeter for very High Frequencies. E. B. Moullin. Instrument measures up to 30,000 kilocycles per second and can carry unshunted a current of any magnitude.

An Ammeter for very High Frequencies. Prof. C. L. Fortescue and L. A. Moxon. A hot wire instrument intended for use at any frequency up to 100 million cycles per second.

A Method of Measuring Mechanical Impedance. Prof. E. Mallett and R. C. G. Williams.

Some Notes on the Design of a Gramophone Pick-up. G. W. Sutton.

Frequency Stabilisation of Valve Oscillators. Prof. E. Mallett.

An Instrument for Projecting and Recording the Response Curves of Electrical Circuits. Prof. C. L. Fortescue and F. Ralph.

Summary (to 1925) of European and American Data on Interference between Power and Communication Circuits. The technical report (Ref. M/T3) of the British Electrical and Allied Industries Research Association. Further information (which will be published as a P.O. Research Report) will be available during this year.

Report of Annual Dinner, 1930.

Journal of the American Institution of Electrical Engineers.

Vol. XLIX., No. 3, March, 1930.

Telephone Interference from A.C. Generators feeding directly on Line with Neutral Grounded. J. J. Smith. It is shown that the triple and non-triple harmonics in the voltage wave shape cause currents which flow in different paths on the power system.

Recent Developments in Toll Telephone Service. W. H. Harrison. Physical and technical phases of the development in recent years of " toll " (trunk in Great Britain) telephone service in America.

Acoustics of Radio Broadcasting Studios. L. E. Voorhees.

Submarine Telegraphy in the Post War Decade. L. S. Coggeshall. Deals with Regenerative Repeaters, loaded cable, 2-element cable recorder code adapted to land-line transmission, cable printer system using 2-element code, Pennot superposed cable carrier apparatus and steps taken to balance a loaded duplex cable.

Volume XLIX., No. 4, April, 1930.

Transoceanic Telephone Service Short-Wave Equipment. Technical features of the new Short-Wave Radio Stations of the Bell System. A. A. Oswald.

Calculation of Induced Voltages in Metallic Conductors. H. B. Dwight.

A Cathode Ray Oscillograph with Norinder Relay. Its design and application. P. Ackermann.

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Calculation of Protection of a Transmission Line by Ground Conductors. H. B. Dwight.

Successive Unidirectional Condenser Discharge. Shiro Sano.

Transoceanic Telephone Service. Short-Wave Transmission. Transmission features of Short-Wave Radio Circuits. Ralph Bown. Problems involved in short-wave work over long distances and bases for design of systems. Choice of frequencies, amounts of power, directive antennas, automatic gain controls in receiver and voice-operated switching devices.

STAFF CHANGES.

POST OFFICE ENGINEERING DEPARTMENT.

PROMOTIONS.

Name.	Grade.	Promoted to	Date.
Baldwin, F. G. C.	Assistant Suptg. Engineer, N. District	Superintending Engineer, N. District.	10-8-30
Herbert, T. E.	Assistant Suptg. Engineer, S. Lancs. District.	Superintending Engineer, S. Lancs. District.	1-6-30
Whillis, C.	Assistant Staff Engineer, E.-in-C.O.	Superintending Engineer, Scot. West District.	9-4-30
Ramsay, F. G.	Commander, H.M.T.S. " Monarch."	Submarine Superintendent, E.-in-C.O.	1-5-30
Francis, E. S.	Executive Engineer, N. East District.	Assist. Suptg. Engineer, S. Mid. District.	1-8-30
Partridge, T. T.	Executive Engineer, N. Mid. District.	Assistant Suptg. Engineer, S. Lancs. District.	10-4-30
Scarr, W.	Executive Engineer, Eastern District.	Assistant Suptg. Engineer, N. Wales District.	1-8-30
Fletcher, J. F.	Executive Engineer, S. Lancs. District	Assistant Suptg. Engineer, S. Lancs. District.	1-6-30
Barralet, F. O.	Executive Engineer, E.-in-C.O.	Assistant Staff Engineer, E.-in-C.O.	9-4-30
Taylor, C. A.	Executive Engineer, E.-in-C.O.	Assistant Staff Engineer, E.-in-C.O.	9-4-30
Bramwell, J. T.	Executive Engineer, N. District.	Assist. Supgt. Engineer, N. District.	10-8-30
Flavel, G. H.	Chief Officer, H.M.T.S. " Monarch."	Commander, H.M.T.S. "Monarch."	1-5-30
Pratt, R. O.	Second Officer, H.M.T.S. "Monarch."	Chief Officer, H.M.T.S. "Monarch."	1-5-30
Holland, A. E.	Fourth Officer, H.M.T.S. "Monarch."	Second Officer, H.M.T.S. "Monarch."	1-5-30
Boryer, W. F.	Assistant Engineer, London District.	Executive Engineer, London District.	1-4-30
Watson-Weatherburn, S. W. ...	Assistant Engineer, Scot. East District.	Executive Engineer, N. Mid. District.	27-4-30
Curling, R.	Assistant Engineer, Scot. West District.	Executive Engineer, Scot. West. District.	19-3-30
Speight, A.	Assistant Engineer, E.-in-C.O.	Executive Engineer, E.-in-C.O.	19-3-30
Bastow, F.	Assistant Engineer, E.-in-C.O.	Executive Engineer, E.-in-C.O.	1-5-30
Hembrough, J. R.	Assistant Engineer, E.-in-C.O.	Executive Engineer, E.-in-C.O.	10-7-30
Gregory, H. J.	Assistant Engineer, E.-in-C.O.	Executive Engineer, E.-in-C.O.	1-5-30
Bartlett, A. W.	Assistant Engineer, London District.	Executive Engineer, London District.	1-7-30
Broomhead, A.	Assistant Engineer, S.E. District.	Executive Engineer, N. Mid. District.	4-7-30
Pearson, E. A.	Assistant Engineer, N. Wa. District.	Executive Engineer, S. Wa. District.	1-8-30
Osborn, W. M.	Assistant Engineer, E.-in-C.O.	Executive Engineer, E. District.	1-8-30
Field, A. W.	Assistant Engineer, N.W. District.	Executive Engineer, S. Lancs. District.	To be fixed later.
Day, W.	Assistant Engineer, London District.	Executive Engineer, S. Wa. District.	
Talbot, H. J.	Chief Inspector, London District.	Assistant Engineer, London District.	1-4-30
Cosh, L. G.	Chief Inspector, E.-in-C.O.	Assistant, Engineer, E.-in-C.O.	21-3-30
Roe, E. A.	Chief Inspector, N. Mid. District.	Assistant Engineer, N. Mid. District.	7-5-30
Casemore, G.	Chief Inspector, S. East District.	Assistant Engineer, S. East District.	21-5-30
Gunston, J. A.	Chief Inspector, Eastern District.	Assistant Engineer, Scot. East District.	27-4-30
Lister, B.	Chief Inspector, S. West District.	Assistant Engineer, E.-in-C.O.	2-4-30
Hopps, F.	Chief Inspector, N. Mid. District.	Assistant Engineer, N. Mid. District.	1-6-30
Lambert, S.	Inspector, N. Wales District.	Chief Inspector, N. Wales District.	1-4-30
Fisher, G. E.	Inspector, Scot. West District.	Chief Inspector, N. Ire. District.	1-5-30
Green, W.	Inspector, Eastern District.	Chief Inspector, Eastern District.	30-3-30
Bingham, A. H.	Inspector, S. West District.	Chief Inspector, S. West District.	6-4-30
Smith, P. G.	Inspector, Testing Branch.	Chief Inspector, Testing Branch.	23-1-29
Bocock, W.	Inspector, N. West District.	Chief Inspector, London District.	13-4-30
McIntosh, H. B.	Inspector, Scot. West District.	Chief Inspector, N. Mid. District.	6-4-30
Brooke, C. H.	Inspector, London District.	Chief Inspector, London District.	17-7-29
Thatcher, C. H.	Inspector, N. Mid. District.	Chief Inspector, London District.	20-4-30
Akester, A.	Inspector, N. East District.	Chief Inspector, London District.	1-4-30
Messenger, C. W.	Inspector, London District.	Chief Inspector, London District.	18-9-29
Smith, G.	Inspector, London District.	Chief Inspector, London District.	28-3-30
Cain, S. J.	Inspector, Eastern District.	Chief Inspector, Eastern District.	
Missen, H.	Inspector, E.-in-C.O.	Chief Inspector, E.-in-C.O.	23-3-30
Howe, H. B.	Inspector, London District.	Chief Inspector, London District.	1-10-29
Harris, R.	Inspector, S.W. District.	Chief Inspector, S.W. District.	
Warren, H. G.	Inspector, N.Mid. District.	Chief Inspector, N. Mid. District.	To be fixed later.
Hibberd, R. M.	Inspector, N.Mid. District.	Chief Inspector, N. Mid. District.	
Thompson, J. W.	Inspector, S. Lancs. District.	Chief Inspector, N. Mid. District.	
Reeves, T. F.	Inspector, S. Mid. District.	Chief Inspector, S. Mid. District.	
Stark, W.	Inspector, Scot. East District.	Chief Inspector, Scot. E. District.	
Collins, T. J....	Inspector, S. Mid. District.	Chief Inspector, E. District.	

PROMOTIONS (*Continued*).

Name.	Grade.	Promoted to	Date.
Vick, E. H.	Inspector, S. Lancs. District.	Chief Inspector, S. Lancs. District.	To be fixed later.
Scott, F.	Inspector, N.E. District.	Chief Inspector, N.E. District.	
Mitchell, T. A.	Inspector, London District.	Chief Inspector, S.E. District.	
Hill, R. J.	Inspector, E.-in-C.O.	Chief Inspector, E.-in-C.O.	
Maddocks, D. C.	Inspector, London District.	Chief Inspector, London District.	
Owen, W.	Skilled Workmen, Cl. I. S. Lancs. District.	Inspector, S. Lancs. District.	24-11-29
Robinson, G. D.	Skilled Workmen, Cl. I., Testing Branch.	Inspector, Testing Branch.	4-5-29
David, A. J.	Skilled Workmen, Cl. I., South Wales District.	Inspector, S. Wales District.	21-1-29
Stewart, J.	Skilled Workmen, Cl. I., Scot. West. District.	Inspector, Scot. West District.	23-3-30
Benson, W. K.	Skilled Workmen, Cl. I., S. Lancs. District.	Inspector, S. Lancs. District.	19-1-30
Anderson, T. N.	Skilled Workmen, Cl. I., Scot. West. District.	Inspector, Scot. West District.	8-11-28
Clayton, F. E.			
Webber, R. N.			11-4-29
Scrivener, S. W.	Skilled Workmen, Cl. I., Eastern District.	Inspector, Eastern District.	To be fixed later.
Banyard, S. C.			
Rance, A. W.			
O'Connor, W.	Skilled Workmen Cl. I., Scot. West District.	Inspector, Scot. West District.	To be fixed later.
Blair, A. M.			
Love, R. C.			

APPOINTMENTS.

Name.	From	To	Date.
Lowry, W. R. H.	Open Competition.	Probationary Inspector.	7-4-30
Cook, A.			7-4-30
Turner, H. A.			6-5-30

RETIREMENTS.

Name.	Rank.	District.	Date.
Medlyn, W. J.	Superintending Engineer.	S. Lancs.	31-5-30
Aitken, R.	,, ,,	Scot. West.	31-3-30
Sell, L. J.	Assistant Engineer.	S. East.	18-4-30
Mears, T.	,, ,,	E.-in-C.O.	31-3-30
Dawson, A. E.	,, ,,	N. Mid.	31-5-30
Strong, E.	,, ,,	E.-in-C.O.	27-3-30
Davidson, J.	,, ,,	N. Ireland.	31-3-30
Walker, J. C.	,, ,,	N. East.	31-3-30
Firth, S. S.	,, ,,	N. Mid.	31-5-30
Montgomery, H.	Chief Inspector.	Scot. West.	30-4-30
Mathewson, J. I.	,, ,,	Scot. East.	16-4-30
Briscoe, H. R.	Inspector.	S. Lancs.	31-3-30
Hayward, F. W.	,,	London.	31-3-30
Draper, T.	,,	N. Wales.	21-4-30
Randell, E.	,,	London.	30-4-30

DEATHS.

Name.	Rank.	District.	Date.
Hives, F. G.	Assistant Engineer.	S. Mid.	29-3-30
Taylor, G.	Inspector.	Scot. East.	7-3-30

CLERICAL ESTABLISHMENT.

PROMOTIONS.

Name.	District.	From	To	Date.
Bell, G. W.	E.-in-C.O.	Staff Officer.	Principal Clerk.	1-4-30
Rhodes, H.	,,	Executive Officer.	Staff Officer.	11-4-30
Robinson, W. D.	Research.	Executive Officer.	Staff Officer.	17-5-30
Brown, B. M.	Equipment.	Executive Officer.	Staff Officer.	5-6-30
Buxton, A. D.	Contracts.	Acting Executive Officer.	Executive Officer.	17-5-30
Wilson, P. A. V.	Radio.	Clerical Officer.	Executive Officer, Staff.	5-6-30
Murray, C. E.	Accounts.	Clerical Officer.	Acting Executive Officer, Equipment.	5-6-30
Child, A. J.	E.-in-C.O.	Actg. Executive Officer.	Executive Officer.	26-2-30
La Croix, A.	,,	Clerical Officer.	Executive Officer.	11-4-30
Buxton, A. D.	,,	,, ,,	Actg. Executive Officer.	18-4-30
Timson, J. R.	Ldn.	Executive Officer.	Staff Officer.	1-6-30
Tucker, E. J.	,,	Clerical Officer.	Higher Clerical Officer.	1-5-30
Thorne, H. H.	,,	,, ,,	,, ,,	1-5-30
Lines, E. R.	,,	,, ,,	,, ,,	23-5-30

RETIREMENTS.

Name.	District.	Grade.	Date.
Ryder, A.	N.E.	Higher Clerical Officer.	10-4-30
Hewins, H. J.	N.E.	,, ,,	30-4-30
Ellery, A. Q.	LED.	,, ,,	30-4-30
Rodway, C. H. S.	LED.	Staff Officer.	31-5-30

DEATHS.

Name.	District.	Grade.	Date.
Williams, J. P.	S. Lancs.	Higher Clerical Officer.	25-5-30
Tennant, T. M.	E.-in-C.O.	Staff Officer.	5-5-30

TRANSFERS.

Name.	Grade.	From	To	Date.
Elsworth, C.	Higher Clerical Officer	S. Lancs.	N.E.	25-5-30.

COMMUNICATIONS.

All Remittances and Communications should be addressed to the MANAGING EDITOR, P.O.E.E. JOURNAL, Engineer-in-Chief's Office, Alder House, London, E.C.1.

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