The L. M. Ericsson Review

VOLUME 1

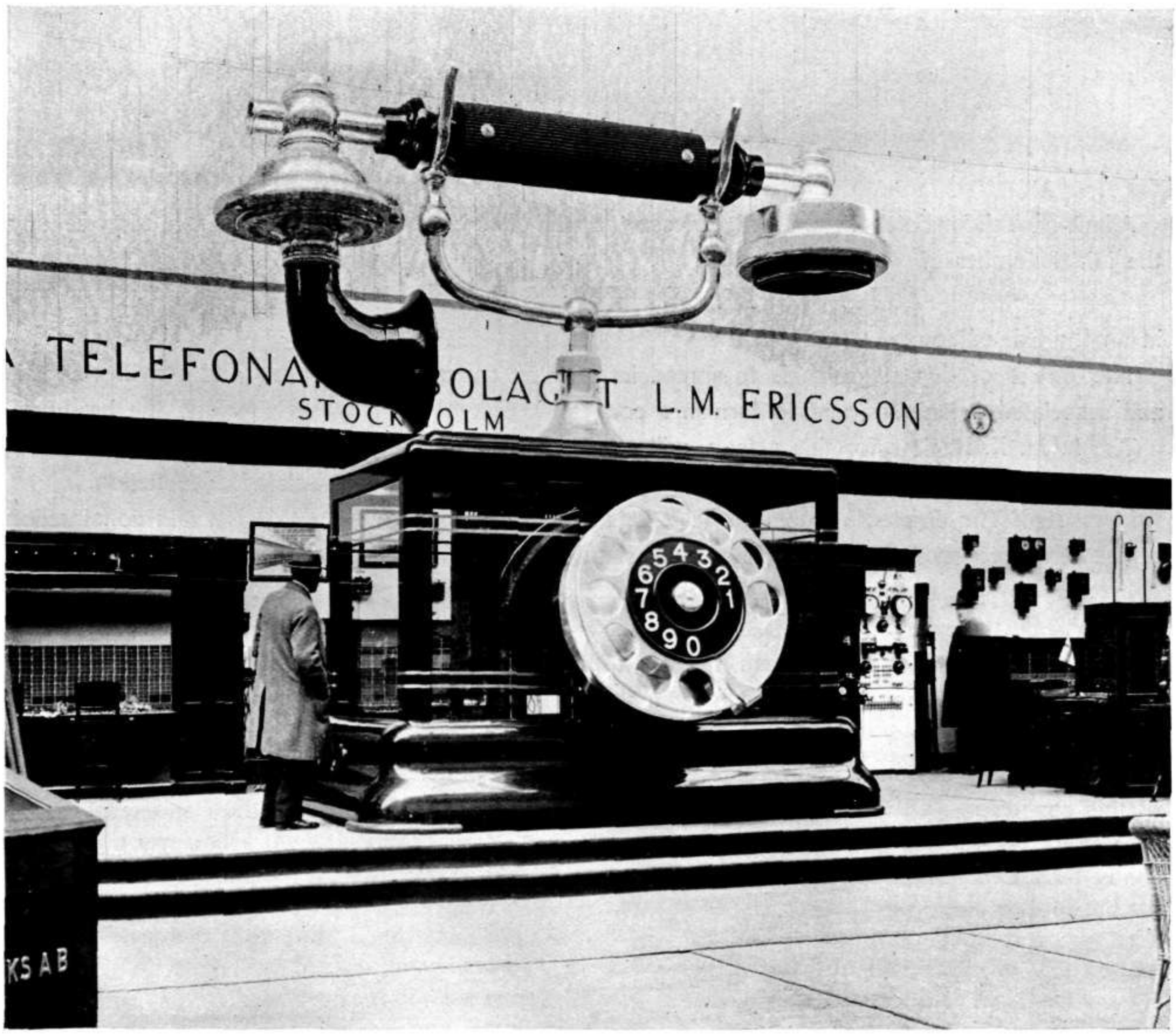
1924

Contents

ALLMÄNNA TELEFONAKTIEBOLAGET L.M. ERICSSON

The L. M. Ericsson Review

VOL. 1 JAN.—FEB. 1924 Nos. 1 & 2



THE L. M. ERICSSON STAND AT THE GOTHENBURG EXHIBITION 1923

ENGLISH EDITION

L. M. Ericsson

THE L. M. ERICSSON REVIEW

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JOURNAL OF

ALLMÄNNA TELEFONAKTIEBOLAGET L. M. ERICSSON, STOCKHOLM.

HEMMING JOHANSSON, Director.

TORSTEN AF GEIJERSTAM, Editor.

Issued monthly. Yearly subscription rate: 7/–

All communications and subscriptions to be forwarded to the Editor.

ANNOUNCEMENT.

Allmänna Telefonaktiebolaget L. M. Ericsson, Stockholm, herewith have the pleasure of presenting the initial number of

THE L. M. ERICSSON REVIEW

in an English edition.

The object of this magazine is to spread information concerning the work and activities of this and associated enterprises, and to furnish a connecting link between these latter and the head firm.

The L. M. E. Review, for this reason, will contain articles relating mainly to design, construction, and installation within the fields of telephony, railway signalling, and fire-alarm construction.

It is also The Review's intention to take up for discussion points of design and construction which have not yet reached a stage of final standardization. Further, notices regarding orders and deliveries of special interest together with data concerning the development of this and affiliated firms will be published.

The Review's staff of contributors includes officials and employees of both the head and branch offices, as well as other experts occupied in the same field of activity.

The L. M. E. Review hopes, through its columns, to prove both useful and of interest to the Company's many customers as well as to all who take an interest in the activities and development of this concern.

THE EDITOR.

Growth and Present Development of the L. M. Ericsson Organization.

The name of L. M. Ericsson was associated with but one concern, i. e. the head firm in Stockholm, when, during the nineties, it began to be recognized throughout the world as a mark of quality on telephones and switchboards. This firm, founded in 1876 and therefore as old as the telephone itself, carried on its work as a private concern under the name of L. M. Ericsson & Co. until 1896, in which year it was taken over by a joint stock company — Aktiebolaget L. M. Ericsson & Co. (The L. M. Ericsson Co., Ltd.). There were no foreign branch offices at this time, neither was the staff of representatives very large. The constantly growing demand for the company's products, however, together with the express desire of its customers to be in closer contact with the firm, necessitated, time after time, the establishing of branch offices in various foreign countries and the successive increase of its permanent staff of representatives.

R 33 H. T. Cedergren.

R 34 L. M. Ericsson.

In certain foreign countries, where the Government Departments themselves were large customers, the manufacture of ordered goods in the country of destination itself was made a stipulation for further business. This gave rise to the establishing of branch factories, the first of which was put in operation in St. Petersburg in 1897.

The first foreign office not combined with a manufacturing plant was established in London, in 1898. The scope of the company was thus broadened from time to time, so as to finally extend over the entire civilized world.

Meanwhile — and parallel with the Ericsson company — another Swedish enterprise had successfully pushed its way to the front in the field of telephony, i. e. Stockholms Allmänna Telefonaktiebolag (The General Telephone Company of Stockholm, Ltd.), founded in 1883 by H. T. Cedergren. During its first years of activity this company built and operated exchanges in Stockholm and other parts of the country, but in 1891 an agreement with the Royal Telegraph Office was arrived at whereby the plants and operating rights of the company in the provinces were acquired by the Swedish Government, reducing the field of activity of the company to Stockholm and surroundings.

After having reached a prominent position and acquired a high reputation in the world's telephone industry, the necessity for expansion beyond the comparatively small field of operation offered in Sweden made itself more and more urgently felt. The first attempt to gain a footing on foreign territory resulted in the acquisition, in 1900, of a franchise for operating telephone exchanges in Moscow and Warsaw, and subsidiary companies were formed to take charge of this work.

In 1908 Stockholms Allmänna Telefonaktiebolag surrendered its Swedish operating rights to a newly formed subsidiary company, Aktiebolaget Stockholmstelefon (The Stockholm Telephone Co., Ltd.) This concern sold its telephone systems to the Royal Telegraph Office in 1918, but continued under the name of Allmänna Industri Aktiebolaget H. T. Cedergren (The H. T. Cedergren General Industries, Ltd.) with the manufacture of miscellaneous line equipment, begun several years earlier.

In the above mentioned year 1918 the private Swedish telephone interests, consisting of Aktiebolaget L. M. Ericsson & Co. and Stockholms Allmänna Telefonaktiebolag formed a coalition, the present Allmänna Telefonaktiebolaget L. M. Ericsson (The L. M. Ericsson General Telephone Company, Ltd.).

After this fusion Allmänna Industri Aktiebolaget H. T. Cedergren remained the resulting company's most important subsidiary company from a financial point of view. In 1921 this company was also merged into the head concern.

This, in short, is the history of the Stockholm Ericsson company's gradual development. As has already been mentioned, it has time after time created a large number of branch companies in different parts of the world, and forms — together with its agencies, subsidiary companies, etc. — a net which covers practically the whole world.

A synopsis of this organization is given below, in which, however, the agents employed by the various companies are not included.

Allmänna Telefonaktiebolaget L. M. Ericsson in Stockholm has the following daughter companies:

(a) Manufacturing companies (Location of head office indicates nationality of concern).

The British L. M. Ericsson Mfg. Co., Ltd., Head office: International Buildings, 67/73, Kingsway, London, W. C. 2, and factory at Beeston, Notts.

Russische Actien-Gesellschaft L. M. Ericsson & Co. Office and works: Gr. Sampsoniewsky Prospekt 70, Petrograd.

Société des Téléphones Ericsson, Main office: 37, Boulevard Haussmann, Paris, and works at Colombes, Seine.

»Ericsson» Oesterreichische Elektrizitäts-Aktiengesellschaft vorm. Deckert & Homolka, with office and works Pottendorferstrasse 25/27, Vienna XII.

»Ericsson» Ungarische Electricitäts-Aktiengesellschaft vorm. Deckert & Homolka, with office and works Fehérvári-ut. 70, Budapest I.

»Ericsson» Elektrizitäts-Kommanditgesellschaft Scholta & Co. Main office: Malé nám 1, Prague; branch office in Brünn and works in Prague.

Nederlandsche Ericsson Telefoonfabrieken, with the main office at Heerengracht 370, Amsterdam; and works at Gilze-Reijen.

Telephonbauaktiengesellschaft of Moscow, for the building of telephone plants and the manufacture of line equipment, with office and works in Moscow.

Compañía Española de Teléfonos Ericsson S. A., with the head office at Príncipe 12, Madrid, and works under construction at Getafe outside Madrid. In addition, the telephone plant of Valencia is owned by this company.

(b) Operating companies.

Empresa de Teléfonos Ericsson S. A., 2ª Calle Victoria 53 y 55, Mexico D. F., which owns the telephone system of Mexico City and the Federal District. Head office in Stockholm.

Svensk—Dansk—Ryska Telefonaktiebolaget of Moscow, which owns the telephone system of Moscow. Head office in Stockholm.

Polska Akcyjna Spółka Telefoniczna, owning telephone systems in Warsaw and other Polish cities. Main office: Zielna 37, Warsaw.

Compañía Entre-Riana de Teléfonos, which owns the telephone system of the province Entre Rios in The Argentine. Main office in Concordia.

Compañía Española de Teléfonos Ericsson, S. A., Principe 12, Madrid (see above, under manufacturing companies).

(c) Construction and sales companies.

Aktiebolaget L. M. Ericsson of Finland. Main office: Esplanadgatan 25, Helsingfors.

»Ericsson» Polska Akcyjna Spółka Elektryczna. Main office: Ceglana 11, Warsaw.

Compañía Sudamericana de Teléfonos L. M. Ericsson S. A. Main office: Esmeralda 1000, Buenos Aires.

Companhia Geral de Telephones; branch of the head company in Stockholm with offices at Rua São Pedro 106, Rio de Janeiro.

Donauländische Telephonbau- & Vertriebsgesellschaft L. M. Ericsson G. m. b. H. Main office: Pottendorferstrasse 25/27, Vienna XII.

Ericsson India Office; common branch concern for both the Stockholm company and British Ericsson, with offices at No. 15 Central Avenue, Calcutta.

Förenade Signalverkstädernas Försäljningsaktiebolag »Signalbolaget», for the sale of the company's line of railway signal equipment, with offices at Vasagatan 9, Stockholm.

Ericsson Telephone Manufacturing Co., with offices at 7 Macquarie Place, Sydney, N. S. W., and 509 Collins Street, Melbourne, Victoria.

(A list of agents and representatives will be printed in our next issue.) *H. J.*

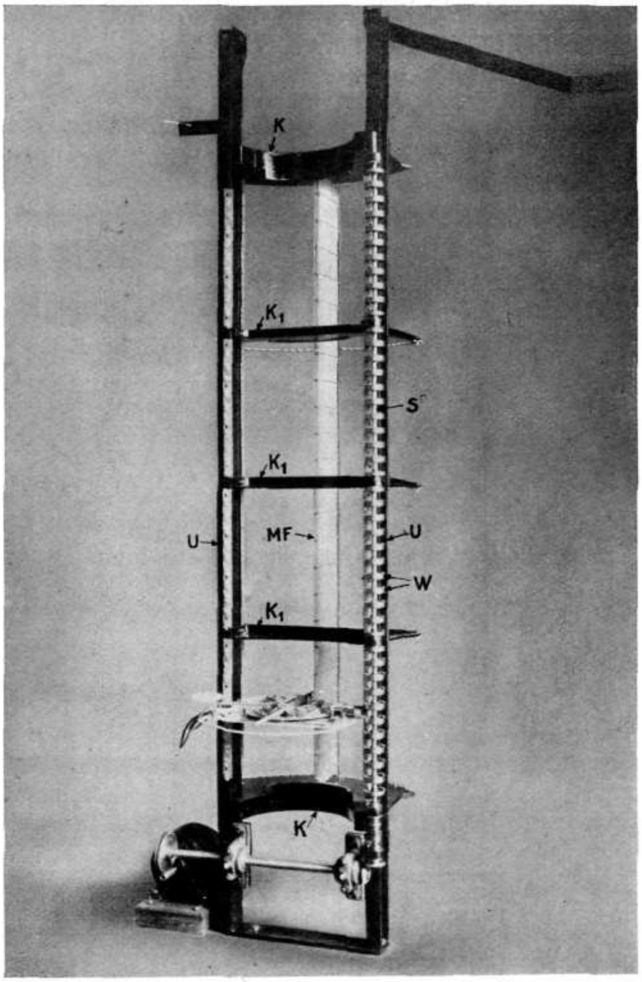
R 35

The L. M. Ericsson Automatic Switching System with 500 line selectors.

The L. M. ERICSSON full automatic telephone system is to be classified as a »power driven» system, inasmuch as the necessary selectors and sequence switches are mechanically propelled by rotating shafts continuously driven by small motors, common to a given number of racks.

The Ericsson system uses register sets, the function of which is to receive and register the impulses sent out from the subscribers' telephone instruments (or, in the case of a semi-automatic station, from an operator's keyboard) and to direct the group selectors and connectors to their correct positions. This directing is accomplished by means of revertive impulse control.

The chief characteristic of this system is that all selectors, i. e. the line finders, group selectors, and connectors, are of the same construction, except for some minor details, all having a capacity of 500 lines. Another feature of this system is the multiple, consisting of vertical, bare wires, forming so-called multiple frames.



R 11 Fig. 1. Selector rack for 40 selectors.

I. Description of the switching apparatus.

A. *The selectors.*

The selectors are mounted in racks accommodating 40, 50, 60 or 70 selectors. Figure 1 shows a rack for 40 selectors. Such a rack consists of two vertical channel irons connected both at the top and bottom by means of the brackets K. Additional brackets K_1 are inserted for each group of 10 selectors.

On the insides of the channel irons are fastened metal strips with horizontal notches into which the selectors are slipped and locked in place.

The vertical driving shaft is mounted in ball bearings on the right hand side of the rack and furnished with double, toothed drivers W one for each of the selectors.

The multiple consists of 25 multiple frames MF (fig. 1 shows such a frame in position) placed radially in relation to the selector's centre of rotation, as shown in fig. 2. Each multiple frame is composed of vertical bare wires for 20 lines, held by strips of insulating material.

Fig. 2 shows in outline a selector rack with one selector, seen from above. A selector is shown in fig. 3. The main selector parts are:

Base plate	BP
Magnet coupling	MH—MV
Rim gear wheel	KR
Rotary disc	TS
Locking magnet for the same	CV
Contact arm	KA
Locking magnet for the same	CR.

The magnet coupling, mounted directly on the base plate, has two magnet coils MH & MV. The shaft M, carrying the toothed wheels FR & FR_1, is run through the armature, which is common to both coils. The armature can be attracted by either the coil MH, giving it an upward movement, or the coil MV, giving it a downward movement. These movements cause the toothed wheel to be brought against either the upper or the lower driver W, thereby giving the shaft M a rotary movement in either the one or the other direction.

The function of the rim KR is to convey the movement from the wheel FR_1 to the rotary disc and the contact arm. The teeth on its outer edge gear into the wheel FR_1 and those on its inner edge gear into the wheel ZR, which is pivoted on the rotary disc TS, and whose function is to convey movement to the contact arm. The rear part of the contact arm is formed into a rack geared to the wheel ZR, as is shown in fig. 2. (ZR consists actually of two wheels, pivoted on the same shaft, the under one being geared to the rim KR and the upper one to the rack on the contact arm).

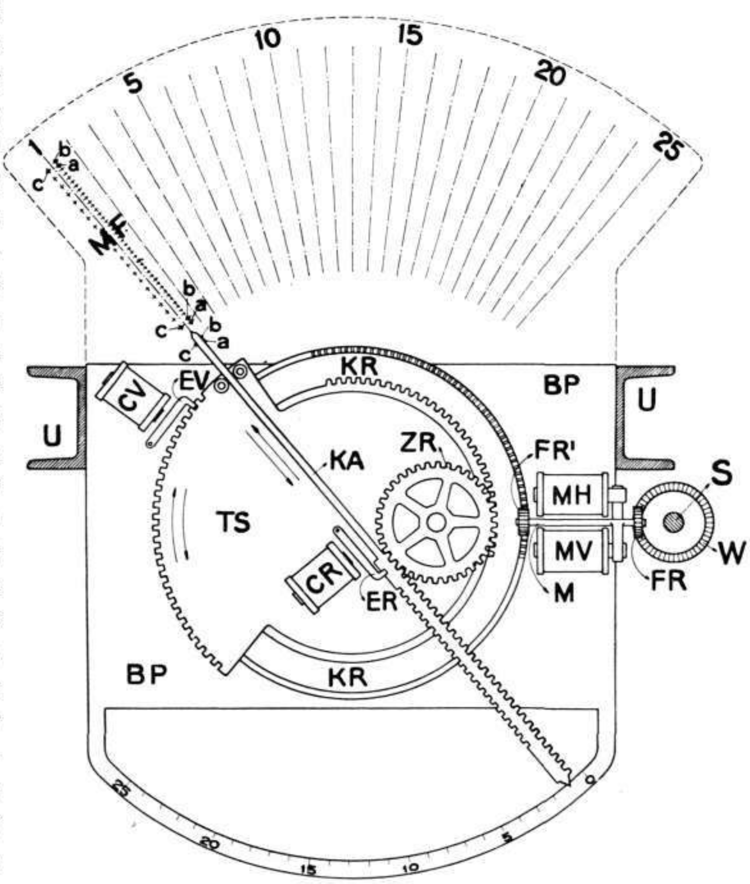
Movably mounted on the rotary disc TS is the contact arm KA, the front part of which is covered by an insulating sleeve of rectangular section, carrying the three selector contact springs, a, b and c. The contact arm has two different movements, namely, a rotary movement, in which it follows the turning of the disc around its axis, and a radial movement, by which it moves in to or out of a multiple frame.

The movements of a selector are controlled by means of the two locking or centering magnets CV and CR.

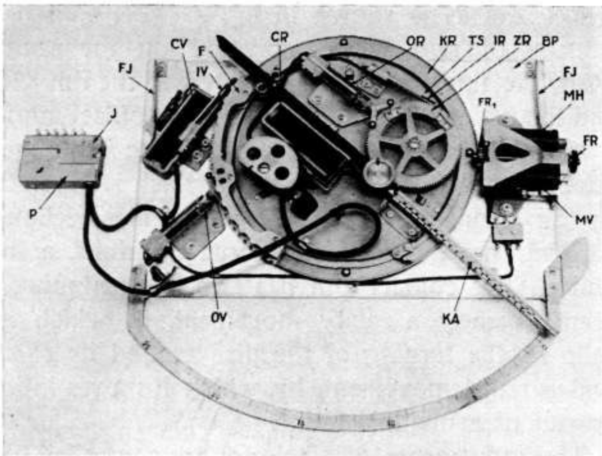
The magnet CV controlls the rotary movement of a selector, its armature being shaped to a dog EV, which fits into notches on the rotary disc, thereby locking it. The notches are spaced so as to exactly conform to the position of the contact arm in relation to the multiple frames. In fig. 2, for example, the contact arm is centred exactly opposite frame number 1.

The magnet CR controlls the radial movement by means of its armature, which forms the dog ER, whose function it is to centre and lock the contact arm. This it accomplishes by striking into notches on the contact arm, corresponding to the positions of the 20 lines of a multiple frame.

The magnets MH and MV are furnished with the necessary current through con-



R 12 Fig. 2. Working principle of a 500 line selector.



R 13 Fig. 3. Connector.

tacts located on the locking magnet armatures, when these latter are attracted. The two following cases can then occur:

(1.) If the locking magnet CV is actuated, the selector is released for rotation and the rotary disc, together with the contact arm, will start turning. This movement continues until the circuit through CV is broken and the dog engages a notch, thus locking the rotary disc, the current supply to the magnet coupling being simultaneously cut off. A left- or right-handed rotary movement is obtained depending on which of the magnet coupling coils MH or MV is energized.

(2.) If the locking magnet CR is actuated the contact arm is released for radial movement. This movement continues until the circuit through CR is broken and the dog engages a notch on the contact arm, thus locking the same, the supply of current to the magnet coupling being simultaneously cut off. The contact arm is either thrust into or withdrawn from a multiple frame, depending on which one of the magnet coupling coils MH or MV is energized.

As has already been mentioned, the three different types of selectors used in this system, i. e. line finders, group selectors, and connectors, are mainly of the same construction. The details in which they differ are as follows:

Each line finder is provided with a special test spring, mounted on the rotary disc (does not occur in fig. 3, which shows a connector), by means of which that multiple frame is found, in which an incoming call is located. The vertical front bars of the multiple frames in the line finder racks are, for this purpose, used as test bars, with which this test spring comes into contact during the line finder's rotary movement.

Group selectors and connectors have always a definite starting position for the rotary movement. They are provided with a cam plate F, mounted on the rotary disc, which alternately closes and opens a group of switching springs IV, thus sending impulses back to the register.

The connectors are further provided with a switching group IR for the sending of impulses to the register when the contact arm is moving into a multiple frame. This switching group is actuated by means of a cam wheel, mounted under and on the same shaft as the toothed wheel ZR.

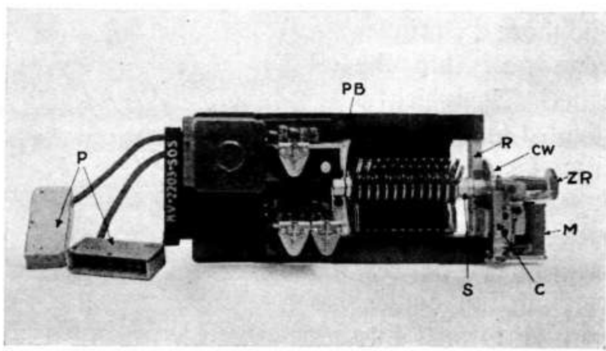
All selectors are furnished with two switching groups OV and OR, mechanically actuated in the extreme positions, one of their functions being to reverse the movements. OV reverses the rotary movement and OR the radial movement.

The connecting of a selector's wiring to the trunk lines is accomplished by means of an 18-point plug P, fitting into a corresponding jack J, mounted on the rack.

After being pushed into place in the rack, the selector is firmly locked in position by means of the two springs FJ.

B. *The sequence switches.*

Each selector is furnished with a sequence switch and relays, the appearance of which is shown in



R 14 Fig. 4. Sequence switch.

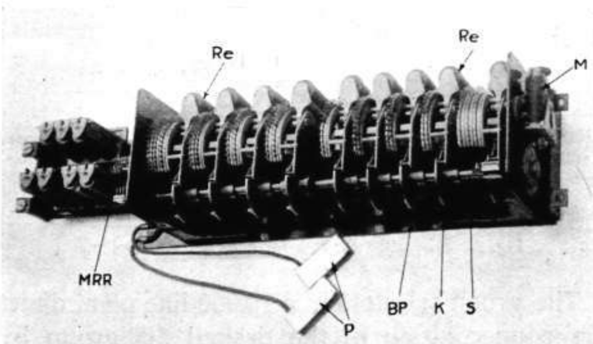
fig. 4. The contact bank consists of circular segments (the length of the arc being $^1/_3$ of a full circle) in which metal contacts are embedded. Each segment has two rows of metal contacts, and a maximum number of 13 segments can be screwed upon a frame R, which, in turn, is screwed to a second framework BP. This framework BP acts also as a support for the sequence switch relays.

As a sequence switch of this type has 12 positions and 13 rows of double contacts, it follows that $12 \times 13 = 156$ different contact combinations are possible, but additional combinations can be obtained by making the bank contacts of different widths, so as to extend over more than one contact position.

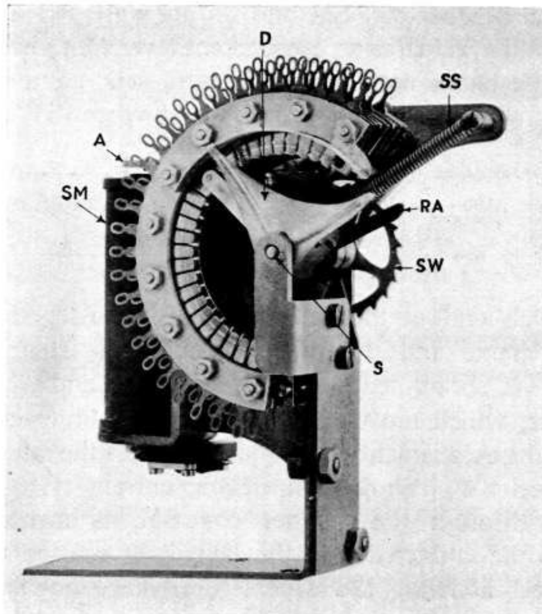
The sequence switches are power driven in the same manner as the selectors. M is the magnet coupling, with the toothed wheel ZR pivoted on its armature. The attracting of this armature causes ZR to engage a driving wheel mounted on the common driving shaft, the rotary movement being transmitted to the shaft S and the wiper arms.

Each sequence switch is furnished with an electrically controlled centering device, consisting of a cam wheel CW and the switching group C. Its function is to control the movements of the wiper arms by keeping the circuit through the centering spring closed until the wiper arms have reached the exact desired position.

Sequence switches are connected to the trunk lines by exactly the same method as selectors, i. e. by means of plugs P to jacks, which are mounted on the racks.



R 15 Fig. 5. Complete register set for a 10,000 line system.



R 16 Fig. 6. Register unit.

The sequence switches are mounted on both sides of the rack, each side or panel accommodating 20 switches, with their fuses and alarm devices.

C. *The register sets.*

A register set is shown in fig. 5, the most important parts being:

The Base	BP
» Register units	Re
» Restoring mechanism, consisting of:	
A Magnet coupling	M
» Shaft S with discs	K
» Sequence switch	MRR

The relays with which a register set is equipped are mounted on the base BP, as shown at extreme left in fig. 5.

A register unit — shown in fig. 6 — is a step-by-step selector. The bank of contacts consists of circular segments of insulation (extending over slightly more than a half circle) in which the metal contacts are secured. The wiper arms are mounted on the shaft S, which also carries the ratchet wheel SW and the restoring arm RA. A register unit has 27 contact positions, i. e. the starting position 0, 25 positions from 1 to 25, and one extra position 26.

The ratchet device of the register unit consists of a magnet coil SM and its armature A. The armature actuates an escapement lever (not visible in the illustration) which, in turn, acts as a releasing mechanism for the ratchet wheel SW.

R 17 Fig. 7. Line finder and group selector.

One end of the coil-spring SS is fastened to the frame and the other encircles the shaft S.

This spring tends to rotate the shaft and wiper arms, which movement, however, is counteracted by the escapement lever, which engages the ratchet wheel SW. Should an electric current now be led through the magnet coil SM, its armature will be attracted and the lever will release the wheel, allowing the wipers to advance one step. A renewed breaking of the current will readjust the lever, allowing the wipers to advance one more step. The wipers are thus advanced two steps for each full impulse (i. e. one closing and one breaking of the circuit).

D is an indicator, which shows the position occupied by the wipers.

The register units forming part of a register set are mounted on the base BP (fig. 5).

The shaft S with the discs K is made to rotate when the restoring magnet coupling is brought to engage the vertical driver shaft. The discs K are provided with studs which operate the restoring arms RA of the register units, thus restoring the wiper arms to the starting position, 0.

Register sets are also removably connected to the trunk lines in the same way as selectors and sequence switches, i. e. by means of plugs fitting into jacks mounted on the racks.

The register sets are mounted on either one- or two-sided racks, with 10 to 12 sets to each panel.

D. *The relays.*

The relays used in an automatic exchange are practically identical with the well-known Ericsson type. A few improvements have been adopted, however, such as the eliminating of all internal connections, all switching group and coil connections being carried out to soldering tabs. The advantage of being able to remove and replace coils and switching groups is hereby gained. The relay armatures have been re-designed so as to make them more sensitive and quick-acting. Special pains have been taken to obtain a correctly balanced pressure for the contact points.

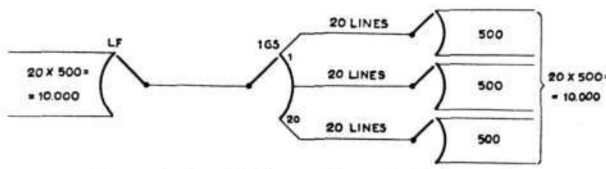
II. The building up of the system.

A. The extending of calls to the group-selectors, in the Ericsson automatic system, is accomplished by means of line finders. The subscribers' lines are brought together in groups of 500. Every such group is connected to the multiple in a line finder rack. The number of line finders necessary for 500 lines depends on the traffic (i. e. the number and average duration of calls during the busy hour) and usually varies between 30 and 50.

B. Each line finder is associated with a group selector, as shown in fig. 7, LF signifying a line finder and GS a group selector. Should 40 line finders be required, the corresponding group selector rack will also contain 40 group selectors. Trunks lead from the multiple frames in the group selector racks to connectors or to further group selectors.

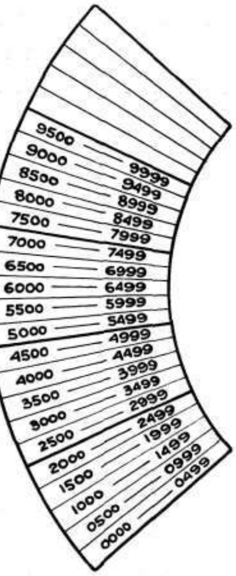
If the full capacity of the twenty five multiple frames of a group selector rack is utilized for trunks to connectors, a capacity of $25 \times 500 = 12{,}500$ lines is obtained. For practical reasons, however, it is not customary to use more than the first 20 frames for this purpose, the remaining 5 (21 to 25) being used for special lines.

A capacity of $20 \times 500 = 10{,}000$ lines is thus reached by the use of only one group selector, as shown in fig. 8.



R 18 Fig. 8. Schematic diagram for a 10,000 line system.

The group selectors in a 10,000 line plant direct the connecting in of the desired 500-group by means of the rotary movement, while the radial



R 19 Fig. 9. Numbering of multiple in a group selector rack.

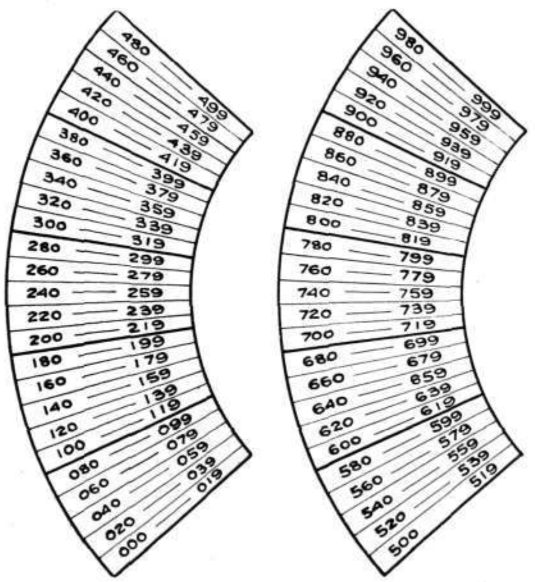
movement is utilized to search out a disengaged connector (that is, when the contact arm enters the multiple frame).

C. The connector makes the final connection to the desired number. The group of 20 which contains the desired number is sought out by means of the selectors' rotary movement, and the final connection is accomplished by means of the radial movement.

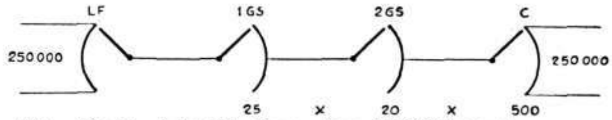
A connector multiple contains 500 lines, similar to the line finder multiple. Each group of 500 lines, therefore, has its connector rack, containing a certain number of connectors, their number depending on the intensity of traffic.

Fig. 9 shows the method of numbering the multiple frames in a group selector rack for a 10,000-line plant, while fig. 10 shows how connector multiples are numbered.

Each group of 1,000 occupies 2 frames in the group selector multiple, the first containing the 5 lower hundreds — from 0 to 4, and the second containing the 5 higher hundreds — from 5 to 9.



R 20 Fig. 10. Numbering of multiple in a connector rack.



R 21 Fig. 11. Schematic diagram for a 250,000 line system.

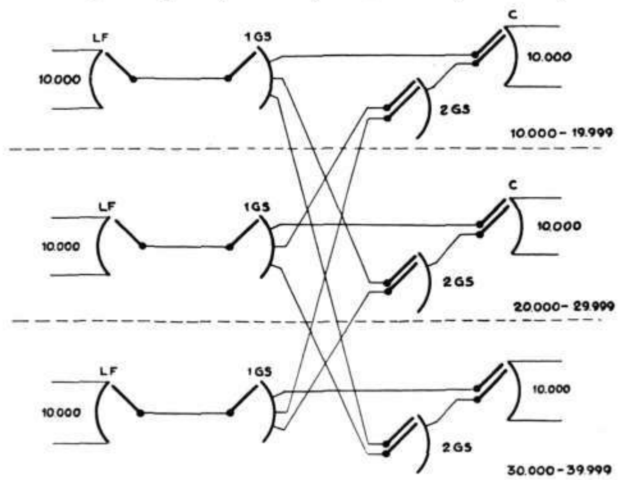
D. The capacity can be increased to $25 \times 20 \times$ $\times 500 = 250,000$ by adding one more group selector, as shown in fig. 11.

Trunks are carried from the first group selectors 1GS to 25 ten thousands groups. These trunks end in second group selectors 2GS, the multiples of which are trunked to the connectors C of the respective five hundreds groups.

E. Another system, in which either one or two group selectors are used to complete the connections, is applicable to plants of from 10,000 to 60,000 lines. A schematic diagram of this system, for a plant of 30,000 lines, is shown in fig. 12.

The 30,000 lines are grouped in 3 ten thousands. The traffic between subscribers whose numbers are within the same ten thousands group is handled by one group selector 1 GS, since the multiple frames of the first group selector rack contain trunk lines to the 20 five hundreds corresponding to their own 10,000 group. Trunk lines from the multiple frames 21 to 25 proceed to the second group selector 2 GS, the multiples of which are in turn trunked to connectors.

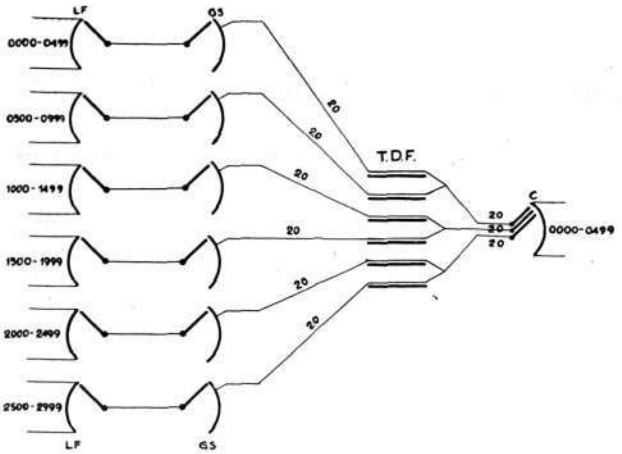
Thus, a capacity of $10,000 + 5 \times 10,000 = 60,000$



R 22 Fig. 12. Schematic diagram for a 30,000 line system.

is reached by this system when all the multiple frames of the first group selectors are utilized.

F. The connecting in parallel of the group selectors' multiples, and the connecting of the cables to the connectors is done in a traffic distributing frame. These frames are composed of two vertical angle irons furnished with tab strips to which the cable wires coming from the group selectors' multiple frames are connected and coupled in parallel so as to obtain an even distribution of connectors in relation to the amount of traffic. An example is illustrated in fig. 13. LF and GS are line finder and group selector racks for 6 five hundreds groups. Trunking to



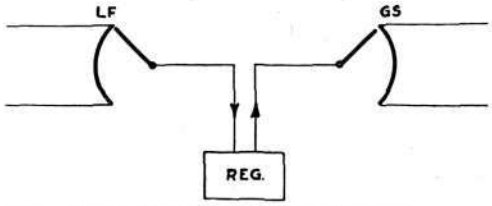
R 23 Fig. 13. Connection of group selector to T. D. F.

the traffic distributing frame is shown from the first multiple frame only, corresponding to the five hundreds group 0000 to 0499. Thus a 20-line cable is led from frame no. 1 in each group selector frame to the T. D. F. Suppose that traffic conditions necessitate the use of 60 connectors for 500 lines; the distribution can then be arranged as shown in fig. 13, for example, by parallel coupling the multiples in pairs, each pair with 20 trunk lines to the connector rack in question.

G. Connecting of the register sets.

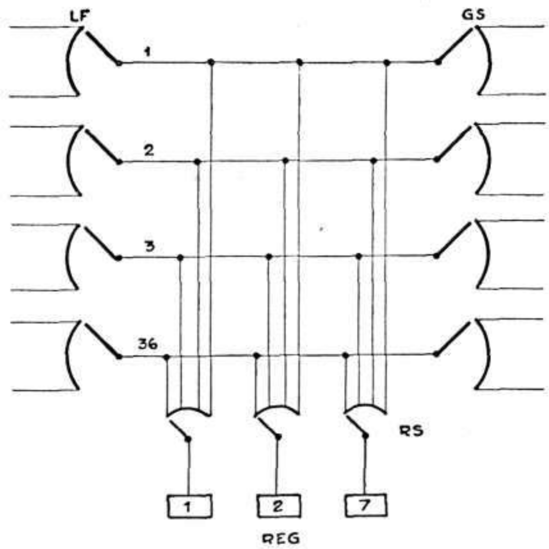
When a line finder is connected to a subscriber's line, a register set must also be connected for the purpose of directing the movements of the group selectors and connectors. Consequently, the register is placed between the line finder and group selector, as shown in fig. 14.

In view of the fact that a register set is engaged only as long as it takes the subscriber to dial the desired number and for the group se-



R 24 Fig 14. Schematic diagram for line finder selector and register.

lectors and connectors to move to their respective positions, while line finders, group selectors, and connectors, on the contrary, are engaged as long as the conversation lasts, it is easily understood that it would be highly uneconomical to provide a register set for each individual line finder, especially as they are comparatively expensive and bulky devices. For this reason, only a certain number are allotted to each group of line finders, the number being determined by traffic conditions. Special selectors are used for connecting the register sets to the line finders. Two different principles can here be applied, clearly illustrated in figs. 15 and 16.

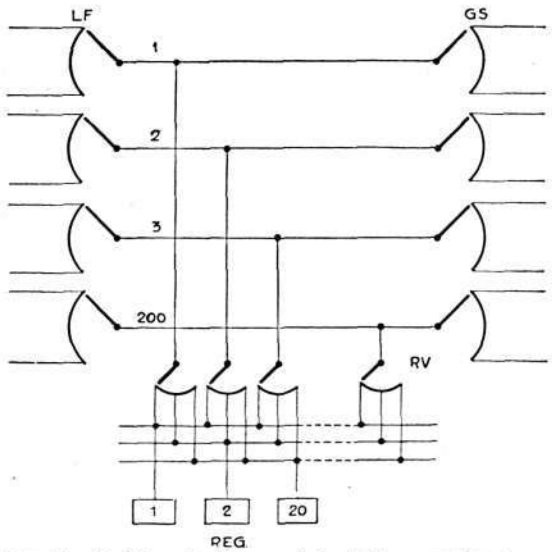


R 25 Fig. 15. Schematic diagram of circuit for connection of register by means of register finder.

In fig. 15 the connecting is accomplished by means of so-called register finders. Each register set is furnished with a register finder (the construction of which corresponds to that of a sequence switch) accomodating 35 lines.

In this case, therefore, the line finders will form groups of 35. To each such group is alloted a certain number of register sets (6 to 9, depending on the traffic). A call entering such a group sets all the register finders RS belonging to disengaged register sets in motion, and the one that first finds the calling line finder LF is connected.

In fig. 16 the register sets are connected by means of register selectors RV, of which one is alloted to each line finder LF. The contact banks of these selectors — consisting of 20 contact



R 26 Fig. 16. Schematic diagram of circuit for connection o register by means of register selectors.

positions — are coupled in parallel and connected to 20 register sets. The number of line finders LF which can be connected to a group of 20 register sets depends on traffic conditions. (One group of 20 sets can, as a rule, be connected to the line finders for 3 or 4 five hundreds groups).

III. **Functioning of register set.**

The mechanical construction of a register set has already been described under II--C. When considering its functions, a register set may be divided in two parts, namely the registering part, which receives and »registers» the numbers dialled from the subscriber's telephone (or, in the case of a semi-automatic exchange, the numbers called from the operator's keyboard), and the controlling part, which directs the proper setting of the group selectors and connectors.

The schematic diagram of a register set for a plant with subscribers' numbers of four digits (0000 to 9999) is shown in fig. 17.

A. Registering part of the register set.

That portion of the register set which registers the numbers consists of:

The impulse relay R_1.

The main function of this relay is to receive the impulses which are sent out by means of the subscriber's dial D. Simultaneously with the connecting of a register set to a subscriber's line, a circuit from earth over the subscriber's line and telephone, and through the impulse relay R_1, to battery, is closed, resulting in the actuation of the relay R_1. The dialling of a digit creates a train of circuit breaks or impulses, causing the relay R_1 to be released as many times as the circuit has been interrupted in the dial. (The number of circuit breaks corresponds in this case to the dialled digit. The figure 1 will cause the circuit to be interrupted once, the figure 2 twice,etc., and the figure 0, lastly, will cause the circuit to be interrupted 10 times.)

The restoring relay R_2.

The function of relay R_2 is to restore the register to normal after a connection is completed. This relay is constructed so as to be slow-releasing only. It is attracted through the contact a) in the relay R_1 at the same moment that the register is connected to a subscriber's line, and retains this position until the connection is completed. Owing to its slow releasing, relay R_2 remains attracted during the impulsing of relay R_1.

The controlling relay R_3.

The relay R_3 controls the movements of the control switch SOR_1. It is a slow acting relay similar in design to R_2, and is, for this reason, attracted once for each train of impulses sent, that is, once for each figure dialled.

The control switch SOR_1.

This apparatus is similar in construction to a register unit, described under II-C, and its function is the successive connecting in of the units Re_1 to Re_4. Its magnet is energized over a contact in the controlling relay R_3.

The registering units Re_1 to Re_4.

The object of these units is to register the dialled numbers. They are successively connected in by the controlling switch and take the positions which correspond to the dialled numbers.

Re_1 is in circuit when the thousands digit is dialled.

Re_2 is in circuit when the hundreds digit is dialled.

Re_3 is in circuit when the tens digit is dialled.

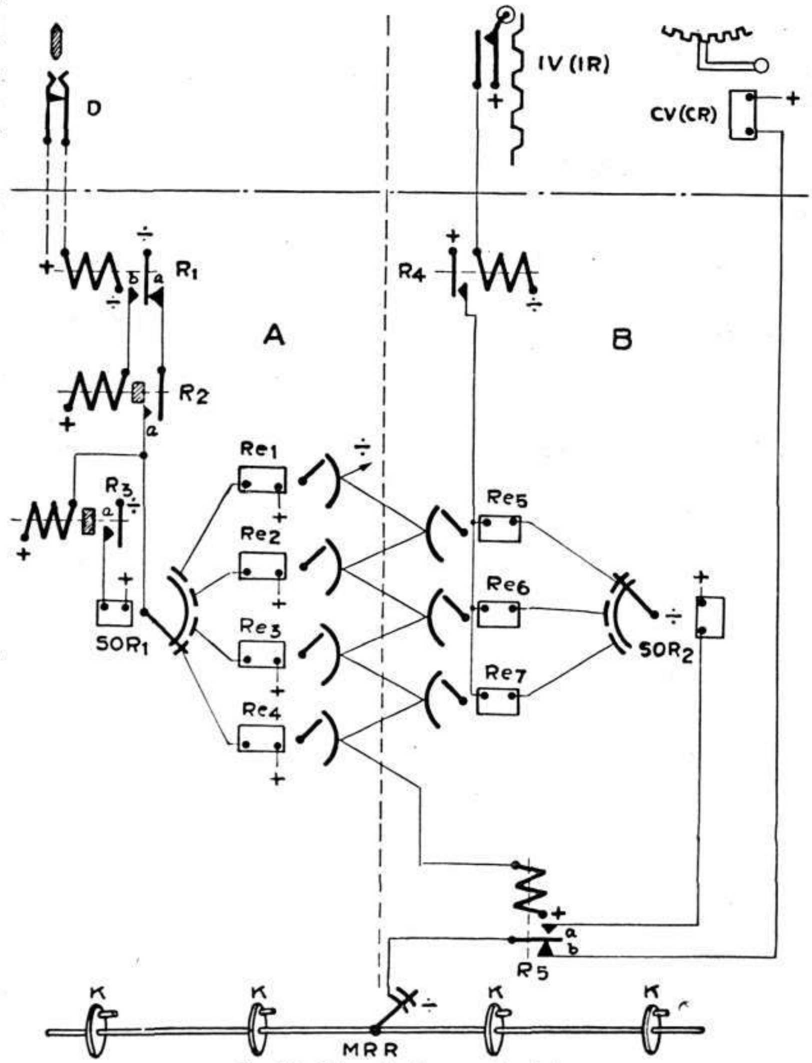
Re_4 is in circuit when the units digit is dialled.

B. *Controlling part of the register set.*

This part of the register set is composed of:

The revertive impulse relay R_4.

The function of this relay is to receive the impulses sent out by the group selectors during their rotary movement and by the connectors during their rotary and radial movements, and repeat them to the controlling units Re_5 to Re_7. These impulses are generated over the impulse contact IV (IR), and correspond in number to the number of steps which the selector and connector movements have advanced.



R 27

Fig. 17. Schematic diagram of register.

The stop relay R_5.

The relay R_5 cuts off the starting current to the group selectors and the connectors and serves also to close the circuit to the magnet of the control switch SOR_2.

The control switch SOR_2.

The function of this control switch is to successively connect in the controlling units Re_5 to Re_7.

The controlling units Re_5 to Re_7.

The controlling unit Re_5 is set by the rotary movement of the group selector,

The controlling unit Re_6 is set by the rotary movement of the connector,

The controlling unit Re_7 is set by the radial movement of the connector.

These controlling units, which receive their impulses from the revertive impulse relay R_4, exactly follow the selector movements, for example, when the rotary movement of a group selector has advanced 11 steps, the controlling unit Re_5 has also been advanced 11 steps, etc.

The restoring mechanism with discs K has a sequence switch MRR connected to its shaft, one of whose functions is to connect in the battery for starting the group selectors and connectors.

The setting of the group selectors and connectors is accomplished by means of so-called revertive impulse control. When a sufficient number of digits has been dialled and registered by the registering units Re_1 to Re_4 (the two first digits for a four-digit numbering system), the sequence switch MRR is reset so that battery is connected in for starting the group selector. The centering magnet for rotary motion CV is energized (over a special relay which, for the sake of simplicity, is omitted in fig. 17), whereby its armature releases the rotary disc and simultaneously closes the circuit to the magnet coupling. Impulses are sent out to the register while the group selector is rotating, whereby the controlling unit Re_5 is properly set. When the selector movement has advanced a number of steps corresponding to the first two figures in the dialled number (the thousands and hundreds figures), a circuit is closed over the registering units Re_1—Re_5—Re_2 through the relay R_5, which hereby attracts its armature and breaks the selector-starting current at the contact in R_5.

The principle of setting for the connectors is the same as for the group selectors. The setting of a group selector, as has already been mentioned, is determined by the first two digits of a four figure number, the first digit determining the thousands group while the second digit determines whether the switching shall be directed to a five hundreds group of a low or high hundreds figure. This principle of setting is also made evident by the numbering of the group selector multiples, as shown in fig. 9.

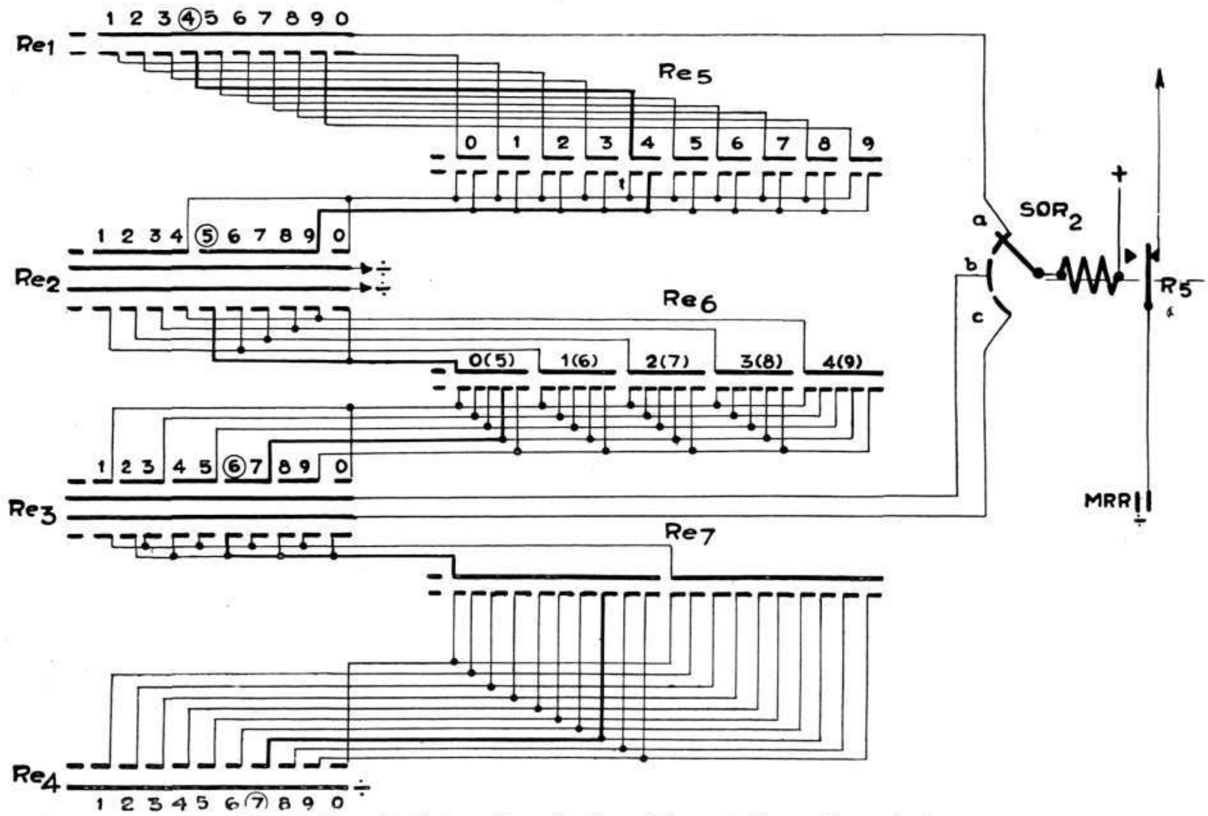


Fig. 18. Connection between the registering and the controlling register-mechanisms.

The rotary setting of a connector is determined by the hundreds and tens figures (see fig. 10). It may here be noted, that the low hundreds figures 0, 1, 2, 3 and 4 are equivalent to the high hundreds figures 5, 6, 7, 8 and 9.

The radial setting of a connector, lastly, is determined by the tens and units figures.

Fig. 18 shows how the connection is made between the registering units Re_1 to Re_4 and the units Re_5 to Re_7, which control the correct setting of group selectors and connectors, so as to accomplish translation from the decimal system to a system corresponding to the grouping of lines in the group selectors and connectors. Suppose that the number 4567 has been dialled. The circuit a) attracts the stop relay R_5 and stops the group selector in front of the tenth multiple frame, circuit b) stops the rotating connector in front of the fourth frame, and circuit c), lastly, stops the connector's radial movement when the contact arm has reached line 7 within the frame.

IV. **Connecting a calling to a called subscriber.**

The process of establishing a speaking circuit between two subscribers is shortly as follows:

A. The call is connected to an idle line finder.
B. The call is connected through the line finder and a register selector (or register finder) to a disengaged register set.
C. The number called is registered within the register set.
D. The group selector is set to its rotary position.
E. The contact arm of the group selector enters the multiple, hunting an idle connector.
F. The connector is set to its rotary position.
G. The connector is set radially.
H. The register set is restored to normal after having completed its function.
I. The connector is testing to see whether the desired number is free.
K. A ringing current is sent out to the called number.
L. The called subscriber answers, thereby breaking the ringing circuit.
M. The selectors are restored to normal when the call is cleared, the call being recorded on the calling subscriber's service meter.

A more detailed description of the connecting process will be given in a future article.

G. G.

Development of the L. M. Ericsson Telephone Plant in Mexico.

The Mexican Ericsson telephone company, owners of the telephone plant of Mexico City and surroundings, has cabled information concerning the number of subscribers enrolled by the company at the beginning of this year. According to this report, the number of subscribers' stations has increased from 16,602 at the beginning of 1923 to 17,581 at the close of the same year, the increase amounting to 979 subscribers. The Mexico City plant has two exchanges at present, namely, the main exchange, Victoria, built in 1907 for a capacity of 15,000 lines, and the sub-exchange, Tacubaia, built in 1911 for a capacity of 5,000 lines, both of which are built according to the common battery system. As the Victoria exchange is now utilized to almost its full capacity, the company has made arrangements for the building of still another exchange in the quarter called Colonia Roma. This exchange, which will be full automatic, will have a capacity of 10,000 lines, with a first equipment for 3,000, and will also be equipped with all the necessary apparatus for co-working with the existing exchanges. Junction traffic in the direction manual to automatic will be handled by B-operators at the automatic exchange. For traffic in the opposite direction, the dialled numbers will be automatically recorded at a B-operator's position in the manual exchange by means of call indicators (carriage call).

This entire plant, as a whole, will be made the subject of an article to appear in The L. M. E. R. columns at a subsequent date.

Readable Type of Calling Device for Automatic Telephone Systems.

The calling device generally used in connection with full automatic telephone systems consists of what is known as a dial (see telephone reproduced on front page). By means of the dial a series of impulses corresponding to the different digits is sent to the switching station. The method of dialling, as we know, is to insert a finger in turn into the respective finger holes on the face of the dial, each time rotating the dial until the finger comes in contact with the metal stop; the dial being then released, it automatically returns to normal. To call a number consisting of six digits, the subscriber must consequently rotade the dial six times. This method of building up the desired number, however, requires no small amount of concentration, and a slip of the finger or the direct dialling of a wrong numeral can only be corrected by commencing all over again and making a new call.

R 5 Telephone with readable calling device.

With a view towards affording subscribers a more convenient method of making calls, a new calling device has been designed by L. M. E. on which all the digits of the desired number are simultaneously visible after the number has been set up. The accompanying illustration shows such a device built into a table set CG 400. The mechanism of this automatic impulse transmitter is equipped with revolving, knurled buttons projecting above the case. The desired number is set by revolving these buttons until the correct digits become visible in the small apertures, thus making it possible for the subscriber to check his call. On the right hand side of the device there is, in addition, a larger disc or control by means of which the mechanism is wound up and the impulse sending started. The method of making a call is as follows:

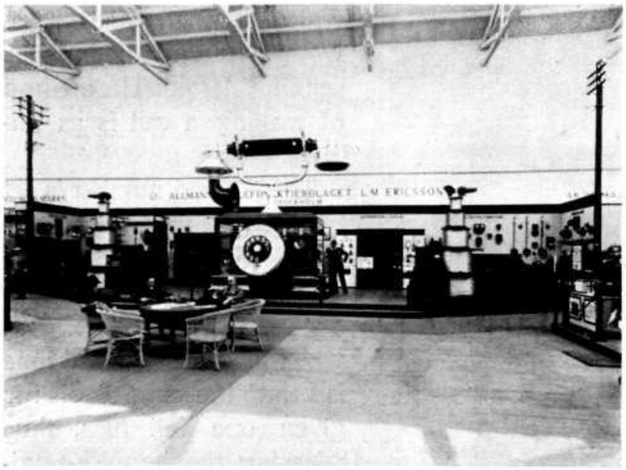
The desired number is set by means of the buttons and checked on the visible digits. The micro-telephone is then lifted from its cradle, and when the so-called dial tone is heard, the control disc is given one full turn, thus releasing the impulse-sending mechanism.

The following are some of the advantages possessed by this calling device over the usual dial:

1. The number called is constantly visible for verification by the subscriber.
2. Wrong connections due to incorrect dialling are entirely eliminated. This is a very important factor in countries where tens and units occur in reversed order (example: fünf- undzwanzig).
3. The numerical setting remains unaltered after making a call. Should the desired number be busy, there is consequently no need of resetting it when repeating the call. All that is necessary is to give the control disc one full turn after making sure that the dial tone is heard.
4. Manual influence does not affect length or duration of impulses.

L. M. Ericsson at the Gothenburg Exhibition 1923.

L. M. ERICSSON's exhibit at the Gothenburg Tri-centennial Exhibition was located in »Electricity Hall», in the centre of its west wall. As



R 1 General view of exhibit.

there was occasion to assume that the visiting public would be largely of an international character, an attempt was made to effect a display that would clearly give evidence of the company's high standing in the field of telephony.

It must also be admitted that L. M. E.'s exhibit attracted all the attention to which it was entitled. An enormous telephone — a copy of L. M. E.'s standard table set with microtelephone and finger dial — enlarged 8,000 times (that is, to a linear scale of 20 to 1), standing in the centre of the exhibit, was an attraction towards which visitors could not help turning their eyes. Inside of this great telephone had been erected a complete, full automatic exchange of the Ericsson system for 500 lines, clearly visible through the plate glass windows forming the sides of the telephone. A few telephones were connected to the exchange, with which visitors could experiment and make calls, and the automatic switching process could be followed by observing the selectors' various movements as the digits of the called number were being dialled. Numbers of interested visitors stood here daily, awaiting their turn to take part in the demonstration. It must be regarded as having been of distinct benefit to both the operating Government Office and the general public, to have thus spread practical information concerning the full automatic telephone and its manner of operation.

The model af a full automatic Ericsson exchange also formed a part of the Government Telegraph Office's historical exhibit, in which it represented the final stage of evolution in modern telephone practice.

Among the L. M. E. products to be seen at the exhibition were displays of the following plant details:

Small automatic exchanges.

Two small automatic exchanges, the one for 50 lines, with a maximum of 25 simultaneous calls as the limiting factor for future extension, cor-

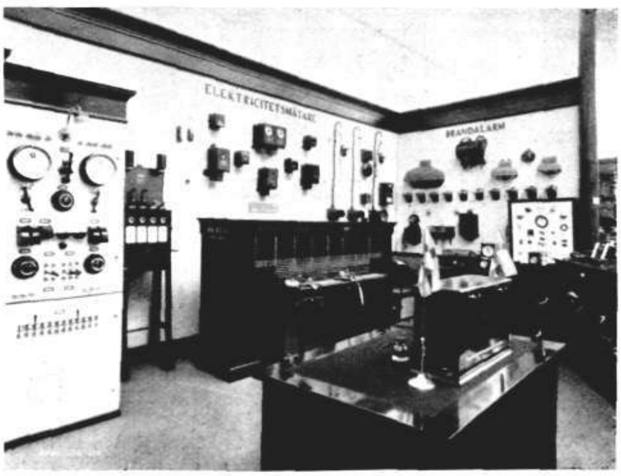
R 2 The manual station with 26,000 lines multiple.

responding to an average total of 300 lines (type OL 500), and the other a smaller type for only 20 lines (type OL 20), were connected up and in full working order.

Large manual exchange.

A section of a large, manual exchange of the usual type with multiple switchboards was also erected and in working order. The switchboard itself attracted no little attention on account of the multiple's unusual capacity, 26,000 lines. This was apparently more than one of the visitors was able to grasp, as he was inclined to believe that the demonstrating engineer was exagerating when told that L. M. E. had constructed an exchange in Moscow, before the war, whose capacity is 66,000 lines.

As previously stated, this group was part of a modern exchange, giving an excellent idea of how such a station is designed and operated. The subscribers' lines were carried from the connected telephone instruments to a distribution box and from there through a 600- pair leaded cable to a pothead, from where they continued through six 100-pair cables to a combined arrester and cross-connecting frame. From this frame the lines were led through braided cables over a cable support to a relay and selector frame, continuing partly by cable to the multiple jacks and partly through automatic selectors to the connecting cords. The automatic selectors, whose function it was to distribute incoming calls to an unoccupied operator,



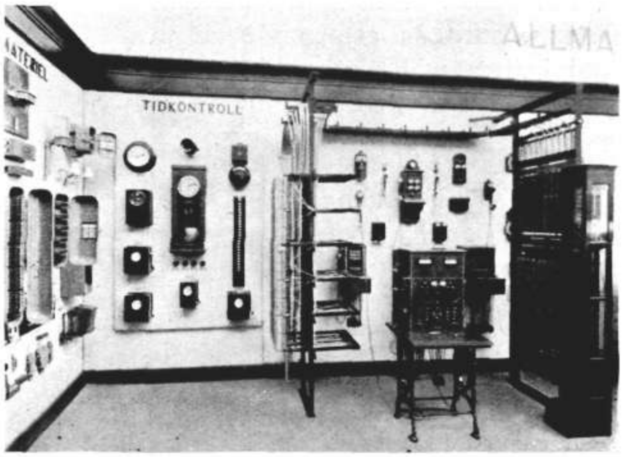
R 3 Electric meters and fire-alarm apparatus.

were of two distinct types, partly the usual step by step selector, and partly a new power driven type, the so-called cylinder selector.

A separate article will, in a coming issue, be devoted to this last type of selector.

Toll switch boards.

Beside the above described multiple exchange was erected a toll board, forming part of an order for a plant of rather unusual size — 350 positions —, which is being built in Rotterdam. This toll board is of the most modern type hitherto designed for such an exchange, and it is mainly



R 4 Time control system and line equipment.

the facilities for fitting the front equipment, together with the wiring of the same, that attract special attention. All of this equipment, consisting of switches, lamps, telegraph key, finger dial, etc., is mounted on the key-shelf in such a manner that any part of it can, by a single manipulation, be easily removed for inspection or replacement. The calculagraphs for which the board is designed are also of special interest on account of the controlling and summation devices which they actuate. They will receive more detailed attention in a coming article.

Additional equipment displayed included:

Chief operator's desk.

This desk is designed for the purpose of enabling a chief operator to ascertain that subscribers are given fast and courteous service.

Test board,

for trouble finding and testing of lines both inside and outside the exchange.

Power switchboards,

for the distribution of power and lighting current within a telephone plant, including two storage batteries and the necessary charging and ringing machinery.

The several exchange units included in the exhibit were furnished with necessary current from this plant.

Multiple switchboards for small exchanges.

Such boards of different types and of various systems, such as common battery with lamps, local battery with drops, signal jacks or visual indicators, etc., were displayed, their capacity ranging from 600 to 3,000 lines.

Switchboards without multiple.

Boards of this type were shown in various designs. Those attracting most attention were of a new construction enabling additional local lines and cords to be installed when traffic conditions should make it necessary.

Telephones.

Only such models as are in general use were displayed. Most of the prevailing types were represented, such as instruments for battery and magneto ringing, for common battery and full automatic exchanges, and finally interphones. Other equipment, such as telephones for mines and for military purposes, coinbox telephones, amplifiers, church telephones for the deaf, various bells and extension line switches, etc., was also displayed in this group.

Telegraph instruments.

The well known types now in general use in all Swedish telegraph offices and railway stations, and various accessories, such as a key, relay, sounder, line selector switch, serrated protector, etc., were displayed.

Testing instruments.

A number of finer instruments, such as Wheatstone bridges in various models, resistance boxes, galvanoscopes, etc., were on display in a large showcase.

Electric meters.

L. M. E. has kept pace with developments in this line and exhibited meters of modern construction for both D. C. and A. C. A twin meter for checking the power factor in power distributing systems was of special interest.

Line equipment.

Leaded and braided cables, cords, wire, air line equipment, together with various types and sizes of distribution and terminal boxes, were included under this heading. A full size manhole had been constructed, to which visitors had access, showing various cable splices. A 600-pair leaded cable with paper insulated wires was laid in a 19-duct cement conduit leading to the manhole, where it entered a Y-splice, the wires continuing on to a 600-line distribution cabinet through two 300-pair leaded cables. All cable, cords, and wire on display were delivered from the company's own cable factory at Älvsjö, near Stockholm.

Fire alarm equipment.

A complete fire alarm switchboard was shown, with time recording clock and telegraph instruments, fully equipped to receive one or several simultaneous alarms. Suitable types of alarm boxes as well as automatic alarm and controlling devices completed this group.

We will here take the opportunity to mention that the entire exhibition grounds were safeguarded by a complete fire alarm system, consisting of some twenty alarm boxes and a fire alarm switchboard, installed by L. M. E.

A night-watchman's service clockand accessories were also shown here.

Time recorders for factories and offices.

Since the general adoption of an 8-hour working day has made accurate time checking in factories a necessity, the manufacture of time checking devices for this purpose has been included in the activities of this concern. A complete plant, consisting of a central clock, an electric impulse clock, a so-called program clock by which the signalling devices are controlled, time recorders for monthly, weekly, or piece work time, and racks for employees time cards, was mounted for demonstration. An electric horn and a large bell, to be sounded at the opening and close of working hours, completed the equipment.

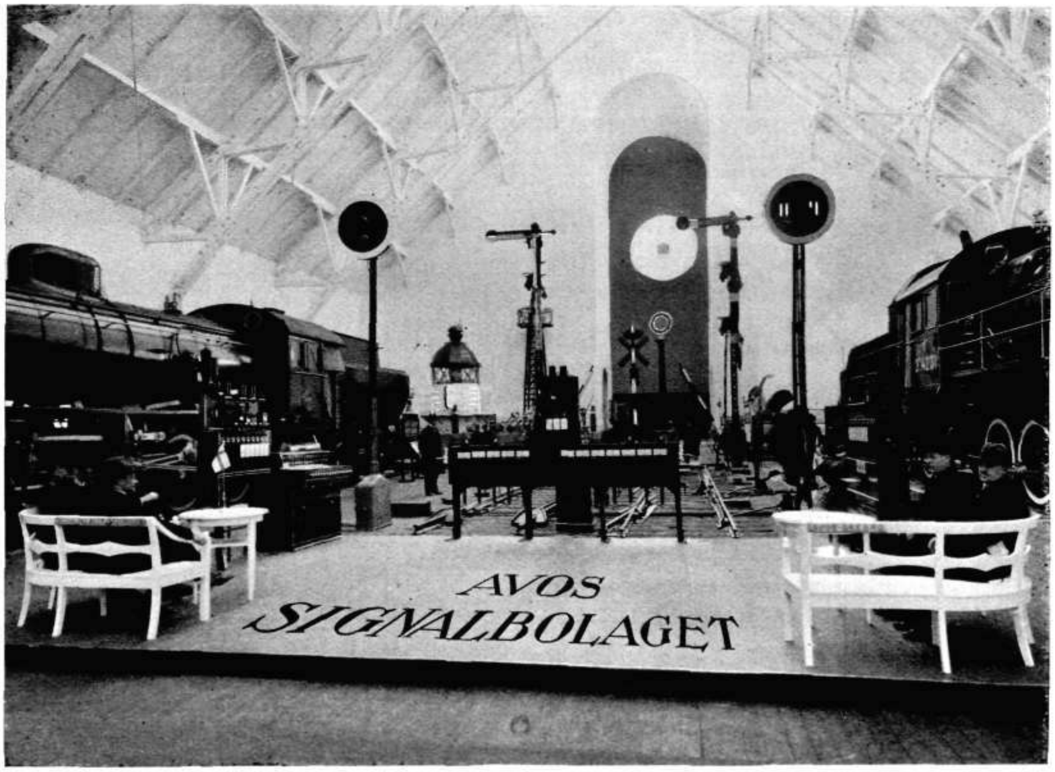
Railway signalling devices.

Only one quadruple block field instrument and an electric light-flashing plant were shown at our exhibit in »Electricity Hall».

Interested visitors, however, were directed to the great »Machinery Hall», where a larger exhibit of such equipment had been arranged by L. M. E.'s Railway Signalling Department, the Avos Company in Örebro, and their common sales corporation, Signalbolaget in Stockholm. This exhibit included three block field instruments and an electric interlocking machine from which switch points and a semaphore signal could be manoeuvered.

An electric detector lock and an electric point lock together with an automatic warning signal for railway crossings were also included in this exhibit.

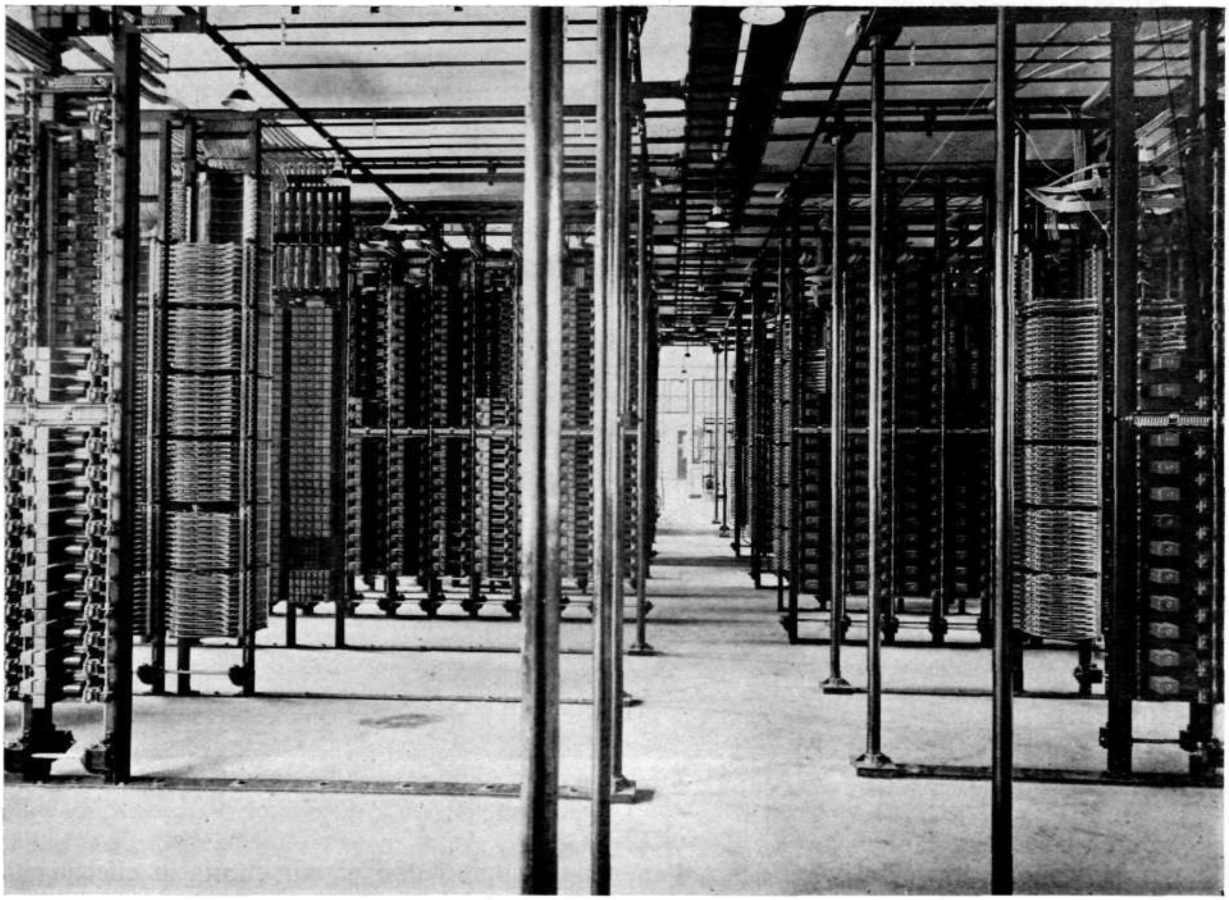
A visitors' autograph album, covering the duration of the Exhibition from its opening on May 8th until its close on October 15th, gives ample evidence of the large number of visitors from various parts of the world such as Tokio, Rio de Janeiro Buenos Aires, Batavia and Soerabaya, New York, Chicago, Cairo, Melbourne, etc., who showed



their appreciation of our efforts in effecting this comprehensive exhibit.

A lively interest in L. M. E.'s exhibit was evidenced by the participants in the International Pressmens Convention. Mr Bento Carquejas from Portugal has written a book in which his impressions from Sweden and the Exhibition are portrayed with true South European vividnes and where he states that — — — »The automatic telephone holds an unusually eminent position within the field of applied electricity, and the practice of telephony has in Sweden its greatest empire.» *G. C.*

The Ericsson Automatic in Rotterdam.

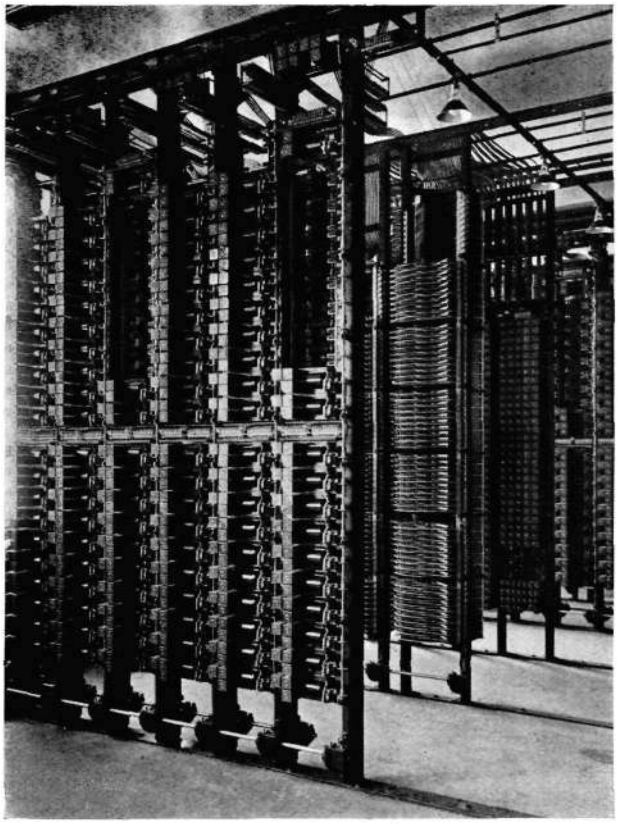


R 8

General view of machine switching room.

THE L. M. E. REVIEW has just had the pleasure of receiving the accompanying photos of Rotterdam's new automatic exchange, which has recently been completed and put in operation. As this is one of the first large plants to be equipped with the Ericsson system and is giving excellent service, it may be of interest to give some data concerning its size and equipment.

This station constitutes the first stage in the construction of a 60,000 line system and has, therefore, a capacity of 10,000 lines, at present equipped for 5,000, besides about 500 P. B. X. lines. This so called »West» exchange shares the traffic with the old manual C. B. exchange — »Centrum» — of approximately 15,000 lines, and also, in another year, with the »Nord» automatic exchange, which is under construction and will have the same capacity as »West», although



R 9 Rack for line relays together with line finders and appurtenant sequence switches.

not more than 4,000 lines will be equipped for the present.

The handling of traffic in the direction auto-

R 10 Semi-automatic operating room.

matic to manual exchange is of special interest, as provisions have, for the first time, been made to accomplish this without the services of a B operator at the manual exchange. This usual method of solving the problem had to be abandoned as the necessary space was not available. Instead, the automatic handling of this traffic from the »West» exchange has been made possible by letting the junction lines at »Centrum» enter group selectors and connectors there, the multiples of the latter being connected directly in parallel with the manual multiple.

This subject will be more fully considered in a subsequent issue of this journal.

New Telephone Plant in Verona.

Negotiations for the construction of a complete new telephone plant in Verona, Italy, have been successfully concluded, during December, with the operating company of that city.

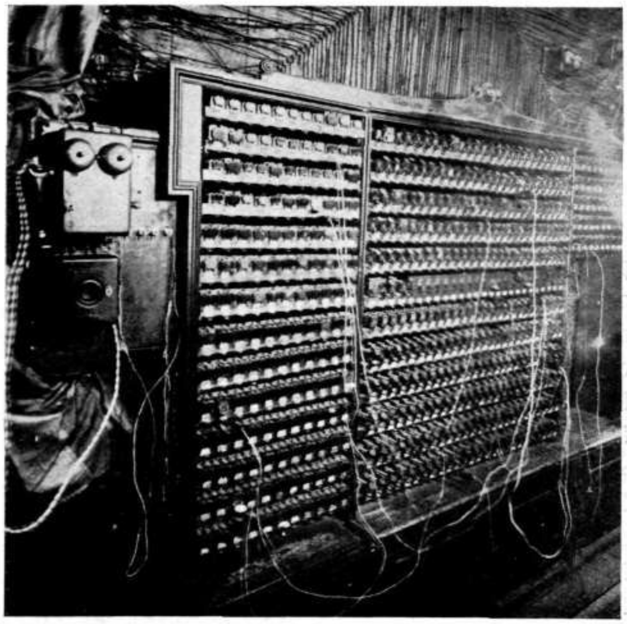
This order includes:

(1) A complete line system consisting of underground cables laid in concrete conduits for the city's central portion, together with overhead cables for distribution and a few bare wire lines in the outskirts of the city.

(2) A full automatic telephone exchange with a capacity of 10,000 lines — present equipment for 1,000 lines — and provisions for connecting on to the interurban net.

(3) All the necessary dial-equipped telephone instruments are included in the order.

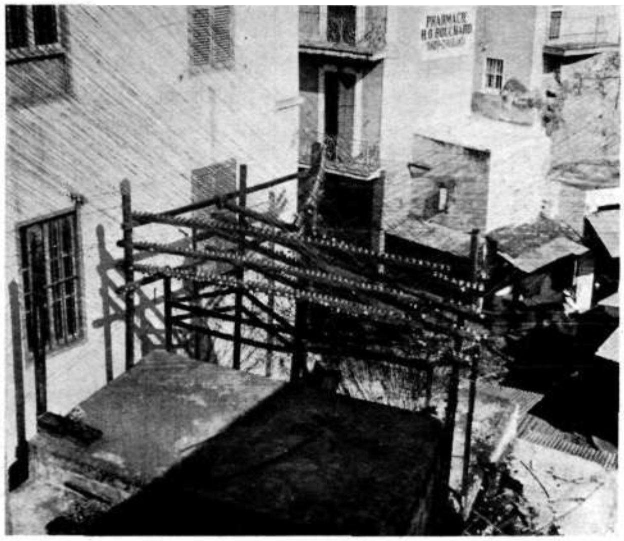
Ericsson Telephones in Tangier.



R 6 Telephone exchange built in 1883

In the city of Tangier, in Morocco — one might say between the desert and the deep, blue sea — a complete new telephone plant is now under construction. L. M. E. is delivering the material and doing the work, which includes a new exchange as well as the necessary lines.

»The L. M. E. Review» reproduces herewith some rather interesting photos that have just been received from the Company's engineer in charge. They give a good idea of what the previous, old plant, dating back as far as 1883, looked like, and illustrate, in their way, the progress which has been made in the field of telephone practice since that time.



R 7 Aerial entrance of line wires to station.

»The L. M. E. Review» will, as concerns the new plant's appearance, return to this subject in a following number.

Printed by Allmänna Telefonaktiebolaget L. M. Ericsson. Stockholm 1924.