

*The L. M. Ericsson
Review*

V O L. 2
1925



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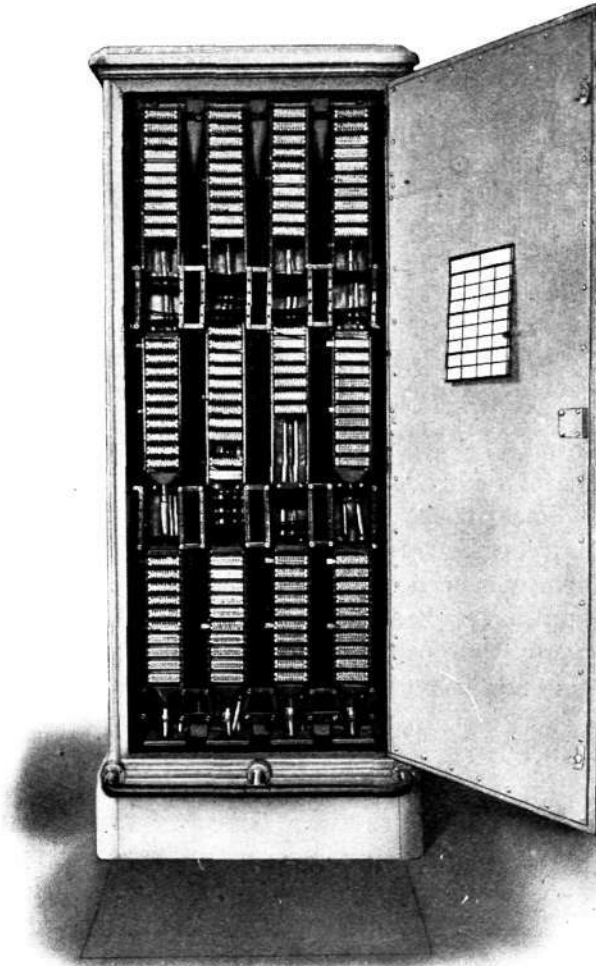


AN ARAB OF TANGIER.

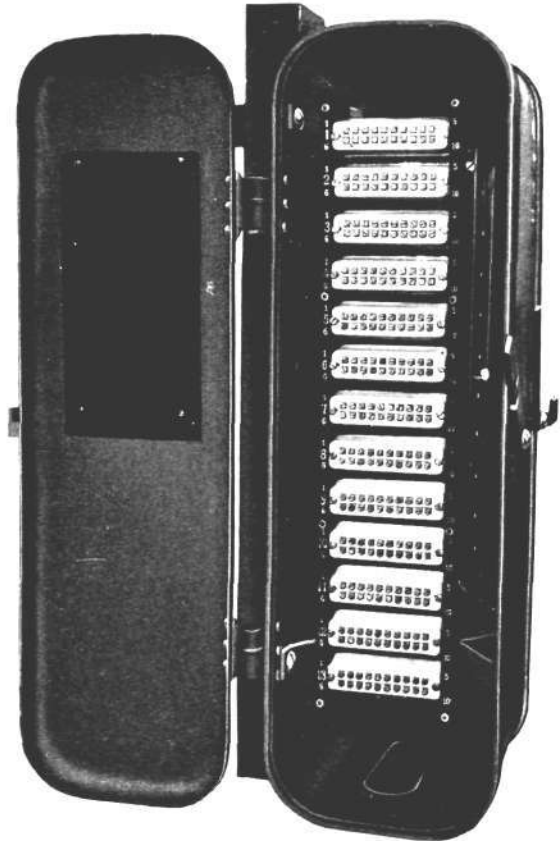
ENGLISH EDITION

not more than two weeks previously. In many places, the terms on which the concession has been granted stipulate that a telephone instrument shall be installed and connected up within a certain short time after the signing of a contract between the subscriber and the operating

than to divide it up into several stages. When building a new or rebuilding an old cable district, it is generally safe to provide the same with a number of extra lines corresponding to a normal 2-years increase in the number of subscribers, as the profits gained through the concentra-



K 4 Fig. 1. Main Jumpering Cabinet, with Total Capacity for 600 Incoming and 780 Outgoing Lines. Made also for 300/390 Lines.



K 5 Fig. 2. Pole Jumpering Cabinet, Total Capacity, 100 Incoming and 130 Outgoing Lines. A Part of the Incoming Lines may be led through the Conduit on the left Side of the Cabinet directly to a Standard mounted on the same Pole.

company. It is necessary, therefore, that the cable net be built in a manner to permit the connecting up of a subscriber on short notice, no matter where he may be located.

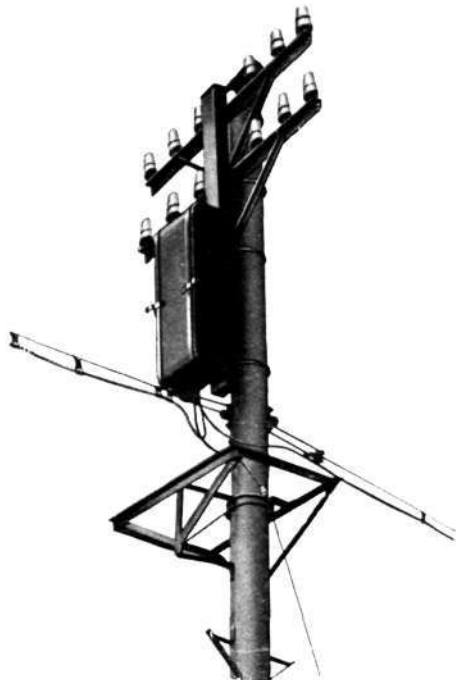
The concentration of cable work, also, is desirable from a purely economical point of view, the carrying out of an extensive piece of work all at one time being generally much cheaper

tion of the work should greatly exceed the loss of interest. A normal increase in the number of subscribers during the intervening time, therefore, should be amply provided for merely by the extension of the individual subscribers' lines.

If we assume that the above-mentioned block of houses contains 1,000 flats or apartments, there shall be provisions made for the simple

and economical connecting up of a telephone in any of these apartments.

at the exchange will have to be tapped and the branch cables carried to conveniently placed dis-

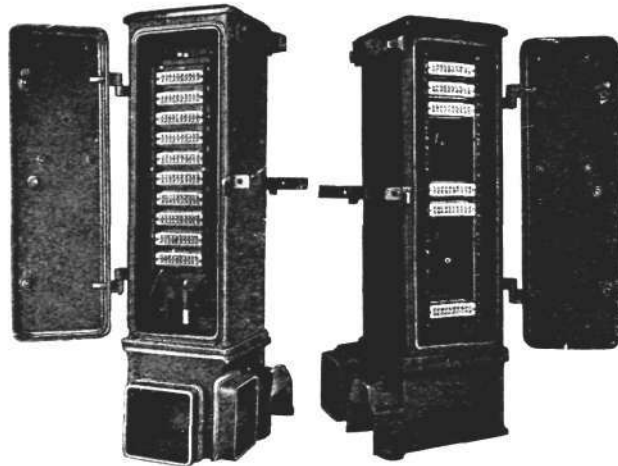


K 6 Fig. 3. Same Cabinet as in Fig. 2, mounted on Pole.

Previous experience should make it possible for the operating company to estimate how many of these 1,000 possible subscribers will take advantage of this facility. In the above example we will assume this number to be 50 % or 500 subscribers.

The yearly increase in subscribers is assumed to be 10 %. According to the above, therefore, cables should be extended for 600 subscribers.

If cross-connecting in the cable net is not resorted to the outgoing cables from the main distributing frame



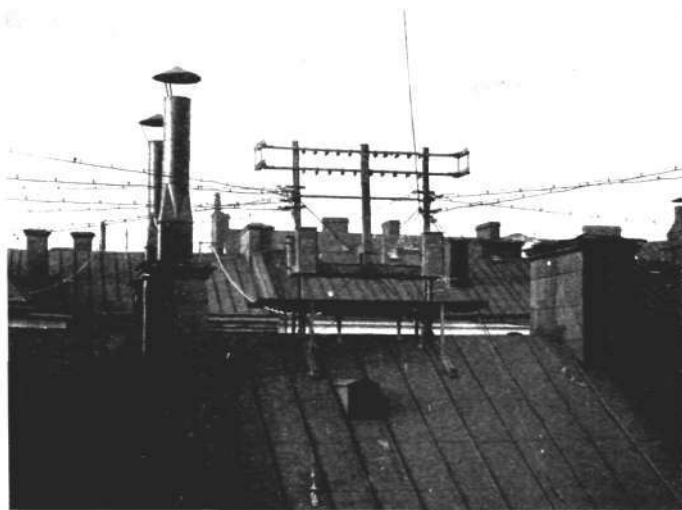
K 7 Fig. 4. Incoming and Outgoing Sides of Jumpering Cabinet for mounting on Roof Standard. Total Capacity, 100 Incoming and 130 Outgoing Lines (See also fig. 5).

tribution boxes from which the individual lines may be extended.

Since it is impossible to determine with any degree of certainty how future subscribers will be distributed and where the distribution boxes had best be placed, 600 connecting points will naturally not be sufficient. On the contrary, experience shows that it is necessary

to have a decidedly larger number available. If they are too closely figured, it may often be necessary to carry an individual subscriber's line a great distance, this being expensive and often causing confusion in the network. As a rule, it is wise to figure with 60 % more connecting points than the actual number of subscribers. In this case, therefore, 800 would be required.

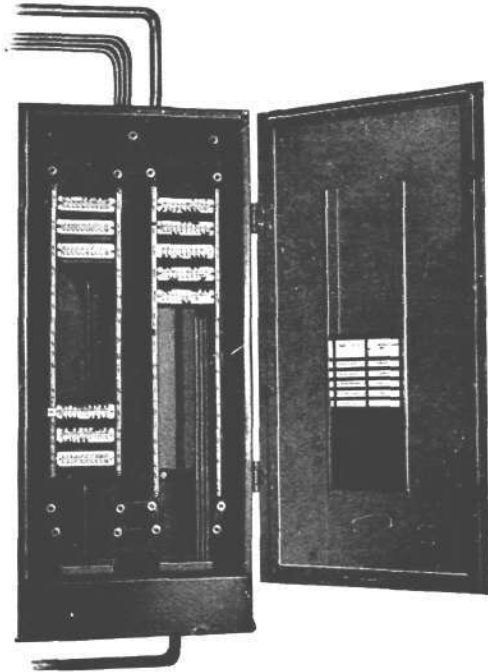
According to the Ericsson system, every



K 8 Fig. 5. Four Jumpering Cabinets mounted on the same Roof Standard. They are interconnected by means of Horizontal Conduits, thus forming a Distributing Unit. A Number of Lines may be led up through the Vertical Conduit for Direct Distribution.

exchange district is divided up into a certain number of cable distribution areas, more commonly

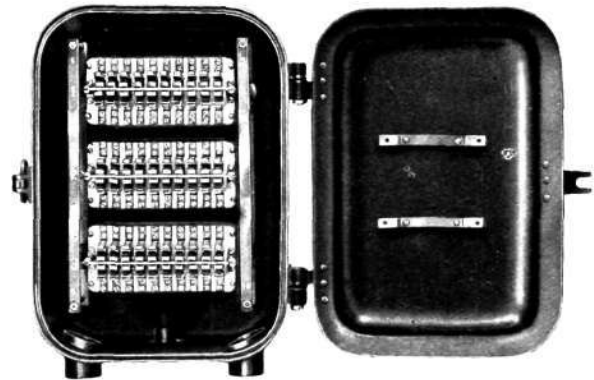
called »cabinet areas». These have definite boundaries and are fed by one or more main cables,



K 6 Fig. 6. Indoor Jumpering Cabinet. Total Capacity, 100 Incoming and 130 Outgoing Lines.



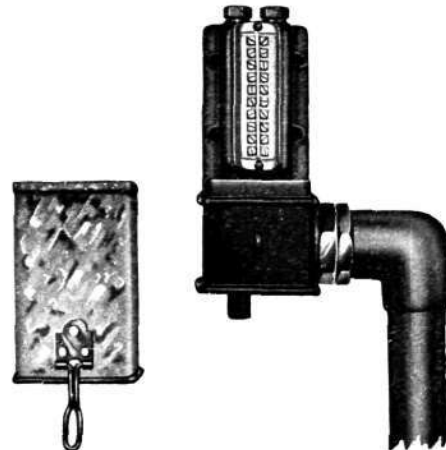
K 10 Fig. 7. Terminal Box, for Distribution of 10 Lines by means of 2-conductor Lead Cable.



K 12 Fig. 9. Pole Distribution Cabinet with Carbon Protectors, for Distribution of 30 Open Lines.



K 11 Fig. 8. Pipe Standard Terminal Box, for Distribution of 10 Open Lines, mounted on Pipe Standard.



K 13 Fig. 10. Pole Terminal Box for Distribution of 10 Open Lines. Furnished also with Carbon Protectors or Fuses.

which terminate in a jumpering cabinet. The sizes of these cabinet areas vary according to existing local conditions. In Stockholm, for instance, only two different types of cabinets are used, for a maximum of either 300 or 600 subscribers. In smaller telephone nets, or where the subscribers are sparsely distributed, smaller cabinets are used.

A cabinet area for a total of 300 subscribers is schematically shown in fig. 11 and includes most of the existing types of cabinets and terminal boxes used by L. M. Ericsson. In actual practice, of course, no such diversity of types or designs is ever used within the same area. They have been included in this case, however, to show how readily the system may be adapted to various types of construction.

A 300-pair main cable (*G*) is led from the main distributing frame (*A*) at the exchange and terminates in a jumpering cabinet (*B*). Here the main cable is connected to three 100-pair cable heads, each one mounted with 10 porcelain terminal bases. The cabinet contains additional space for 39 such terminal bases, mounted on cable heads for 1, 2, 3, 4, 5 or 10 bases. These cable heads, in turn, are connected to primary outgoing cables. The jumpering is done by means of rubber insulated jumper wires.

Secondary distributing cables (*H*) are led directly from the main jumpering cabinet — cabinet No. 1 — to the buildings in its immediate vicinity and terminate in distribution cabinets or 10-pair terminal boxes (*C*). Primary distribu-

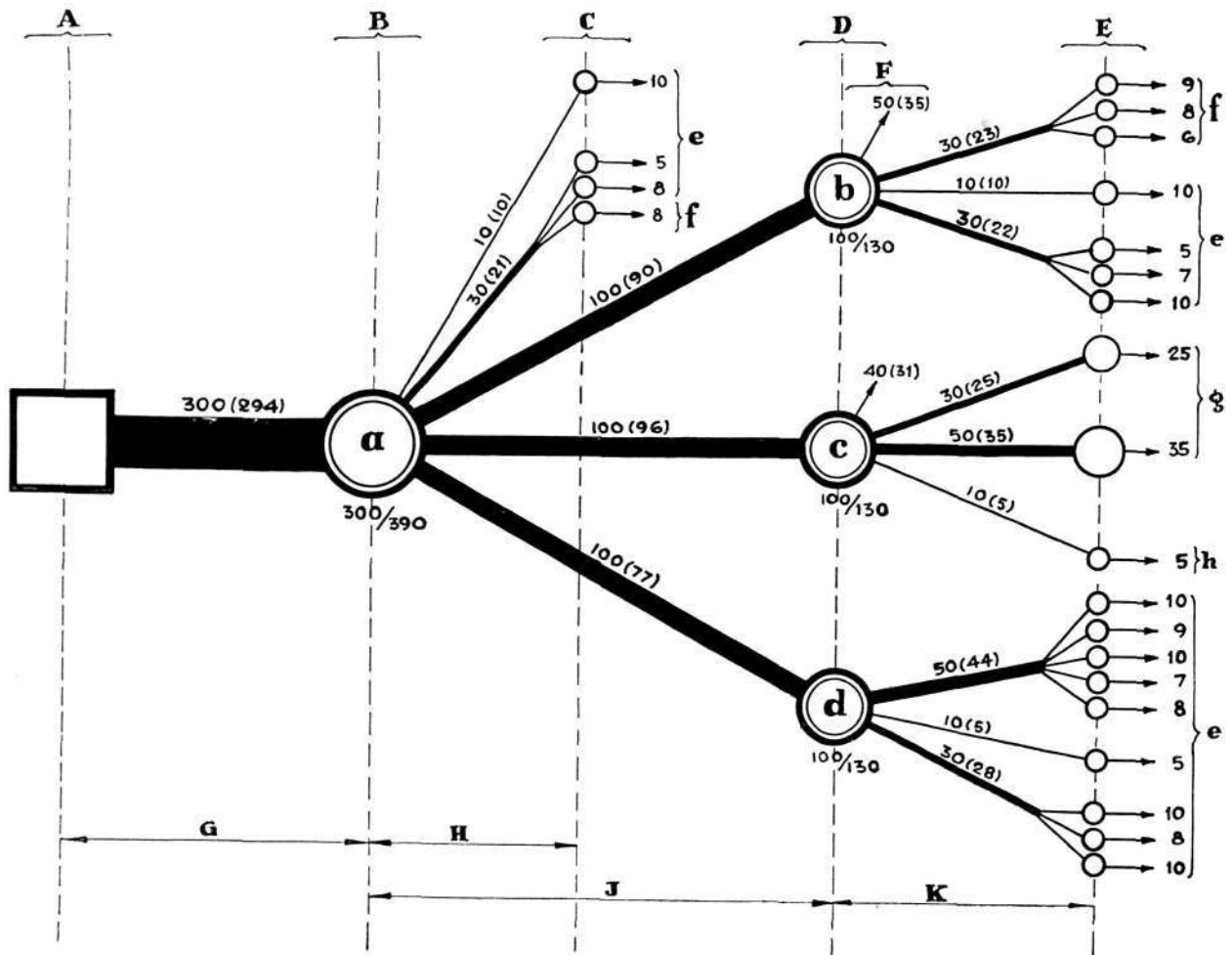


Fig. 11. Schematic Diagram of Cable Distribution Area.

ting cables (*J*) are led to the other buildings or groups of buildings and terminate in smaller jumpering cabinets (*D*), which are termed »No. II cabinets». A number of lines (*F*) may be led from these cabinets directly to roof standards for open wire distribution. All the other lines are jumpered to secondary distributing cables (*K*) which terminate in distribution cabinets or 10-pair terminal boxes (*E*).

Thus we find that the above described cabinet

area has been subdivided into four smaller secondary cabinet areas.

If cross-connecting were not resorted to in the above example, it would have been necessary to carry 480 lines out from the main distributing frame to attain the same number of connecting possibilities. This would mean an increase of at least 50 % in the first cost of both main cables and cross-connecting facilities at the exchange.

DEFINITIONS FOR ACCOMPANYING DIAGRAM, FIG. 11.

- A. *Main distributing frame.*
 - B. *Main jumpering cabinet*, termed »area cabinets» or »No. I cabinets».
 - C. *Distributing cabinets and terminal boxes*, belonging to No. I cabinet.
 - D. *Jumpering cabinets*, belonging to No. I cabinet. These are called »No. II cabinets» and constitute the secondary cross-connecting point within the net. Additional jumpering cabinets are sometimes used, which are then called »No. III cabinets».
 - E. *Distribution cabinets and terminal boxes*, belonging to No. II cabinets.
 - F. *Lines, led directly from No. II cabinet*, and connected to the open net by means of rubber insulated wires.
 - G. *Main cables.* These go out from the main distributing frame and terminate in the main jumpering cabinet.
 - H. *Distributing cables*, secondary, belonging to No. I cabinet.
 - J. *Distributing cables*, primary, belonging to No. I cabinet.
 - K. *Distributing cables*, secondary, belonging to No. II cabinets.
 - a. *Jumpering cabinet* (see fig. 1) made for 300 or 600 incoming lines and for 390 or 780 outgoing lines respectively.
 - b. *Jumpering cabinet for mounting on iron standard*, for 100 incoming and 130 outgoing lines. (See figs. 4 and 5).
 - c. *Pole jumpering cabinet*, for 100 incoming and 130 outgoing lines. (See figs 2 and 3).
 - d. *Indoor jumpering cabinet*, made in three sizes, for 50/80, 100/130 and 100/260 incoming and outgoing lines respectively. (See fig. 6).
 - e. *Terminal boxes*, for the distribution of 10 lines by means of 2-conductor lead covered cables. (See fig. 7).
 - f. *Pipe standard terminals*, for the distribution of 10 open lines. (See fig. 8).
 - g. *Pole arrester cabinet*, made in two sizes, for 30 and 50 lines resp. Furnished with either carbon arresters or fuses. (See fig. 9).
 - h. *Pole terminal*, for the distribution of 10 open lines. (See fig. 10).
- Numbers 5, 8, 10, etc. denote number of outgoing lines from the various cabinets.
300 (294) denotes capacity of cable and number of occupied lines respectively.
300/390 denotes capacities of jumper cabinets on incoming and outgoing sides respectively.
- B. K.

Automatic Switching for Private Telephone Exchanges.

When speaking of private telephone exchanges we generally mean exchanges which provide a means of communication between the various departments of an office or factory, or within any restricted area. Such a plant may be without any means whatever of communication with other nets, or may be furnished with P. B. X. lines for public exchange facilities.

A direct result of the increasing popularity of the telephone is a growing demand for private telephone exchanges. The efforts being made to reduce operating expenses by replacing manual labour with all manner of mechanical devices, in telephony as well as in other fields of technical endeavour, have naturally also been applied to private telephone systems. The result of these efforts now lies before us in the form of the private automatic exchange.

When selecting a system for a private exchange, the choice lies principally between three different systems, i. e. the manual system, with an operator for making the necessary connections, the intercommunicating system, and the full automatic system.

The manual system is undoubtedly the most convenient from the user's point of view, as all the switching operations are handled by telephone operators. In such cases where traffic is so light that an operator's spare time may be used to advantage for other work, or where certain unusual conditions absolutely require the use of an operator, the private manual exchange is still fully justified. On the other hand, we find that the manual system is not without its disadvantages. For instance, there are cases where it would be very desirable to have the telephone service at one's disposal outside of the regular office hours, but where the added cost of extra help makes such an arrangement out of the question.

The intercommunicating system eliminates the

disadvantages of the manual system in so far that the user is not dependent on the services of an operator, but is able to make all the necessary switching manipulations himself. The telephone instruments used with such a system are of a very intricate construction, however, and the cost of the plant is relatively high. Since all of the lines must pass through each telephone instrument, we find that the total cost increases very rapidly with an increase in the number of lines. Thus, the total number of telephone instruments must be kept within certain limits from a technical as well as from an economical point of view. Furthermore, on account of the expensive wiring, the intercommunicating system is suitable only where the distances between the various telephones are comparatively short.

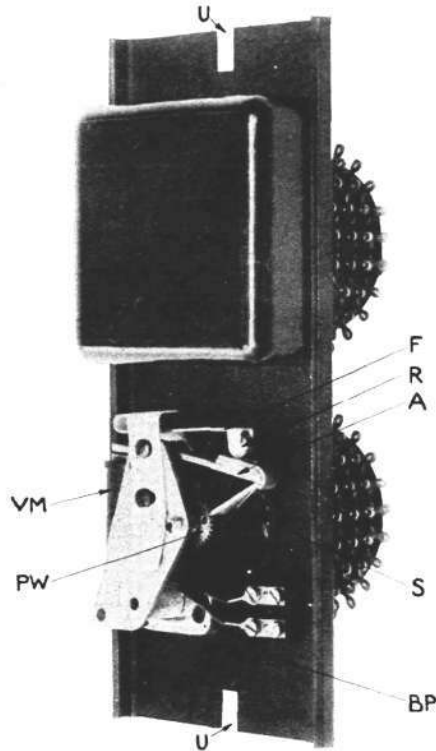
It will, in all probability, be found to one's advantage to equip a private telephone exchange with automatic switching, provided that no special features or unusual requirements render this impossible. L. M. Ericsson's have constructed three different automatic systems for private exchanges, short descriptions of which will here be given.

All three of these systems are equipped with switching devices of exactly the same type as the preselectors in Ericsson's system for automatic distribution, i. e. 25-point step by step cylinder switches.

Two switches of the above mentioned type are shown in fig. 1, the one with its cover removed. A cylinder switch is composed of the following parts:

The *base plate BP*, on which the switch is mounted. This base is formed out of a strip of steel with the two long edges bent up and is usually of sufficient length to accommodate 10 switches, the strip being fastened to the rack by means of the slots *U*.

The *contact bank*, which is cylindrical and within which the contact brushes rotate. Each contact section is composed of an unbroken ring



R 215 Fig. 1.

of metal, to which the incoming line is connected, and 25 metal contacts, arranged in the form of a circle, to which 25 outgoing lines are connected. The switches are termed 4-terminal, i. e. they are composed of 4 contact sections, their respective metal rings and rows of contacts being placed side by side with alternate layers of insulating material, thus forming a hollow cylinder.

The *contact brushes*, which are four in number, i. e. one for each contact section. They are mounted on the shaft S by means of a holder of insulating material, each brush forming a metallic connection between the metal ring and the contact which corresponds to the position in which the switch has been set.

The *driving mechanism*, consisting of the electromagnet VM, the armature A to which the feed and locking pawls are affixed, the ratchet wheel PW on the shaft S, and the spring F with the

roller R, for restoring the armature to normal when the magnet coil VM de-energizes.

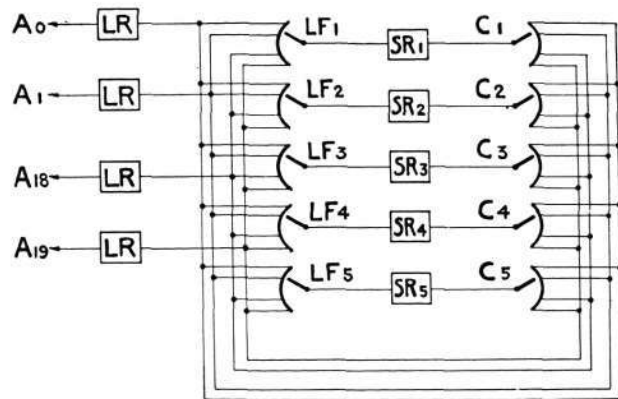
20-line automatic exchange, type OL 20.

This type of switchboard is intended for very small exchanges with a maximum of 20 lines. The principle of the system is clearly shown in fig. 2.

The exchange has 5 so-called cord circuits, S_1 to S_5 , each one consisting of a line finder LF, a connector C and the necessary relays SR. The function of the line finder is to find the calling line and connect up the same to an idle cord circuit. The connection to the called line is accomplished by means of the connector.

All of the subscribers' lines — each one of which is provided with a line relay LR — are connected to the contact banks of the line finders and connectors. Since an exchange is equipped with 5 cord circuits, it follows that 5 conversations may be in progress at the same time.

The telephone instruments are of the common battery type with finger dials for the dialling of the desired number. Each telephone is also provided with a key for the sending out of a ringing signal to the called number, this system being equipped with so-called battery ringing, requiring the calling subscriber himself to give a ringing signal after the dialling of the number.



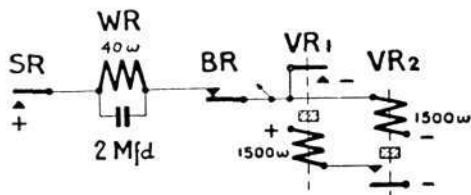
R 216 Fig. 2.

The system functions in the following manner:
The calling subscriber removes his receiver from the cradle, causing his line relay and a

common starting relay to energize. All the line finders which happen to be idle at the moment are set in motion to find the calling line. The line finders have no definite starting position. They are actuated by means of a common impulse-sending device consisting of two relays connected as shown in fig. 3.

VR_1 and VR_2 are two slow-acting relays. WR is the driving magnet of a selector and is paralleled with a condenser of 2 mf capacity so as to eliminate sparking. This arrangement functions in the following manner:

The energizing of the starting relay SR closes a circuit over the magnet coil WR and the slow-acting relay VR_2 , and the latter energizes. This current, however, has not yet the power to actuate the stepping magnet WR . Relay VR_1 is brought in circuit over the contact in VR_2 . Negative is connected directly to the stepping magnet



R 219

Fig. 3.

WR , thereby causing it to actuate its armature. VR_2 is simultaneously shorted and de-energizes. The circuit through VR_1 is broken, causing this relay to de-energize, thus releasing the armature of the stepping magnet. Relay VR_2 is again energized. VR_1 is brought in circuit, this latter, in turn, connecting negative to the stepping magnet and short circuiting VR_2 , and so forth. For each time the armature of the stepping magnet is released, the brushes of the selector are stepped forward one step. This movement continues until the current is cut off by the connecting relay BR of the cord circuit.

A frequency of about 20 impulses per second, which is the most suitable for the driving of the selectors, may be attained by giving the relays VR_1 and VR_2 a properly balanced adjustment and speed of action.

The first line finder whose brushes make contact with the terminals of the calling line stops,

thus closing the circuit simultaneously with the energizing of the connecting relay and the cutting off of the current to the stepping magnet. The other line finders immediately stop and are in readiness to start hunting again as soon as a new call is originated.

The subscriber calls a desired number by means of the dial on his telephone instrument, whereby a series of impulses — consisting of breaks in the current passing through the subscriber's line and instrument — are sent out. These impulses are received by the impulse relay of the cord circuit, and are re-transmitted directly to the stepping magnet of the connector over a contact in this relay. The connector, which has a definite normal position, is then stepped forward a certain number of steps corresponding to the dialled number, coming to rest opposite the terminal of the called line.

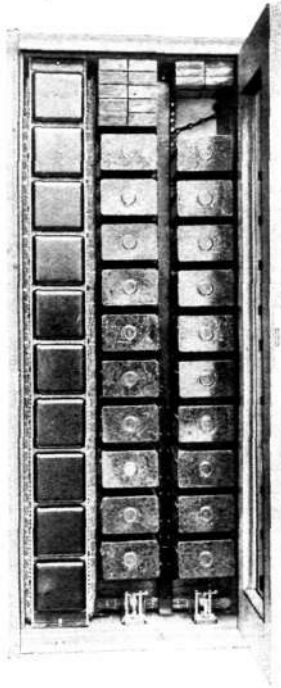
After the dialling of the desired number, the calling subscriber depresses his ringing key. If the called line is disengaged, the final stage of the switching process is accomplished over the connector's connecting relay and a ringing signal is sent out. This signal is heard by the calling subscriber in the form of a humming tone. If, on the other hand, the called line is busy, no connection takes place and no ringing tone is heard.

The called subscriber's bell rings as long and as often as the ringing key is depressed.

When the conversation is ended and the speaking parties replace their microtelephones, the connector is automatically restored to normal and the cord circuit is in readiness to handle a new call.

The calling dials used with this system are of the standard type with the exception of the numbering, which differs from that ordinarily used. Instead of being numbered 1, 2 — — 9, 0, the dials for the automatic system OL 20 are numbered 0, 9 — — — 2, 1, in order to make possible a simple numbering of the lines without necessitating the use of a special dial with 20 or 25 numbers. The lines are numbered from 0 to 19. For a connection to the line 0, the connector is set to position 1, for a connection

to line 9, it is set to position 2, etc. Thus in the contact fields of the connectors the lines occur in the following order: 0, 9 — — — 2, 1, 10, 19 — — — 12, 11.



K 14 Fig. 4.

Since the selectors have 25 contact positions, the OL 20 system may be extended — if so desired — so as to include 25 lines. The numbers of the last 5 lines, however, must contain 3 digits each, i. e. 110, 119, 118, 117 and 116.

A switchboard OL 20, enclosed in an oak cabinet for mounting on the wall, is shown in fig. 4. To the extreme left we see the strip with the 10 selectors, i. e. 5 line finders and 5 connectors. The 5 cord circuit relays and the common relays are placed on the right hand side.

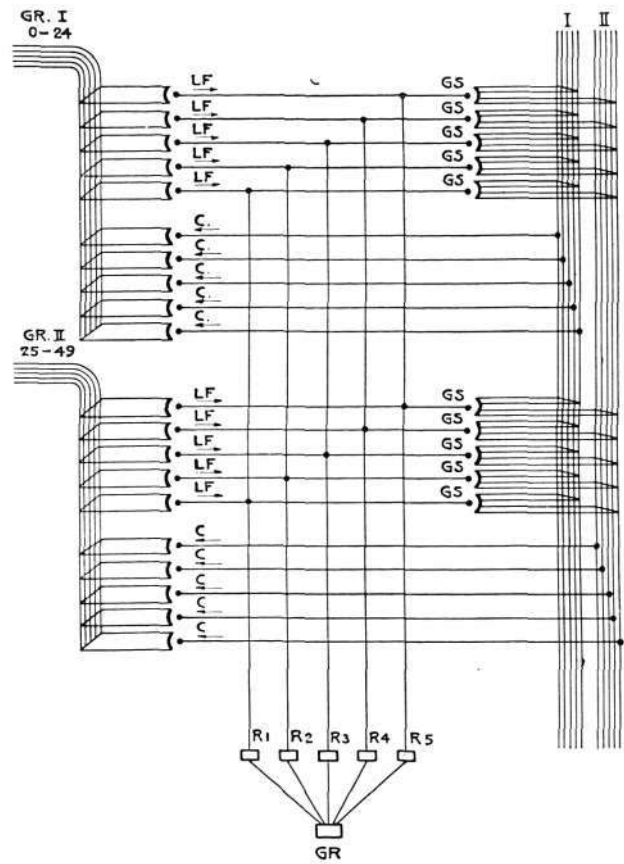
A power plant consisting of one or two 24-volt storage batteries is required for this plant, for which charging equipment, suited to the existing conditions, can be furnished.

Automatic exchange, type OL 100.

The OL 100 system is intended for exchanges with a maximum capacity of 100 lines. The principle of the system is schematically shown in

fig. 5. The lines are brought together in groups of 25, each such line group being connected to the multiple contact banks of a number of line finders *LF* and connectors *C*. The number of line finders and connectors per group has been determined at 5 as this number corresponds to the requirements of a normal traffic and permits 5 simultaneous outgoing calls from and 5 incoming calls to the group in question. Should the necessity arise, however, it is possible to increase the number of line finders and connectors to correspond to the existing requirements in each special case.

Each line finder is connected directly to a group selector *GS*. A line finder together with its



R 217

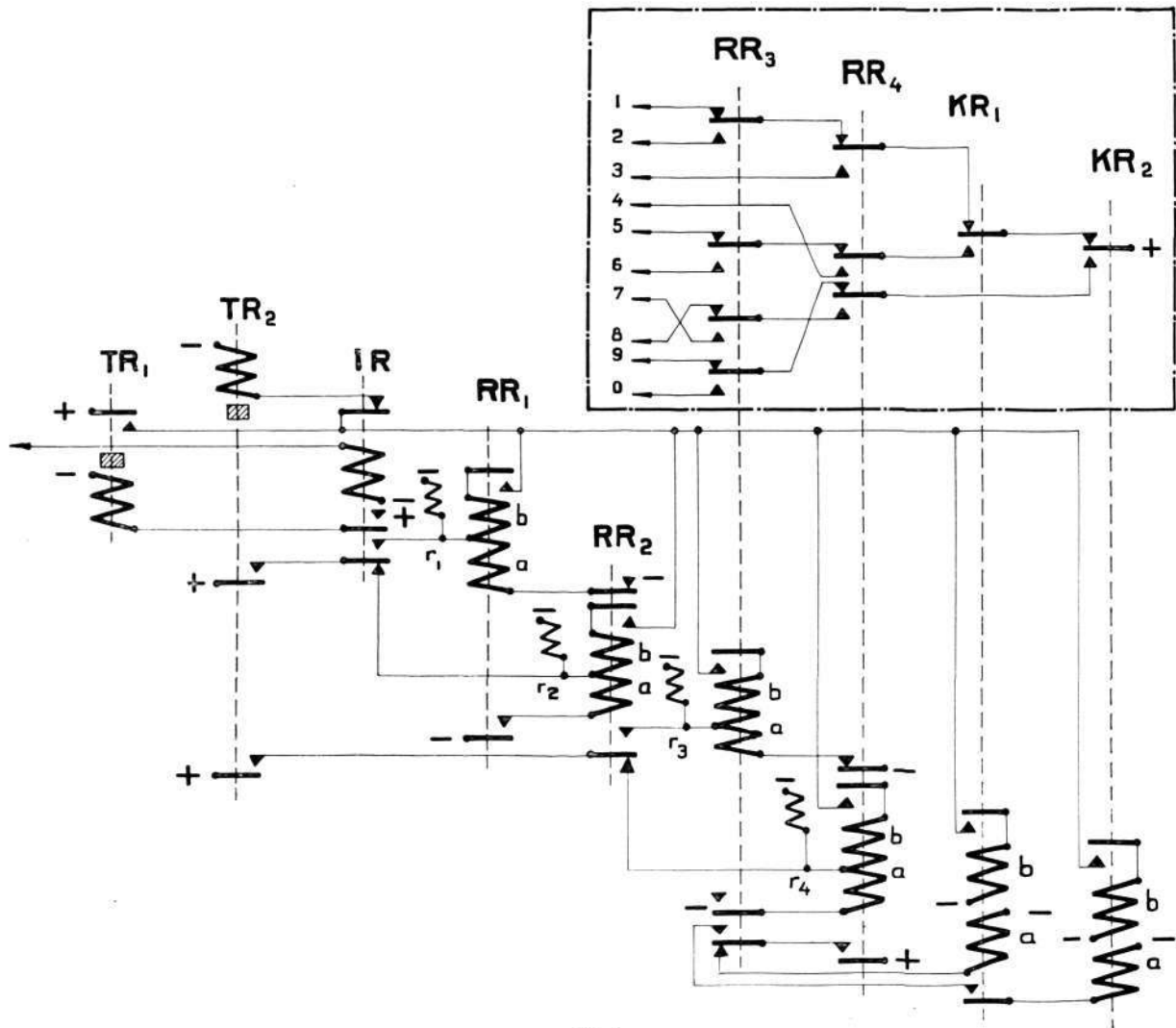
Fig. 5.

group selector and relays constitutes a unit, called a cord circuit. Each group of 25 subscribers' lines, therefore, has 5 cord circuits.

The contact banks of the group selectors, which

are paralleled over all the group selectors in the exchange, are divided into a number of groups corresponding to the number of subscribers' line groups. Thus, if the exchange is built for 100 lines, it follows that there are 4 such groups. The multiples of the group selectors are joined to the connectors by means of trunk lines. Thus,

Each cord circuit is connected to a register *R* so that the cord circuits No. 1 in all the groups are connected to a common register R_1 , the cord circuits No. 2 to a register R_2 , and so forth. A 100-line exchange usually contains 5 registers all of which, in turn, are connected to a common group relay *GR*.



R 226

Fig. 6.

the group selector multiple of a 100-line exchange with 5 connectors per group of subscribers' lines contains $4 \times 5 = 20$ outgoing lines. The five remaining contact positions of the group selectors are utilized for busy signalling, the cutting out of short circuited lines, connections to central exchange lines, etc.

The function of the registers is to receive and register the numbers which are dialled on the subscriber's telephone instruments and to determine or mark the positions to which the group selectors and connectors shall be set so as to effect connections with the registered numbers. This marking is accomplished by means of the above-

mentioned group relays, which also may be termed marking relays.

The registers consist entirely of relays, and are usually constructed for 2-digit numbers. By adding a few relays, however, it is possible to register 3-digit numbers as well, thus increasing the capacity of the exchange to over 100 lines.

As the principle on which the design of this register is based is comparatively new, a description of the same may be of interest. In fig. 6 *IR* is the impulse relay which receives the impulses produced by the dialling of a number. The dials are numbered in the usual manner, i. e. in the order 1, 2 — — 9, 0. When digit 1 is dialled, the impulse relay *IR* de-energizes and energizes once, twice for the digit 2, and finally, ten times for the digit 0.

*TR*₁ is the register's releasing relay, this relay being connected up simultaneously with the connecting of the register to the calling subscriber and the energizing of the impulse relay. On account of its slow action, this relay remains energized even during the short breaks in its holding circuit, produced when the relay *IR* alternately releases and attracts while receiving impulses from the subscriber's dial. The relay *TR*₁ does not de-energize until the connection between the subscriber's line and the register is broken, causing the impulse relay to return to normal. *TR*₂ is the register's switching relay and, like *TR*₁, is slow-acting. It energizes at the same moment as the first impulse causes *IR* to release, and remains energized during the whole first series of impulses. Only when this train of impulses is ended and *IR* again is continuously attracted, does it de-energize, and is again re-energized simultaneously with the sending out of the train impulses caused by the dialling of the second digit.

*RR*₁, *RR*₂, *RR*₃ and *RR*₄ are counting relays

which register the impulses with the aid of the controlling relays *KR*₁ and *KR*₂.

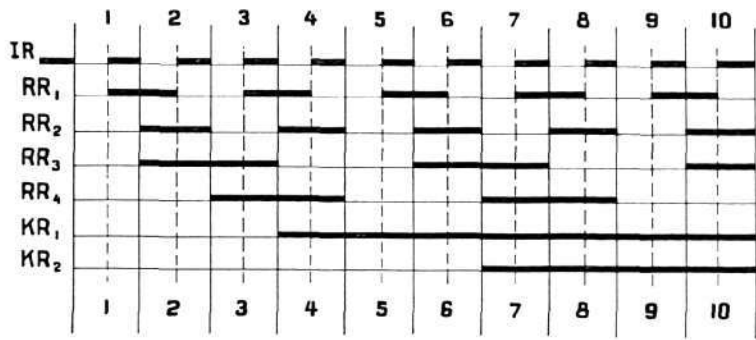
The functioning of the register while receiving and registering the impulses produced by the dialling of a digit — consisting, as already mentioned, of one breaking and one closing of the circuit through the impulse relay *IR* — is briefly as follows:

When the register is brought into the circuit and *IR* energizes, *TR*₁ is also energized. *TR*₂ energizes when *IR* de-energizes, at the beginning (break of circuit) of the first impulse. When *IR*, at the end (closing of circuit) of the first impulse, is again energized, the coil *a* of relay *RR*₁ is brought in circuit and this relay energizes. When *IR* de-energizes at the beginning of the second

impulse, the coil *a* of relay *RR*₂ is brought in circuit and this relay energizes, *RR*₁ being simultaneously held through the resistance *r*₁, its winding *b*, and over the contact in *TR*₁. When *IR* again energizes at the end of the

second impulse, relay *RR*₁ is short-circuited and de-energizes. *RR*₂ is now held through the resistance *r*₂, its winding *b*, and over the contact in *TR*₁.

Relay *RR*₂ is short-circuited at the beginning of the third impulse and de-energizes, relay *RR*₁ energizing at the end of the third impulse, after which *RR*₁ and *RR*₂ alternately energize and de-energize until the train of impulses of the first digit is ended. Thus we find that relay *IR* attracts and releases once for each complete impulse, while *RR*₁ and *RR*₂ either attract or release once, two impulses being required if, for instance, *RR*₂ is to attract and release once. The number of impulses is thereby reduced to one half, and by placing a switching contact on *RR*₂ and connecting the same to the relays *RR*₃ and *RR*₄ in the same manner as the contact of impulse relay *IR* is connected to *RR*₁ and *RR*₂, still another similar reduction may be accomplished,



R 227 Fig. 7.

whereby the relays RR_3 and RR_4 will require 4 impulses to attract and release once. By connecting the controlling relays KR_1 and KR_2 as shown in fig. 5, it is possible to register the impulses produced by the calling dial. Thus the relays RR_3 , RR_4 , KR_1 and KR_2 may form 10 different combinations corresponding to the number of impulses received by IR , and ten different circuits are formed — each corresponding to a digit — by placing spring groups on these relays. (These spring groups are actually placed on special auxiliary relays, i. e. the above-mentioned group or marking relays, as it is impracticable to build relays with such a large number of spring groups.)

Fig. 7 shows schematically which relays are energized for the various impulses. The figures denote the number of impulses transmitted by the finger dial and received by the impulse relay IR , each impulse consisting of one breaking and one closing of the circuit. The heavy lines indicate that the relays are energized, and the fine lines that they are de-energized.

As shown by the contact combinations for the 10 different circuits (see fig. 6), relays RR_1 and RR_2 do not take part in the final marking of the figures, but may be switched over so as to take part in the marking of the figures for both the tens and units. By mounting switching contacts on relay TR_2 and connecting these to two relays similar to RR_1 and RR_2 , a switching over from the marking of tens digits to the marking of units may be effectuated. Also, the dial tone which is sent back to the calling subscriber at the connecting up of the register may be discontinued after the first digit has been dialled. Lastly, when the units digit has been registered, a circuit may be formed which serves to connect the register to the marking relays — common to all the registers —, causing these to energize and form a combination corresponding to the dialled and registered number. Since this circuit may be formed for only one register at the time, it is carried over the contacts of relays belonging to the various registers and is arranged so that it cannot be closed from a register until the common relays have been

restored to normal following a previous switching operation.

In the OL 100 system, neither line finders, group selectors or connectors have definite starting positions, but remain standing in the positions occupied at the close of the previous switching operation. The intermittent direct current with which the selectors are actuated is produced over impulse relays according to the principle described in connection with the OL 20 system.

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

When the calling subscriber removes his micro-telephone from the cradle, this subscriber's line relay and a starting relay — common to all the 25 lines within the group — energize. All the idle line finders belonging to this group and whose registers also are idle, are now actuated over this starting relay. The line finder which first reaches a terminal of the calling line connects up and the other line finders immediately stop hunting.

The calling subscriber is now connected to a cord circuit and a register over the line finder, this being announced by the sending out of a dial tone through the receiver of the telephone.

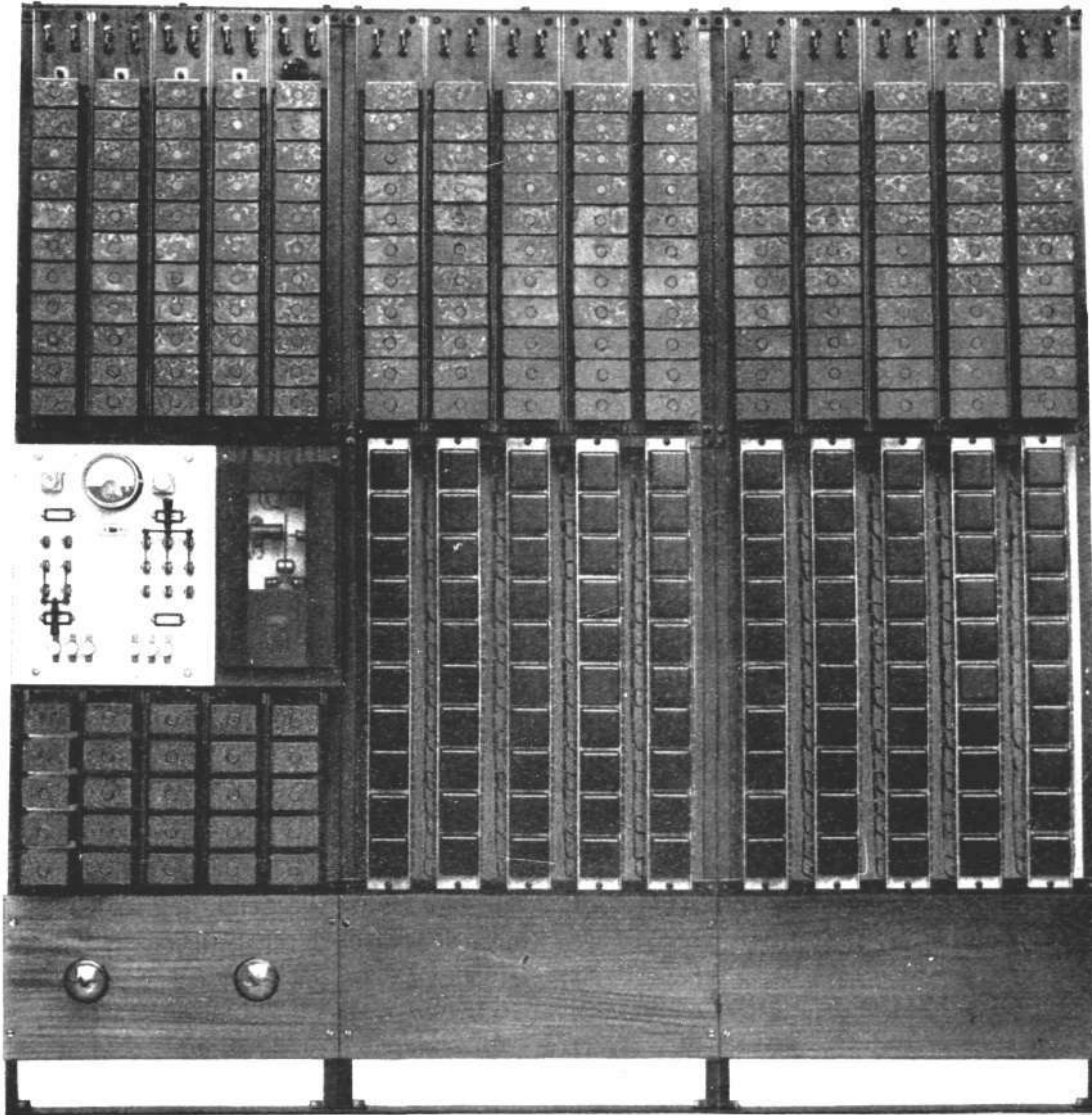
The connected cord circuit is now blocked to further calls until the conversation is ended. The register is occupied and blocked during the time required for the registering of the dialled number. All the other cord circuits connected to this register are also indicated as busy during this interval, but are again released as soon as the register has completed its function.

As soon as the calling subscriber hears the dial tone, he may begin to dial the desired number, which is then received and registered by the register. When this is accomplished, the register is connected to the above-mentioned marking or group relays GR . Should these relays be occupied at the time, the register will have to wait until they again are idle, when the connection will immediately take place.

The function of the marking relays, as already mentioned, is to denote positions in the contact banks of the connectors, which correspond to the dialled number. For an exchange with 100

2-digit numbers, therefore, there are 10 relays for marking the tens digits, each relay having 10 contacts for marking the units and one contact

over the contact of this relay which corresponds to the units digit. This marking is also led over the cut-off relay of the line in question to test whether



K 15

Fig. 8.

over which is marked that group in the contact bank of the group selector, to which the call is to be directed.

The common relays are actuated at the same instant in which they are connected to the register. The tens relay, corresponding to the tens digit, energizes and the marking of the subscriber's line in the contact banks of the connectors takes place

the line is idle or busy. The following two alternatives can occur:

- a. The line is idle.

The group selector is set in motion and continues hunting until the first idle line is found in the group denoted by the marking relays. When this is accomplished, the group selector

is connected and the connector is set in motion, and continues hunting until the contact position marked over the group relays has been reached. The connection to the subscriber's line is now completed and a ringing signal is sent out. The ringing current is supplied by means of a pole changer mounted on the switchboard. A speaking circuit is now established, and the common relays as well as the relays of the register are restored to normal and are in readiness for the next switching operation.

b. The line is busy.

Should the dialled number be busy, the marking in the contact bank of the group selector will take place over a special contact to which a busy signal line is connected. On being set in motion, the group selector, therefore, is directed to this position, and the calling subscriber receives a busy signal. In this case, no connector is set in motion.

When a conversation is ended, both the cord circuit relays and the subscribers' relays are restored to normal.

The OL 100 system is arranged so that subscribers' lines can be equipped with service meters, if desired.

This system is equipped with so-called periodic ringing, which continues until the called subscriber answers or, if no answer is obtained, until the calling subscriber replaces his micro-telephone, thereby breaking the connection. On the other hand, the ringing signal of the OL 500 system described here below consists of but one single signal of about $1\frac{1}{2}$ seconds' duration. *Automatic exchange, type OL 500.*

The private automatic exchange of the OL 500 system is specially adapted for larger establish-

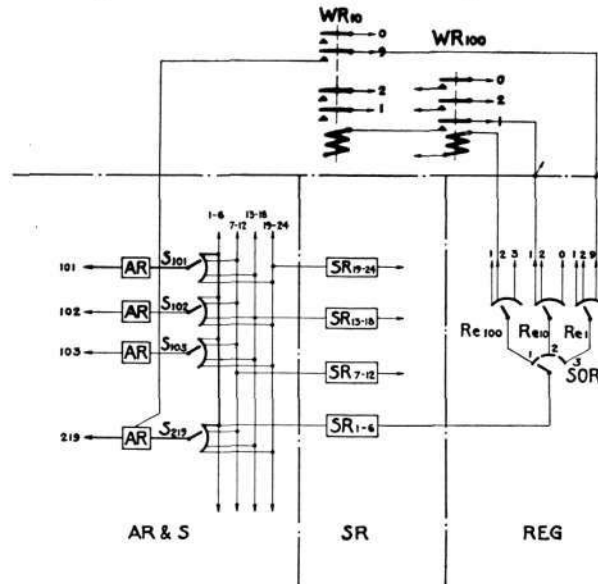
ments such as warehouses, offices, banks, factories, etc., and also for small communities. Theoretically, an exchange of this type can accommodate an unlimited number of lines. From a practical point of view, however, the number of lines is limited by the number of simultaneous conversations, these latter being limited to 24 by the scope of the selectors; the size of the exchange with regard to the number of lines is thus dependent on the intensity of traffic. The 24 cord circuits for which the various OL systems are built are capable of carrying a load of 780 speaking minutes per hour under the assumption that two calls per thousand are lost on account of an insufficient number of switching devices. With light traffic amounting to say $1\frac{1}{2}$ calls per subscriber and hour, each call with a mean length of approximately 1 min., the number of lines may run up to 500. For plants with comparatively heavy traffic, for instance 3.8 calls per subscriber and hour, each call with a mean length of 1 min., the corresponding figure will not exceed 200.

Fig. 8 shows an automatic switchboard of the type OL 500, consisting of:

- a. A service rack, shown at the extreme left. This rack contains the following switching devices:
 - The necessary relays for 24 cord circuits.
 - » » » » 4 registers.

Common relays for the marking and testing of the called lines, ringing relays, etc.

This rack also contains a panel with instruments, fuses and switches for the charging and discharge of the necessary storage batteries, and a pole changer for providing the ringing current.



R 218

Fig. 9.

b. A subscribers' line rack in bays of 50 lines each. The switchboard shown in fig. 8 contains two such bays. Each subscriber's line is furnished with a set of 3 relays, i. e. a line relay, a connecting relay and a ringing relay, together with a cord circuit selector over which connection to one of the 24 cord circuits takes place.

During a subsequent extension, additional bays may be added to the subscriber's line rack without disturbing the service. Also, these additions can be made in small units of say 10 lines.

In such cases, where the traffic is so light that 24 cord circuits are not required, a service rack with equipment for a lesser number, for instance 6, 12 or 18, is furnished, whereby the first cost is considerably reduced.

The principle of the OL 500 system is shown in fig. 9. To the extreme left are shown the incoming subscribers' lines 101 to 219 with their relays AR and selectors S_{101} to S_{219} . The contact banks of the selectors are paralleled and connected to 24 cord circuits 1 to 24. SR_1 to SR_{24} are the cord circuit relays. The cord circuits form 4 groups of 6 lines each, each group with one register Reg . As in the OL 100 system, the function of the registers is to receive and register the dialled numbers and to direct the setting of the selectors.

A register is built up entirely of relays, on the same principle as for the exchange OL 100, but is here indicated by 4 selectors for the sake of simplicity. Also, the registers on the earlier types of switchboards were actually composed of selectors.

The function of SOR is to successively connect up the number selectors Re_{100} , Re_{10} and Re_1 .

The selector Re_{100} is set during the connecting of the hundreds digit.

The selector Re_{10} is set during the connecting of the tens digit.

The selector Re_1 is set during the connecting of the units digit.

The contact banks of the number selectors are connected to the marking relays WR . For instance, if the exchange is built for 300 lines, there will be 3 relays WR_{100} , i. e. one relay for

each one hundred lines, these relays being connected to the terminals 1, 2 and 3 in the hundreds selectors Re_{100} .

Each relay WR_{100} has 10 contacts 1 to 0, over which the relays WR_{10} — for marking the tens digits — are connected up. This connecting also takes place over the contacts 1 to 0 of the tens selector Re_{10} .

Each tens relay WR_{10} has 10 contacts 1 to 0 for the final marking of the dialled number. These contacts are connected to the contacts 1 to 10 of the units selector Re_1 and to the line relays AR . Thus, contact number 9 of the tens relay WR_{10} which is energized over the hundreds relay WR_{200} , is connected to line 219, etc. Thus, if the exchange is built for 300 lines, there are 3 hundreds relays and 3×10 tens relays, each with 10 contacts, each such contact in the units relays being connected to the relay of the subscriber's line which has the corresponding number.

We will assume, for example, that subscriber 101 intends to call up subscriber 219. The switching process will then briefly be as follows:

Subscriber 101 removes his microtelephone, causing the line relay to energize and the selector S_{101} to start hunting a disengaged cord circuit within a group whose register happens to be idle. For instance, let us say that the selector finds cord circuit No. 3 to be idle and makes a connection, causing a simultaneous connecting up to the register. The calling subscriber receives a dial tone, indicating that the connection has been made and that the dialling of the desired number may commence.

The switching device SOR stands connected up in position No. 1, the hundreds selector Re_{100} being set to position No. 2 when the hundreds digit 2 is dialled. During the interval between the dialling of the first two digits, SOR is advanced to position No. 2. The tens digit 1 is now dialled, causing the tens selector Re_{10} to be set to position No. 1. SOR is now advanced to position No. 3, and when, finally, the units digit is dialled, the units selector Re_1 is set to position No. 9. When the whole number has been registered, the register is connected up to the relays WR , common to the whole exchange.

Should these relays be momentarily engaged, the register will wait until they again become disengaged.

The registering of the number 219 by the register now causes the corresponding marking relays, i. e. the hundreds relay WR_{200} and the tens relay WR_{10} , to energize, the marking of a call on the subscriber's line 219 being effected over the register's contact No. 9. Assuming that this line is idle, its selector S_{219} is then set in motion, and stops when it has found the cord circuit to which the calling subscriber 101 has been connected, in this case circuit No. 3. The connection between the subscribers 101 and 219 is now established over the circuit denoted by heavy lines in fig. 9. A ringing signal is sent out to the called subscriber over the ringing relay of his line, and the calling subscriber hears this signal in his receiver in the form of a humming tone. Should the desired line be engaged, its selector, naturally, is not set in motion, as this would mean a breaking of the conversation in progress. Instead, a busy signal is sent back to the calling subscriber.

The ringing current is supplied by a pole-changer, which is started by means of relays at the making of a call.

At the same moment as the register and the marking relays have completed their functions, they are restored to normal in readiness for the next switching operation. The cord circuit relays de-energize when the conversation is ended and both subscribers have replaced their micro-telephones.

The current for driving the selectors is supplied over impulse relays in a manner similar to that described in connection with the OL 20 system. The selectors do not have any definite starting positions. The selector of the calling subscriber's line hunts for and connects itself to an idle cord circuit, and the selector of the called subscriber's line is stepped forward and connected to the same cord circuit.

The power plant for an OL 500 exchange consist of 2 24-volt storage batteries, and the charging equipment should be adapted to existing conditions at the place of erection.

All of the three above described systems may be furnished with public exchange facilities. These facilities can be arranged in various ways, depending on which special features or requirements are to be complied with in each different case, and will be dealt with in a separate article.

G. G.

L. M. Ericsson obtains Concession in Italy.

The Italian government has recently passed a decision providing for the granting of private concessions for operating all of the telephone nets in the country — with the excepting of longer toll lines.

According to this plan, the entire country was divided up into five zones and the concession for each such zone was made the subject of public competition. A consolidated group of business interests, formed by L. M. Ericsson and comprising, among others, the Fatme telephone company of Rome (this company carries on its activities in cooperation with L. M. Ericsson) Stockholm's Enskilda Bank, AB. Svenska Handelsbanken in Stockholm and Hambro's Bank

in London, were successful in obtaining a 50-year concession for the zone comprising southern Italy and Sicily, the cities of Naples, Palermo and Messina, among others, being located in this zone. The concession includes also the suburban traffic within this district. The concessions for the other zones have been granted to groups of local Italian business interests, some of which have already made arrangements for securing the benefit of L. M. Ericsson's wide technical experience.

The above-mentioned zone has about 22,000 subscribers at the present time and the existing net is to be modernized and developed by the concessionary in accordance with present day requirements.

The L. M. Ericsson Water-tight Microphone Capsule.

During the late nineties, L. M. Ericsson constructed a water-tight microphone with

was improved upon so that all of the various parts were mounted in a removable capsule. This

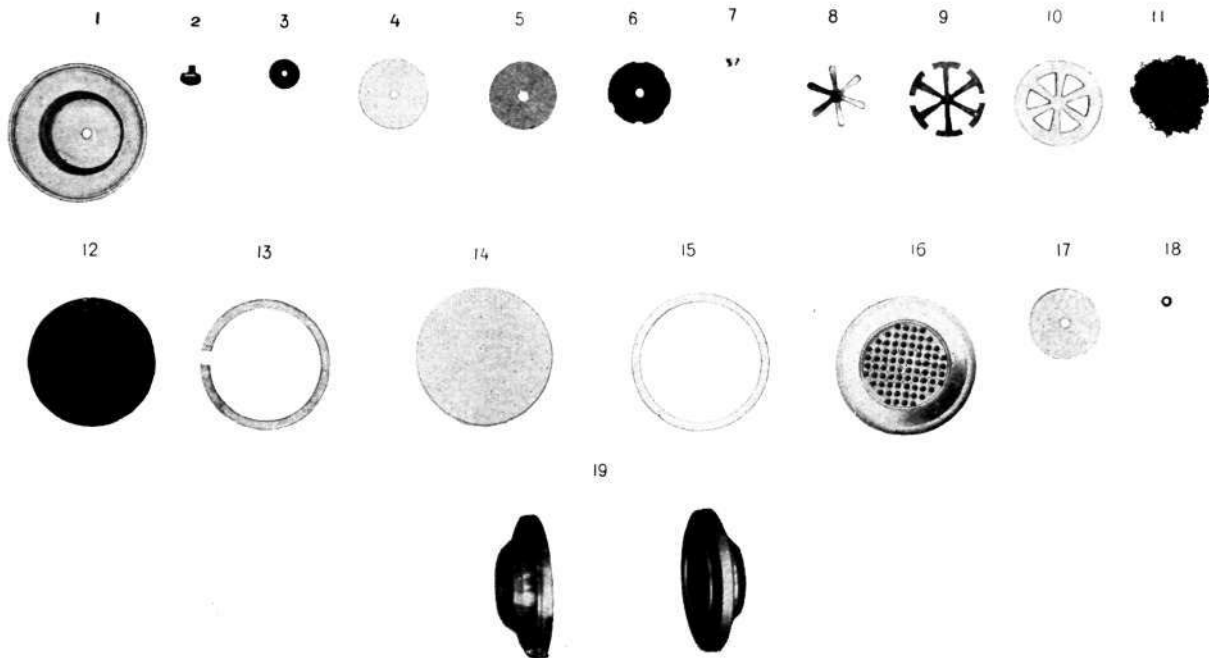


Fig. 1.

carbon granules which has been patented in nearly all the civilized countries of the world. Its sound reproducing qualities were excellent and it was used exclusively for several years. Its construction, however, was such that all of its component parts were mounted directly in the outer case, and for this reason it became water-tight only after the microphone case had been screwed together.

arrangement offered many advantages, especially for maintenance men who, when repairing telephone instruments at the subscriber's stations, were able to substitute a new capsule for a damaged one by means of just a few simple manipulations. The trouble could be easily remedied later on in the repair shop. With the previous construction, such repair work could not be done without a great deal of inconvenience.



Fig. 2.

Later, this construction

R 210

The earliest designed capsule, however, did not prove entirely satisfactory when called upon to withstand the injurious effects of very damp lo-



R 211

Fig. 3.

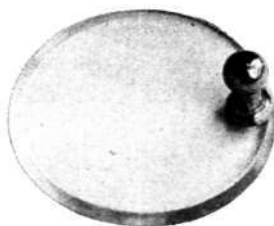
calities. Under such unfavourable conditions it was impossible to keep the carbon granules absolutely dry; they caked together and were attacked by erosion, which gave rise to disturbing noises. For this reason, it became necessary to renew these capsules at frequent intervals.

The above mentioned weaknesses led to still further improvements resulting in the construction of an absolutely water-tight capsule. This capsule has now been on the market since 1920, and since its telephonic qualities are equal to that of the older type, it is now being manufactured exclusively. This new construction has proved its worth in the most trying tropical climates, as in Java, for instance.

The inconveniences previously met with on this island in connection with the extremely heavy dews have entirely disappeared — as far as the microphones are concerned — since the new capsules have been introduced.



R 212 Fig. 4.



R 213 Fig. 5.

The outward appearance of the capsule, as well as all of its component parts, are shown in fig. 1. The water-tight qualities of the capsule are obtained by securing a membrane of tinfoil between the case and the cover when these two are pressed together.

The capsule microphone may be used with local battery as well as with common battery systems. In the first case, the microphone is given a resistance of from 25 to 40 ohms, while in the latter case the resistance is 200 ohms. In special cases, the microphone has sometimes been given a resistance of 100 ohms.

The tools and instruments by means of which the capsule is most conveniently refilled are shown in figs. 2 to 6. The tongs shown in fig. 2 are used for opening the capsule. After having been refilled, it can be put together again without impairing its water-tight qualities.

The six cells of the microphone are filled with exactly the right quantity of carbon granules by means of the carbon filler shown in fig. 3.

It is of the utmost importance that the carbon electrode (detail No. 6 in fig. 1) be adjusted so



R 214

Fig. 6.

that its position with reference to that of the carbon diaphragm is absolutely correct. This can be ascertained by the aid of the gauge angle shown in fig. 4.

The adjustment glass shown in fig. 5 is used to see whether each microphone cell contains exactly the correct quantity of carbon granules, at the same time as the felt star is pressed down to its correct position in the grooves of the carbon electrode.

The holding ring for the diaphragm is easily placed in position by means of the tweezers shown in fig. 6.

In tropical climates, measures must be taken to keep the air dry in the room in which the capsules are to be refilled. For this reason the degree of moisture in this room must be less than that which will cause the condensing of water (the falling of dew) at the lowest temperature occurring in this locality.

The L. M. E. Review will deal with the Ericsson microphone in a following article in connection with investigations which have been made in regard to its length of life and telephonic qualities, etc.

The Old and the New.

Some Facts about the Telephone Plant in Tangier.

When landing in Tangier, after a two hours' trip by boat from Gibraltar, one is welcomed by a gaudily clad, clamouring and wildly gesticulating flock of arabs, all fighting for the privilege of carrying one's luggage. Everything here is so different from what it is in Europe — the customs of the people, the mosques with their picturesque minarets, the primitively built and dazzlingly white buildings, and the gardens with their hedgerows of geraniums and cactus. The distance between Europe and Africa at this point is inconsiderable, but the difference in character is enormous.

Tangier may still, and with good reason, be called a veritable arab city. Of its population of approximately 80,000 inhabitants, about 50,000 are arabs, and it is they, with their distinctive features and gaudy raiment, who determine its character. Almost any day of the week, one may see oriental fakirs and dervishes at the principle market place, «El Socco Grande», performing their various tricks, such as snake charming, fire eating, walking on glowing coals, etc.

This city was the proud possessor of a very small telephone plant, erected in 1880, which was replaced in 1924 by a new, modern plant,

built and equipped by L. M. Ericsson. In these days, it is something decidedly out of the ordinary to find a telephone plant more than 40 years old, 20 years being usually considered a normal length of life.

The old exchange came into existence through the initiative of a Spanish consular official who took a great interest in physics and purchased three telephone instruments from Alexander Graham Bell's factory in America. This was in 1883, at which time the European colony did not count more than a very small number of persons. On their arrival, these instruments were immediately installed, the one in the home of the purchaser and the other

two in the homes of two of his friends. The news of this wonderful invention spread with the rapidity of fire, and it was not long before other inhabitants of Tangier were inquiring whether they too, might not purchase such instruments. Thus did Sñr. D. Emilio Rolando y Nicolau — the same man who took the initiative — conceive the idea of building a telephone exchange in Tangier.

A number of additional telephone instruments were purchased, together with a few drop indicators, these latter being mounted directly on a wall. The number of subscribers grew steadily



R 231 Fig. 1. Typical Street Scene from the Arab Quarter in Tangier.

from year to year and the venture became profitable. In fig. 3 we see a view of the old exchange with the above-mentioned drop indicators. The entire operating room did not occupy more than about 100 sq. feet of floor space. This photograph was taken in may 1924, just before the old exchange was torn down in connection with the inauguration of the new net.

For several years, the owner had to wage constant warfare against the prejudice and malevolence of the arabs. According to their idea the telephone was some sort of devilish contraption, and they cut the wires at every opportunity. He was fortunate, however, in obtaining an excellent superintendent at the very outset, who, with unbelievable patience and assiduousness, repaired the lines almost as fast as they were cut by the arabs. On several occasions, he barely succeeded in saving his life, when the arabs attempted to ambush and do away with this dangerous »magician». This superintendent died just three years ago, after having devoted 40 years of his life to the care of the telephone net of Tangier.

The service given by the old exchange was very primitive, and it did not do for the subscribers to be in any great hurry. As a curious example may be mentioned the fact that they

often sent an arab boy to the exchange with instructions as to which connection was desired or that a conversation was ended and a new connection was desired.

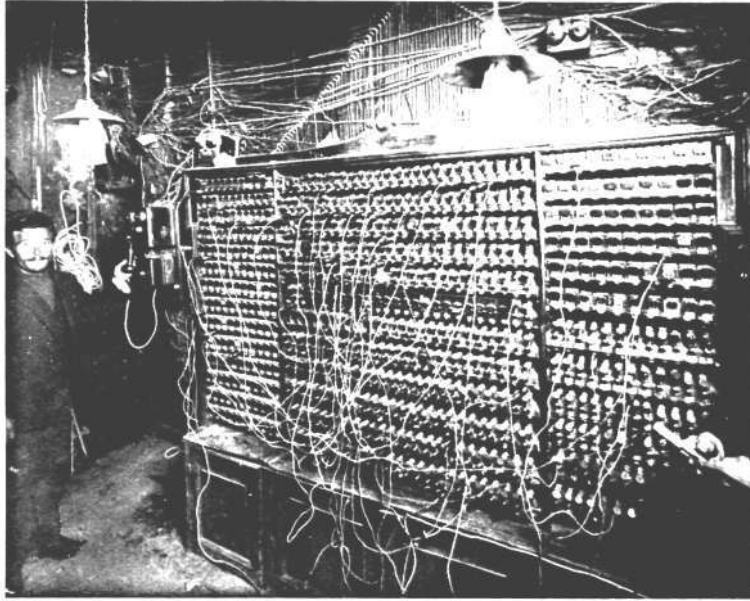
In 1923, when the building of the new exchange was started, the number of subscribers at the old exchange amounted to a trifle over 600. The new exchange is equipped for 800 lines, with provisions for a final capacity of 1200 lines.

Eight 100-pair cables are carried from the cross-connecting frame of the new exchange to the distributing tower on the roof of the building, from which they spread out in all directions. Aerial cables only have been used, as nearly all the streets are being repaved or straightened out, and the laying of conduits, therefore, was out of the question. The net of cables is very widespread and complete, not more than five bare wires — as a rule — running parallel for any great

distance. According to the Ericsson system, the cables are divided up into primary and secondary, i. e. all the 100-pair cables from the cross-connecting frame are carried to a jumpering cabinet, in which they are connected to cables of lesser capacity by means of jumper wires. The secondary cables end in arrester terminal boxes, and the lines are connected to the open

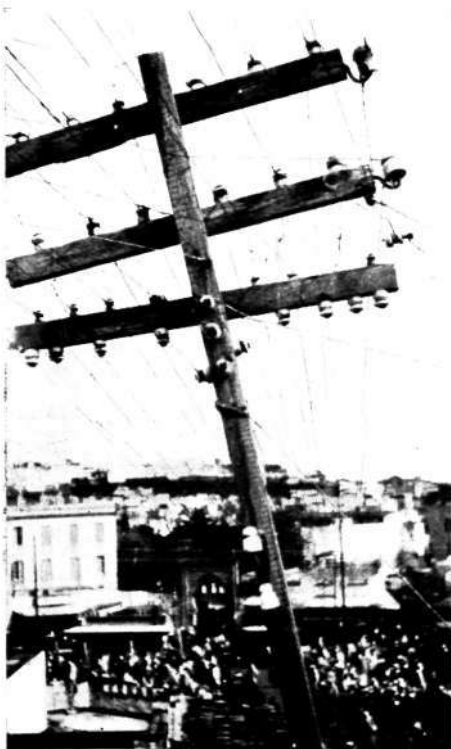


R 234 Fig. 2. 50-pair Distribution Pole erected on a Roof. The larger Cabinet is a Cross Connecting Cabinet for 100 to 130 lines, the smaller one a 50-pair Distribution Cabinet.



R 232

Fig. 3. Interior View of old Exchange.



R 233 Fig. 4. Typical Pole in the old Telephone Net.



R 235 Fig. 5. Structural Steel Tower on Roof of new Exchange.

wires by means of rubber insulated wire. Phosphor-bronze wire 1 mm. in dia. is used exclusively for the open telephone lines, whereby the use of a very light cross-arm construction was made possible.

The planning and building of the overhead net in Tangier proved to be a rather difficult matter, the houses being generally high and the streets so narrow and crooked that there was no possibility whatever of carrying the cables along these latter. In the central portion of the city, therefore, there was no other choice but to carry the cables right over the flat roofs, which in many cases are all cluttered up with various superstructures. This has often necessitated the erection of pole lines on the tops of the roofs. In fig. 2 we see a 25-foot distribution pole erected on the roof of a 4-story building. In one case it was even found necessary to place a 40-foot pole of steel tubing on the top of a roof.

Fig. 6 shows an interior view of the new exchange. It is constructed according to the local battery system with an initial capacity of 800 lines and a total multiple capacity of 1200 lines

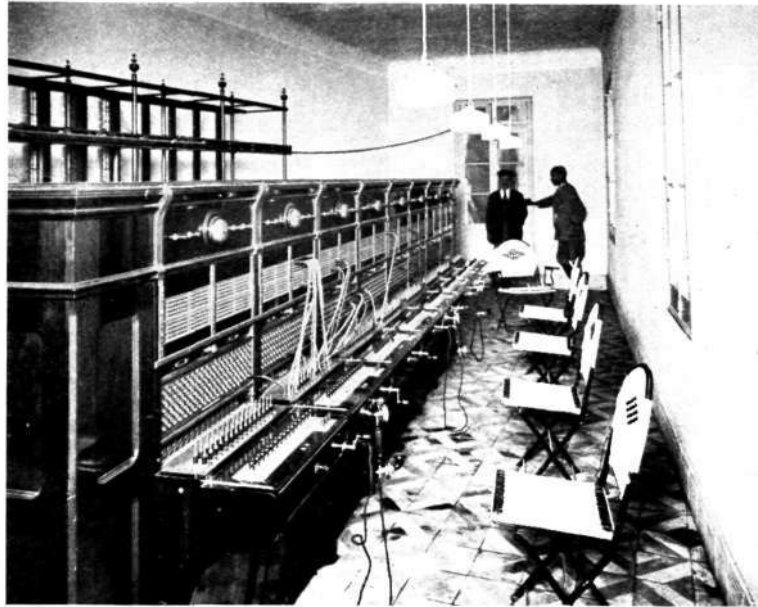
when multiplied over 2 positions. The local multiple is equipped with L. M. Ericsson's so-called indicator jacks.

The old indoor lines of all the subscribers' stations have been replaced with 2-conductor leaded cable and equipped with carbon and heat-coil arresters. As difficulty was experienced in obtaining good earth connections indoors, the earth

lines were generally carried out and connected to the nearest messenger wire.

The order for this plant was obtained through the offices of L. M. Ericsson's representative in Spain, Viuda y Sobrinos de R. Prado, Lda., of Madrid.

B. K.



R 236

Fig. 6. Interior View of new Exchange.

CONTENTS OF THIS NUMBER: The L. M. Ericsson System for the Distribution of Cables in Telephone Nets. — Automatic Switching for Private Telephone Exchanges. — L. M. Ericsson obtains Concession in Italy. — The L. M. Ericsson Water-tight Microphone Capsule. — The Old and the New. Some Facts about the Telephone Plant in Tangier.

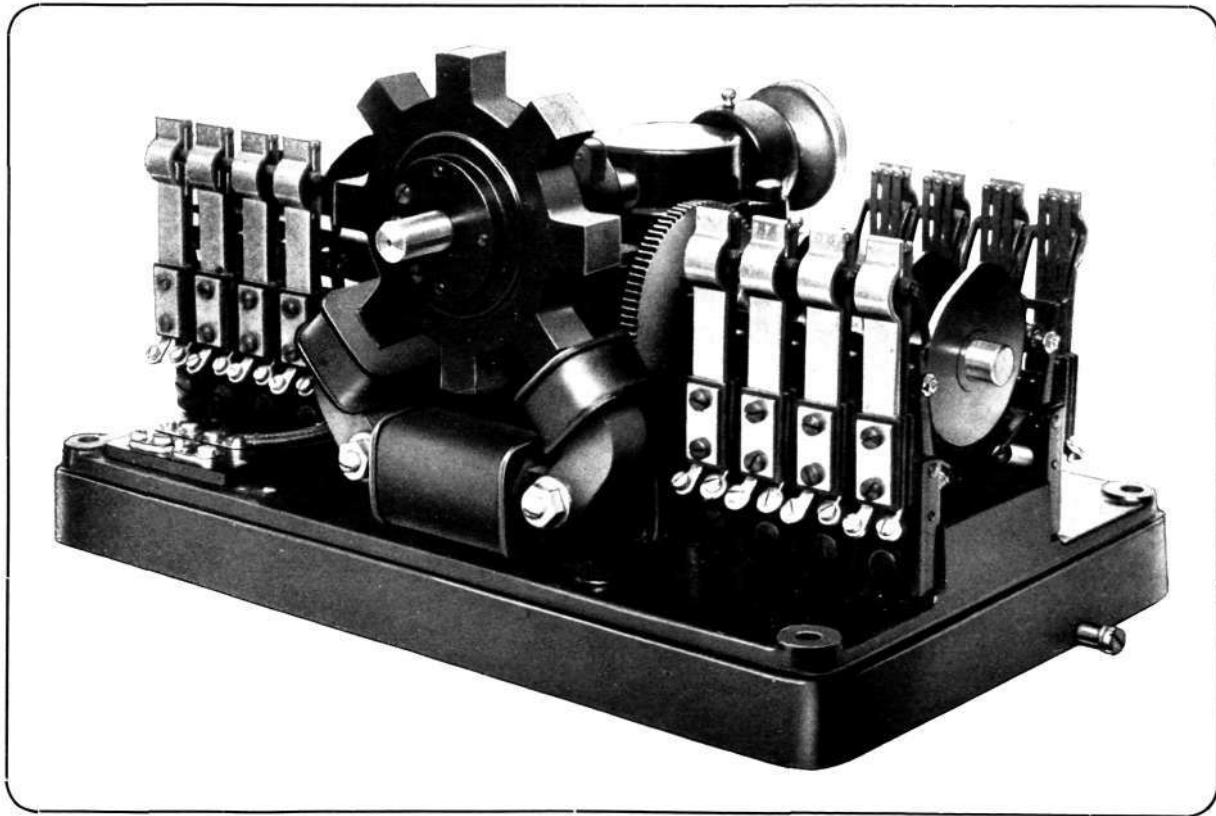
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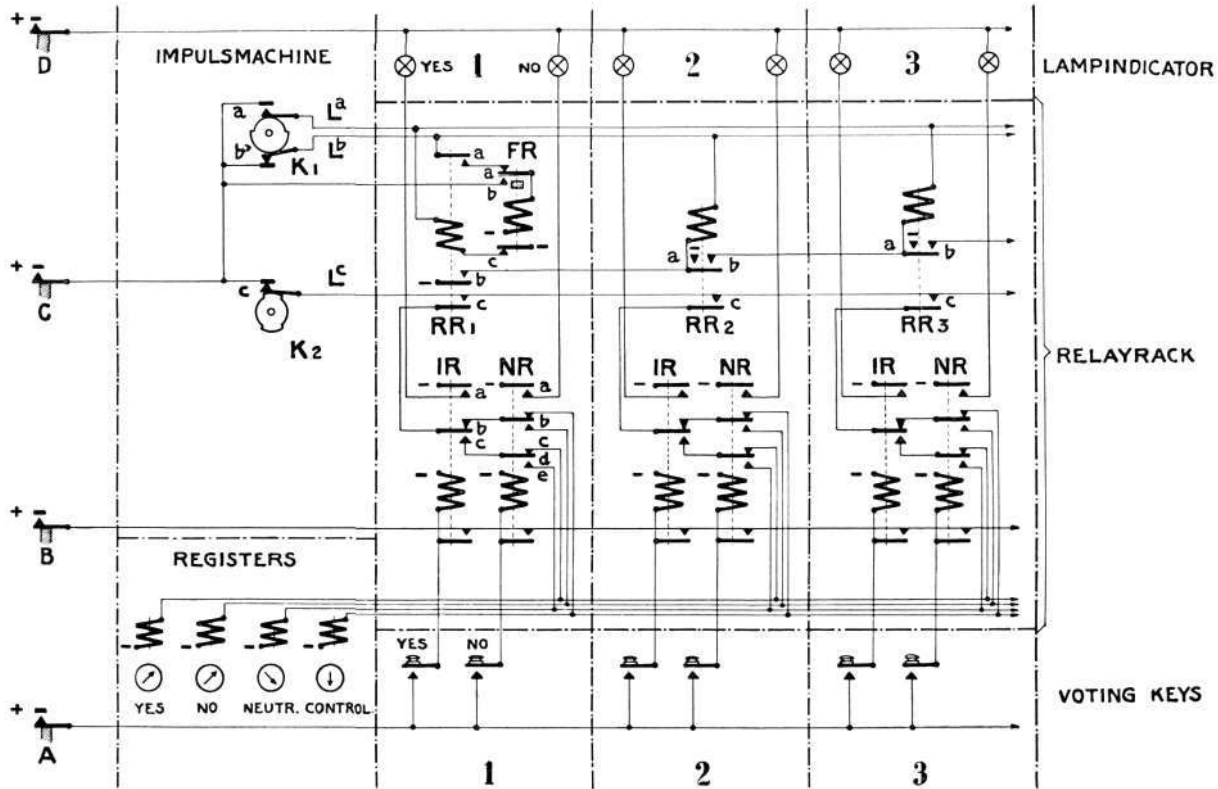
IMPULSE MACHINE.

ENGLISH EDITION

both contacts are simultaneously closed during a very short period.

The impulse disc K_2 closes and breaks its contact c twice during one revolution. The first closing takes place while contact a is closed and the second while b is closed. The time during which contact c is closed is much shorter than for contacts a and b , however.

struction as the standard Ericsson subscribers' meter for telephone exchanges, with the exception, however, that they are furnished with an arrangement for restoring to normal after having been read. Special arrangements with panels on which the total numbers of votes are indicated by means of illuminated numerals — clearly visible to the entire assembly — can also be furnished.



R 263

Fig. 1.

The function of the registers or vote meters is to sum up the total number of votes cast. They are four in number, i. e. one for summing up the *Ayes*, one for the *Noes*, one for the *Neutral* votes, and lastly a control meter which sums up the number of positions from which no vote has been given. By means of this last meter an absolutely reliable check on the correct functioning of the system is obtained, since the sum of the registered totals must always be equal to the number of positions for which the system is built. The meters can be of the same con-

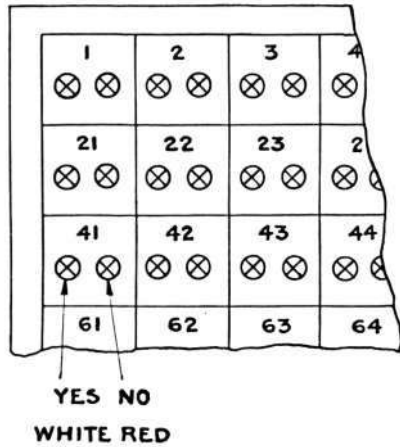
The upper part of fig. 1 represents a lamp indicator with two lamps — one for *Ayes* and one for *Noes* — for each position. The *Ayes* and *Noes* lamps are furnished with lenses of different colours, for instance white for the *Ayes* and red for the *Noes*. The actual appearance of such a lamp indicator is shown in fig. 2. The numbers denote the different positions.

The chairman controls the voting device by means of 4 switches.

The closing of switch A connects positive to the position keys so that relays IR

and *NR* energize when these keys are depressed.

The closing of switch *B* connects positive for the locking of relays *IR* and *NR*.



R 269

Fig. 2.

The closing of switch *C* starts the impulse machine and connects positive to its contacts *a*, *b* and *c*. A holding circuit for the relay *FR* of the first position is also simultaneously closed.

The closing of switch *D* connects up the lamps on the lamp indicator.

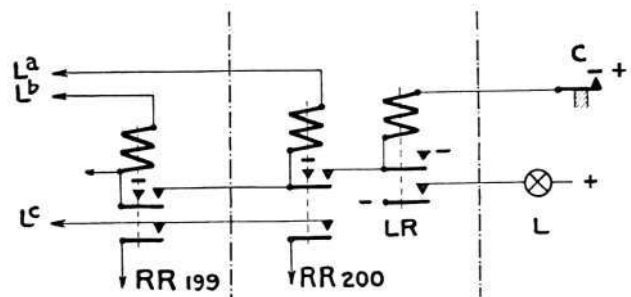
These switches *A*, *B*, *C* and *D* are given the form of simple push buttons with mechanical locking, i. e. they remain in their depressed positions until again raised by hand. Since these keys, however, are not able to withstand the tension used in the various circuits, intermediate relays are used for closing these circuits, these relays, in turn, being actuated by means of the keys.

The function of the counting relays *RR* is to close the circuit for the counting impulses sent out over contact *c* of the cam disc *K*₂. The switching process is as follows.

When switch *C* in the chairman's position is closed, the impulse machine is started in the manner already stated. The counting relay *RR*₁ of the first position is energized simultaneously with the closing of contact *a*. A moment later the impulse contact *K*₂*c* is closed and a first counting impulse is sent out over contact *RR*₁*c*. When the cam disc *K*₁ has rotated almost one

half revolution, its contact *b* is also closed, resulting in the energizing of relays *FR* and *RR*₂ through the closing of the circuit for *FR* over *RR*₁*a*, and for *RR*₂ over *RR*₁*b*. Relay *RR*₂ is held to negative directly over its contact *a*, making it independent of relay *RR*₁. Relay *FR* is held over its contact *b* and the switch *C*. *FR*, which remains energized until switch *C* is restored to normal, breaks the circuit for *RR*₁ so that this relay cannot be again energized. A moment after the energizing of relay *RR*₂, a second counting impulse is sent out over *K*₂*c* and *RR*₂*c*. When the cam disc *K*₁ has again rotated almost one half revolution, its contact *a* is again closed, causing the counting relay *RR*₃ of the third position to be energized over contact *b* of relay *RR*₂. *RR*₃ is held over its contact *a* thus remaining energized after the de-energizing of *RR*₂, which takes place when contact *K*₁*b* is broken a moment after the energizing of *RR*₃. A third counting impulse is now sent out over *K*₂*c* and contact *c* of relay *RR*₃.

When the cam disc *K*₁ has again rotated almost one half revolution, the counting relay of the fourth position is energized, a fourth counting impulse being sent out, etc. This continues until the counting relays of all the positions have been actuated once. The speed of the impulse machine as well as the adjustment of the relays are balanced so as to give each counting impulse a length of abt. $\frac{1}{5}$ second, with $\frac{1}{5}$ sec. intervals. Thus, with a device for



R 266

Fig. 3.

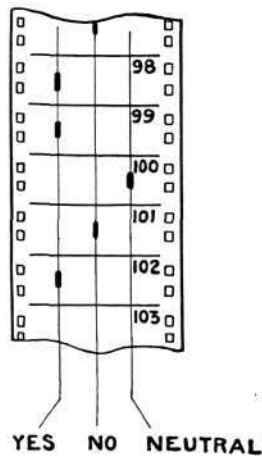
200 positions, about $\frac{2 \times 200}{5} = 80$ sec. (1 minute 20 sec.) is required for all the members to vote. A counting impulse — sent out over contact *c*

of an energized relay *RR* — can be directed over 4 different circuits. For a vote with the *Ayes*, relay *IR* of the position is energized. The impulse is led over the contacts *IRc* and *NRd* and actuates the *Ayes* meter, this latter registering one vote. If the *Noes* relay *NR* is energized, the impulse is led over the contacts *IRb* and *NRc*, actuating the *Noes* meter. If the voter desires to remain neutral he depresses both keys and the *Neutral* meter is actuated over contacts *IRc* and *NRe*. Finally, if no vote whatever is returned from the position, the *Control* meter is actuated over contacts *IRb* and *NRb*.

If desired, the positions can be equipped with three keys instead of two, i. e. one for the *Ayes*, one for the *Noes* and one for *Neutral*. In such a case, the *Neutral* key is wired so as to actuate both position relays when depressed.

The procedure when voting with the aid of the above device is as follows:

The chairman closes switches *A* and *B* and requests the members of the assembly to cast their votes. Each voter votes in the position

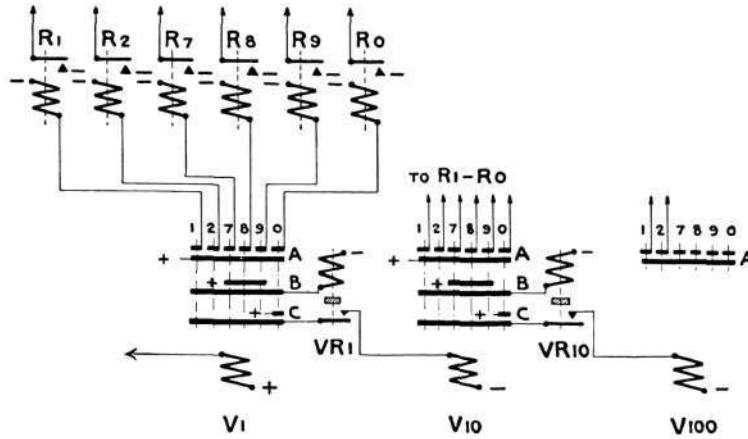


R 268 Fig. 4.

which has been assigned to him and where his voting keys are placed by depressing the desired key for a short moment.

After having convinced himself that all the

members who so desire have cast their votes, the chairman restores the switch *A* to normal. It is now impossible for any voter to change a vote already made, as the current which actuates



R 265

Fig. 5.

the relays *IR* and *NR* over the voting keys is broken in *A*.

The counting of the votes now takes place by closing switch *C*. The counting relays *RR* are now brought into function, transmitting their impulses over the relays *IR* and *NR*. These relays divide the impulses into 4 categories, which are separately registered by the four meters.

When the automatic device has completed its function, the chairman is apprized of this fact by a lamp which is made to glow by the energizing of an extra relay, this latter being energized over the relay *RR* of the last position. A diagram of this circuit is shown in fig. 3, which shows the counting relays *RR*₁₉₉ and *RR*₂₀₀ of the last two positions together with the extra relay *LR* in the last position. This relay *LR* is energized simultaneously with *RR*₂₀₀ and is held over its own contact and the switch *C* at the chairman's position. The lamp *L* glows. The switch *C* can now be restored to normal, stopping the impulse machine. The extra relays of the first and last positions de-energize and the lamp *L* ceases to glow.

The closing of switch *D* brings the lamp indicator in circuit and its lamps indicate the outcome of the voting. The various vote totals may

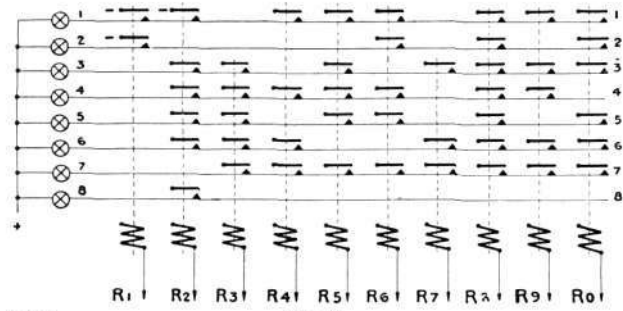
be read on the meters, and their sum shall be equal to the total number of positions.

When switch *B* is restored to normal, all the relays *IR* and *NR* de-energize and the indicator lamps cease to glow. Switch *D* is also restored to normal and the meters again point to 0.

The above described device is an automatic voting machine of the most simple form for open voting. It is necessary, however, to figure with cases where special conditions or requirements call for the solving of other problems. Descriptions of certain other arrangements for which a necessity may arise are given here below.

Automatic recording of votes.

Three Morse recorders are connected in parallel with the *Ayes*, *Noes* and *Neutral* meters, all



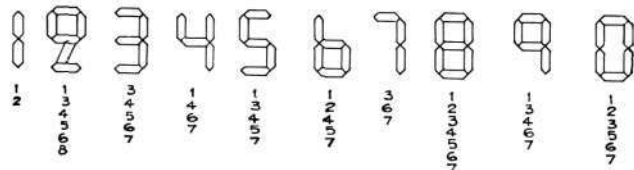
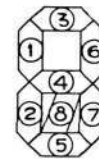
R 267

Fig. 6.

three recorders having one common tape, the appearance of which is shown in fig. 4. The feeding device for this tape is actuated by the same motor that drives the impulse machine, a perfectly synchronized tape feed in relation to the impulse transmission being obtained by means of perforations along both edges of the tape similar to those which occur on cinema films. The projecting teeth of the feeding wheel engage these perforations. A strip of tape 1 cm. long is allotted to each position and furnished with the number of the corresponding position. The three recorders function simultaneously with the meters when the tape is fed forward synchronously with the impulse transmitting during the voting proceedings and a record of how the various positions have voted is automatically made. This record tape, which for 200 positions

has a length of 200 centimetres, is referred to when the list of voting members is being made out later on.

An automatic record may also be obtained by making a photographic reproduction of a lamp indicator similar to the one hereinbefore described, but of much smaller dimensions. The size of such an indicator for 200 positions is not more than abt. 220 x 265 mm. This indicator is equipped with lamps of the type in general use at telephone exchanges, so-called switchboard lamps. Each lamp is masked so that a clear, sharp outline is obtained. All of the lamps are white, but the *Ayes* lamps are distinguished from the *Noes* lamps by means of black crosses painted on a



R 270

Fig. 7.

pane of glass which covers the whole front of the indicator.

A sheet of photographic printing paper is placed in a printing frame and secured in front of the indicator. This paper is exposed when the lamps glow and is developed and fixed in the usual manner, giving a picture of the lamp indicator with round black spots showing against a white background wherever lamps have been lit. The lamps for the *Ayes* are distinguished from those for the *Noes* by means of white crosses over the black circles.

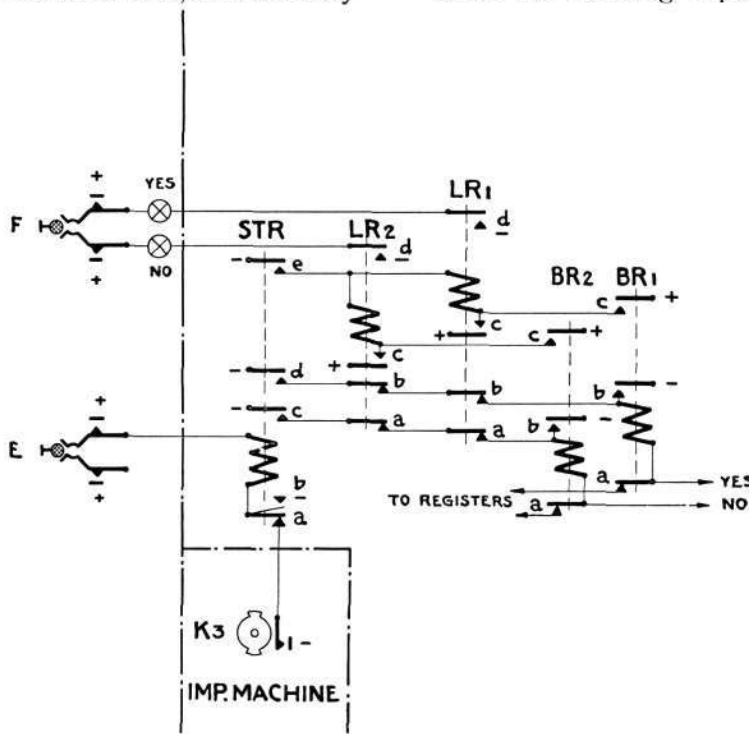
The print is placed under a transparent chart, ruled into squares and numbered to correspond with the marking of the positions on the indicator, after which the results are easily read. One might also use printing paper ruled and numbered in advance, in which case ink or co-

lours which will not disappear in the developing or fixing baths must be used.

The main advantage of the photographic record is its convenient size. The necessary arrangements are also much cheaper than those required for printing with Morse recorders. One disadvantage, however, is that the photographic print requires developing, fixing, washing and drying before a finished record is obtained. The printed tape record, on the other hand, is immediately ready for use.

The advantage of using one of the above described automatic recording systems is easily understood. It is not at all necessary for the secretary to make out a list of the voting members during the proceedings and with the aid of the lamp indicator, but this may be done at the time which best suits him.

Indicator with illuminated numerals for giving vote totals.



R 264

Fig. 8.

An indicator chart on which the voting results are shown by means of illuminated figures is mounted in the assembly room. Three special electrical switching devices for lighting the various lamp combinations are connected in parallel with the meters for the *Ayes*, the *Noes* and the *Neutral* votes, the principle of the circuits being shown in fig. 5. V_1 , V_{10} and V_{100} are three selectors, each with 10 positions. Each of the selectors V_1 and V_{10} are furnished with three rows of contacts, while the selector V_{100} has only one row. Each position contact in row *A* is connected to a relay R_1 to R_0 . This holds good for the two selectors V_1 and V_{10} only, V_{100} having only as many relays as

correspond to the hundreds digits. Thus if the device is for 300 positions, only 3 relays are connected to the positions 1, 2 and 3. Relays R_1 to R_0 are for the connecting up of the lamp combinations which form the numbers.

The selector magnet V_1 is paralleled with the vote meter, 0 being the normal position for all the selectors. The device functions in the following manner:

When the counting impulses are sent out and registered by the vote meters, the selector magnets V_1 will also be actuated. The selector whose electromagnet is thus paralleled with the meter for the counting of the *Ayes*, therefore, will be stepped forward one step for each of the *Ayes* counted. In positions 7, 8 and 9 relay VR_1 is connected up. The circuit for VR_1 is again broken in the position 0 , but this relay is so slow to de-energize that the electro-magnet V_{10}

has time to energize and step the selector V_{10} forward one step each time the selector V_1 passes its 0 position, i. e. for each ten votes counted. Selector V_{10} is furnished with a device similar to the one on V_1 , for stepping selector V_{100} forward one step for each one hundred votes counted. When the vote counting is completed the selectors V_{100} , V_{10} and V_1 stand in the respective positions corresponding to the hundreds, tens and units digits in the total. The lamp combinations forming the vote total are now connected up over relays R_1 to R_0 . There are three such combinations, i. e. one for the hundreds digit, one for the tens digit, and one for the units digit

One lamp combination is composed of 8 lamps furnished with special reflectors and placed in the positions shown in fig. 6. All figures from 1 to 0 can be obtained out of such a combination by the lighting of different lamps. The reflectors screen the light and give it its proper contour. These contours are softened by placing a pane of frosted glass in front of the whole device, giving the figures a more natural appearance.

Fig. 7, lastly, shows how the lamps are connected up over relays R_1 to R_0 .

The selectors V are automatically restored to their 0 positions when, after the voting is finished, the chairman switches off the current.

Device for voting with ballots.

In such cases where ballots are used, the above described devices must be modified to a certain extent. The lamp indicator, showing how each position has voted, is naturally eliminated, as is also the case with the Morse recorders for automatic recording of votes.

At that time, when ballots were still used in the Swedish Parliament, the casting vote was determined in the following manner.

After all the voters had placed their folded ballots in the ballot box, one of these ballots was withdrawn, sealed and laid aside. If, at the count, the *Ayes* and *Noes* were found to be of equal number, the sealed ballot was opened and its vote constituted the casting vote. With an unequal number of votes, the sealed ballot was left unopened.

The withdrawing of a casting vote can also be automatically arranged, a schematic circuit diagram for such an arrangement being shown in fig. 8. The chairman's position is equipped with two control switches E and F and two lamps. BR_1 and BR_2 are two relays for cutting out an *Ayes* or a *Noes* impulse, and are connected in parallel with the corresponding vote meters. LR_1 and LR_2 are two relays for connecting up the two lamps in the chairman's position, and STR is a starting relay. This relay is connected to the contact of the cam disc K_3 , which is on the same shaft as the cam

discs K_1 and K_2 and rotates synchronously with these. K_3 is adjusted so that its contact is closed when the contact of K_2 is broken, and vice versa. This arrangement functions in the following manner:

Switch E is depressed by the chairman at an arbitrary moment during the counting of the votes. The relay STR is energized in the same moment as the contact of the cam disc K_3 is closed, i. e. during a pause in the impulse transmission from K_2 . Relay STR holds itself over its contact b and remains energized until the chairman restores the switch E to normal after the count has been completed. The contact $STRa$ is now broken and the relay is no longer influenced by the impulses transmitted by K_3 . Relay STR connects negative to relays BR_1 , BR_2 , LR_1 and LR_2 . The first counting impulse sent out by K_2 after the energizing of STR will actuate one of the relays BR_1 or BR_2 , depending on whether it is an *Ayes* or a *Noes* impulse. Let us suppose that it is an *Ayes* impulse. Relay BR_1 energizes over contact $STRd$ and attracts its armature, remaining energized over its own contact b . Contact BR_1a is broken, disconnecting the meter for the *Ayes*. On account of the speed with which this relay works, the counting meter does not have sufficient time to start functioning.

Simultaneously with the energizing of BR_1 , relay LR_1 is energized over the contacts BR_1c and $STRe$ and is held over its contact c . Contacts LR_1a and b are broken, preventing further energizing of relays BR_1 and BR_2 .

At the end of the counting impulse relay BR_1 is again de-energized, and it is then impossible for either this relay or for relay BR_2 to energize again since positive has been disconnected by relay LR_1 .

Relay LR_1 remains energized until the chairman restores the switch E to normal. This relay, therefore, has cut out an *Ayes* vote from the reckoning and registered it, having performed the same manoeuvre as when a ballot is removed from the ballot box and laid aside.

If it is a *Noes* impulse, the same manoeuvre as above described will be performed by relays

BR_2 and LR_2 when STR is energized. This will cause one of the *Noes* to be cut out of the reckoning. It is absolutely impossible for the person controlling the connecting in of this device to influence the result in one way or the other but chance is the only determining factor, as is the case with the withdrawing of a written ballot.

If the *Ayes* and *Noes* are equal in number, the chairman throws the switch F , causing either the *Ayes* or the *Noes* lamp to glow, depending on which vote has been cut out. All the relays de-energize when E is restored to its normal position.

Consumption of power.

Power for relays, lamps, the impulse machine and the vote meters is furnished by a 24-volt storage battery. A voting device for 200 positions requires about 1.5 ampère hours for one complete voting, the maximum consumption amounting to about 18 ampères. These figures are based on the assumption that all positions take part in the voting and that the voting relays IR and NR and the indicator lamps are in circuit for an average of 5 minutes.

A battery with a capacity of say 30 ampère hours, therefore, will last for 20 votings without having to be recharged. If D. C. is available, the battery can easily be recharged with the aid of resistance lamps. If the public net is A. C. a motor-generator or pole changer will be required. Recharging of the battery by means of either D. C. or A. C. can take place while the voting proceedings are going on without the slightest inconvenience.

Requirements.

To be absolutely reliable an automatic voting device must satisfy very exacting demands. It must be easy to maintain, must function speedily and accurately and be self-controlling.

As is evident from the above description, its operation is the most simple imaginable. The person who leads the proceedings need only request the members to vote. After the voting is finished, all he need do is to operate the switches in their correct order. After that, the functioning of the system is entirely automatic, the only thing necessary being to read off the results on the meters and to restore the switches to normal.

For the purpose of obtaining the highest possible factor of safety, all heavily stressed contacts are of a very sturdy construction. The contact devices of the impulse machine are of the same construction as those used in telephone exchanges where the stresses are much greater than in the present case. The impulse machines being the only moving parts in the system, wear has been reduced to a minimum. Speed is one of the main requirements in automatic voting devices and in this respect the above described device undoubtedly fills all reasonable demands.

Automatic control is taken care of by the control meter. With the use of a lamp indicator, double control is obtained, as the number of glowing lamps must be equal to the sum of the totals shown by the meters for the *Ayes*, the *Noes*, and the *Neutral* votes.

G. G.

The Calcutta Telephone Exchanges.

The complete telephone plant of the city of Calcutta consists of four exchanges, and the L. M. E. Review has had the pleasure of receiving a number of photographs — reproduced here-with — from two of the newest ones. The exchanges are all built according to the common battery system with automatic periodic ringing, and are operated by the Bengal Telephone Corporation.

These exchanges are

The Main Exchange, giving service to 8000 subscribers and built by two English companies;

Burra Bazar, with a total capacity of about 5000 lines, the present

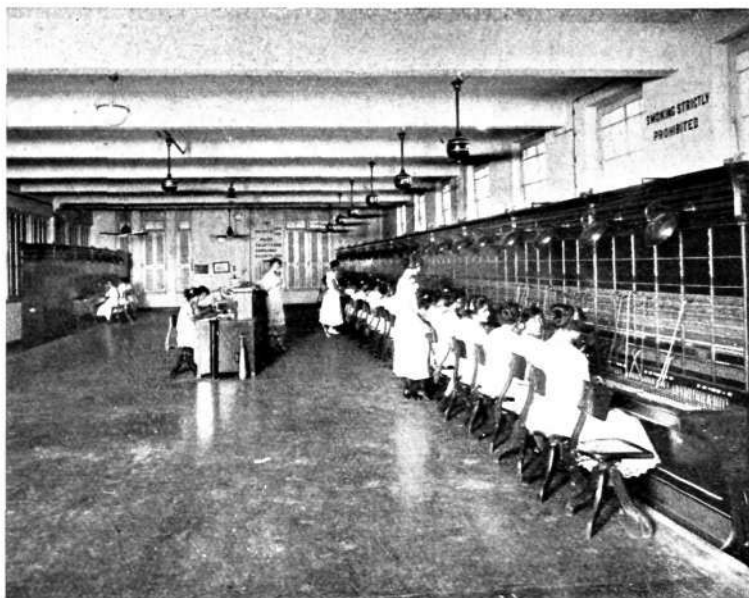
equipment being for 3600 lines. This exchange is equipped with 12 local switchboards, each board with 3 positions, and 6 positions for junction traffic. Each local operator, therefore, does not need to handle more than 100 lines, which must be regarded as a very low figure;

The South Exchange, with a capacity of 3600 lines, the present equipment being for only 1600 lines.

These last two exchanges are equipped almost entirely with material furnished by L. M. Ericsson in Stockholm. In addition, material from the old magneto exchange — delivered by L. M. Ericsson

in 1905 — has also been used. Only the frame work of the switchboards and the jackstrips of this old exchange have been utilized, however. The jackstrips, strangely enough, were found to be perfectly serviceable after having been only slightly altered so as to fit in with the new system;

Howrah, with approximately 1000 lines, and situated in the oldest section of Calcutta (the Hindu town). This exchange was delivered in 1912 for junction traffic with the above-mentioned magneto exchange, but was rebuilt according to the common battery system in connection with the building



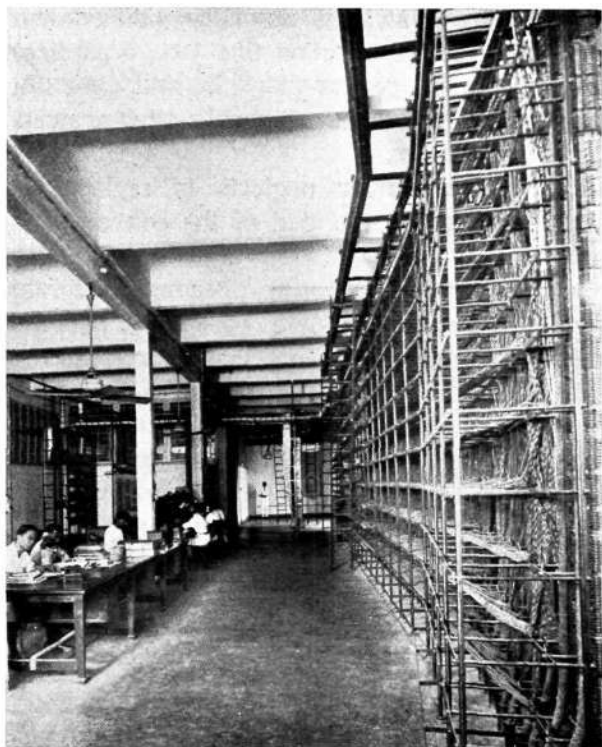
P 250

The Operating Room, Burra Bazar.

of the Burra Bazar and South Exchanges.

The operating company has taken a serious interest in the junction traffic between these four exchanges, the various arrangements having been very carefully planned so as to make this service as efficient and speedy as possible.

The fundamental principle for the junction traffic is that all orders for junction lines are made over special order wires. Furthermore, the junction lines are furnished with automatic ringing sent out from the receiving exchange. Thus, the ringing current is never carried over a junction line but is sent out directly over the desired



R 180 The Main Distributing Frame, Burra Bazar.



R 251 The Line Relay Rack, Burra Bazar.

subscriber's line. Lastly, the connecting is accomplished so that even if the operator should make a wrong switching operation, no disturbing signals will result therefrom.

A connection between a subscriber at the exchange A and another subscriber at the exchange B is accomplished in the following manner.

After having received the desired number from the calling subscriber in the usual manner, the A-operator calls the operator at the exchange B over an order wire and re-

peats the number. The B-operator then gives the number of an idle junction line, and immediately plugs in the called subscriber's line if it

is idle. A ringing signal is then sent out from the B-position as soon as the A-operator has plugged in the junction line. This signal is periodic and does not cease until the called subscriber has answered, regardless of whether this latter answers during a signal or during the interval between two signals.

If, on the other hand, the called



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The Operating Room, South Exchange.

subscriber is busy, the B-operator gives a »busy back» signal by plugging in a line which causes the periodic glowing of the clearing lamp of the A-operator's ringing cord. Thus, the A-operator need not wait for information as to whether the called line is idle or not, thereby increasing the speed of the service. Simultaneously with the flashing of the busy back lamp, a busy tone is sent out to the calling subscriber. When the A-operator disconnects, the clearing lamp of the B-cord glows in the usual manner, after which the B-operator also disconnects.

The following extra features form apart of the switching operation. A ringing signal is not sent out over the B-cord until the A-operator has introduced her plug. Should the latter make a mistake and introduce the plug into a wrong junction line, the clearing lamp of this junction line will glow. It is then possible for the B-operator, by plugging into the same junction line, to communicate with the A-subscriber, obtain the desired number and complete the connection.

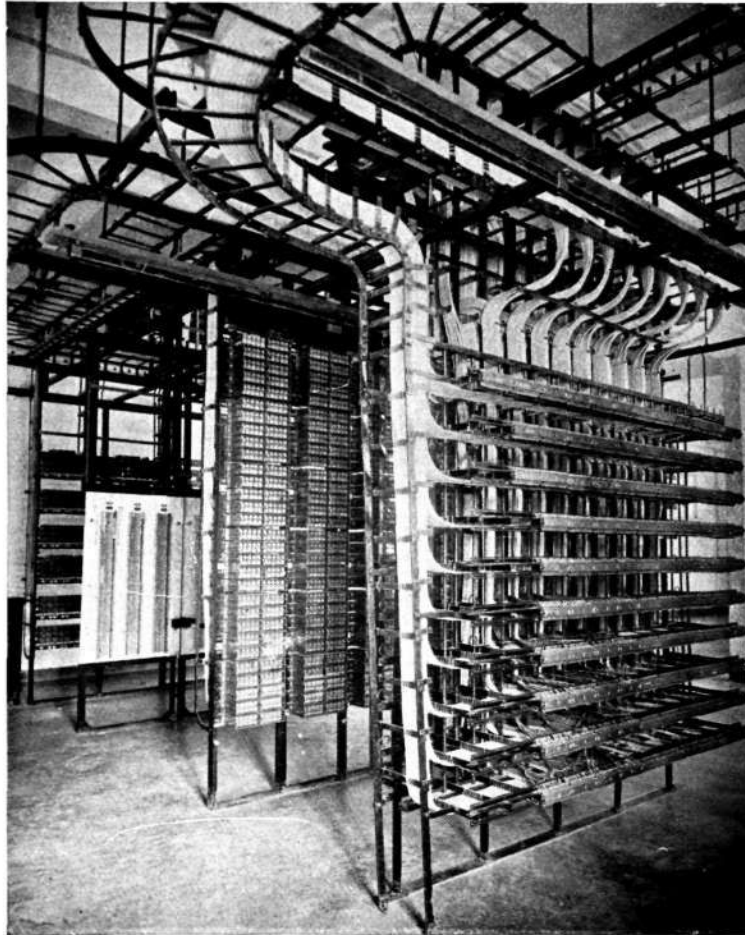
In the same manner, it is possible for the B-operator — should she break the connection by mistake — to come in on the line, obtain the number and restore the connection.

Further, the clearing lamp of the A-operator's

ringing cord glows as soon as this cord is plugged into the junction line jack, regardless of when the B-operator plugs in, and does not cease to glow until the called subscriber answers at the B-exchange.

If the B-subscriber neglects to replace his microtelephone at the end of the conversation, and the A-operator becomes aware that a pair of cords is occupied for too long a time with only one clearing signal on the answering cord and therefore takes down the connection, the ring-off lamp of the B-cord will nevertheless be made to glow.

As a result of the foregoing, it is possible for the B-operator — when the number of an idle junction line is requested — to give the number of a line standing with a clearing signal, and, after having received the new number, she can move the plug directly over to the new line.



R 184 The Main Distributing Frame and Line Relay Rack, South Exchange.

The climate of Calcutta is unusually damp, especially during the rainy season. It has been claimed to be even more trying, in this respect, than that of Java, depending on the great difference between the day and night temperatures. Also, the telephone material has been manufactured with due regard to the requirements of such severe climatic conditions.

As previously mentioned, the plant for the

recently completed exchanges has been furnished by L. M. Ericsson in Stockholm, the construction work having been done by the Telephone

Corporation, which has also put the exchanges in operation. Also, the entire wiring of the switchboards has been done in Calcutta.

The Madrid Exhibition of Telephone and Kindred Appliances.

An exhibition of electric material and apparatus was held in Madrid during the month of December 1924, the exhibits consisting chiefly of telephone and radio material.

L. M. Ericsson's were represented by their general agent in Spain, Casa de R. Prado, as well as by their newly formed subsidiary company, Compañia Aspañola de Telefonos Ericsson S. A.

Telephone material, including instruments,

switchboards and a full automatic telephone exchange, as well as radio material — component parts, valve sets and crystal sets — were demonstrated at the Ericsson stand, a view of which is herewith reproduced. A complete time control plant was also exhibited.

The exhibition could boast a very large attendance and the automatic exchange, in particular — which was connected up and in full working order — attracted an unusual amount of interest.



The New Poland.

AN ECONOMIC SURVEY.

At the close of the Great War of 1914—1918, the ancient state of Poland was born anew out of the ruins of a few of the participating countries. In its declaration of independence, this country has finally seen its century-old efforts for the unity and independence of Poland — dreamed of by generation after generation — crowned with success.

Present day Poland covers an area of 386,634 square kilometres, ranking sixth among the countries of Europe. Although its area is smaller than that of Sweden, its population is about five times as large. According to the latest statistics, the population amounts to almost 30 million inhabitants. This population, however, is not very evenly distributed, the western and south-western parts of the country, known as Greater Poland, being much more densely populated than the eastern portions. The mean density amounts to 72 inh. per sq. kilometre.

The boundaries determined by the Versailles peace treaty are not natural, the country lying

open and unprotected towards both the East and the West; only towards the South do we find a natural protection provided by the Carpathian mountains.

In point of language, the population of the country may be classified as follows:

20.7 millions, or 69 % of the entire population, are Poles;

4 millions, chiefly in the southern and south-eastern parts of the country, are Ruthenians;

1.5 millions in the East are White Russians,

1.5 millions in the West are Germans.

In addition, about 2.5 million jews are scattered over the whole country, the greater part of them living in Congressional Poland and Galicia. Some Lithuanians and Greater Russians are also to be found, but they constitute only a very small part of the whole population.

Modern Poland is a republic with a president as the chief executive.

He is elected by both the sejmen and senate in common. From an administrative point of view the country is divided into 16 *wodje-wodstwo* (provinces) which are subdivided into



R 252

Wawel, the old Castle and Cathedral of Cracow.

powiaty (counties), these latter being composed of *gminy*, or parishes. The capital is Warsaw with about 1 million inhabitants, 27 % of which are jews. The city next in size is Lodz, an important industrial centre with about half a million inhabitants. Other large cities are Lwow (the old Lemberg), Wilno, Poznan, Cracow, Lublin and Bialistok

The fact that the different parts of the country belonged to several different governments before the Great War is responsible for the varying educational systems. Galicia was best circumstanced under the old rule, having had official Polish schools for very many years. The German possessions were also very well off, although all instruction in the Polish language was strictly prohibited. The degree of education was lowest in Congressional Poland where 60 % of the population could neither read nor write.

The new republic has had great difficulties to overcome on account of this great difference in the educational standard. Serious efforts have been made during the last years, however, for the raising of this standard. Enforced school attendance has been introduced so that during the school year 1920—21 the country's 26,100 public schools had a total attendance of about 4 million pupils. The lack of necessary space is acutely felt, however, several schools being used for separate forenoon and afternoon sessions. Also, the staff of teachers is inadequate. The higher education is taken care of by 780 both private and public high schools and a number of schools for special branches of education, such as technical, business, agricultural, art and industrial

schools. Poland has six universities, two engineering colleges, one mining college, one agricultural college, a dental college, a veterinary college, an academy of art, a normal school etc., etc.

The means of communication have given the authorities even greater difficulties to overcome than the educational problem. It is true that the republic took possession of a very widespread railway net, but its condition — after all the years of warfare — was more or less deplorable. After having repaired and rebuilt all the tracks, bridges and station buildings which had been

destroyed, the government concentrated its efforts on procuring the necessary rolling stock. The building of several new lines has been planned, construction work having been started on a number of them. The total length of all the railways now owned by the Polish Government amounts to 16,650 kilometres. Although these railways were operated



R 257

The Palace Square in Warsaw.

at a considerable loss during the first years of Poland's independence, their financial status has now been considerably improved.

The very same conditions existed within the fields of telegraphy and telephony, these means of communication being also in a very poor condition when the present administration came into power. The toll lines had been repeatedly altered to satisfy the demands of the various occupying armies and were therefore far from adequate for the efficient service required in times of peace. The local nets, again, were either wilfully put out of commission or else in a deplorable condition for want of necessary care and maintenance. The country has now about 20,000 kilometres of toll

lines. The number of telephones amounts at the present time to about 109,000, of which 45,000 are connected to the nets of the Polish telephone company, Polska Akcyjna Spółka Telefoniczna.

The highways in the western and southern portions of the country are in comparatively good condition, the eastern provinces leaving much to be desired even in this respect.

The least developed of all the means of communication, however, are the waterways, depending mostly on their shallowness and the abundance of sand which necessitates a systematic and radical regulating of the same. So far, only the Weichsel (Wisla) is in part furnished with canals.

The present government was forced, at the very outset, to combat severe financial difficulties. The country was desolate, the inhabitants on the verge of financial ruin, and the state treasury was empty. The various monetary mediums in circulation through-
out the country

— German, Austrian and Russian paper money, together with the »Polish mark» introduced by the Germans in 1915 — were all practically worthless, and a development of the country's finances on an unsound basis, therefore, was only to be expected. The expenses for the war against the bolshevists in 1920 drained the government treasury and it was found impossible to put a stop to the inflation of the stock market, the financial situation being brought to a crisis in the fall of 1923. The present secretary of the treasury, Wl. Grabski, finally succeeded in bringing order out of chaos, chiefly by exacting the payment of the governments claims, such as taxes in arrears, custom duties, etc., and by stabilizing the monetary value, the gold franc being adopted as the standard.



R 255 View over Lwów (Lemberg) from the Tower of the City Hall.

This economical reorganization was introduced without delay, efficient methods for the collection of taxes being adopted and energetically applied. The printing of bank notes could be discontinued already on the 1st of February 1924, the financial reorganization having been begun in December 1923. According to a decree of January 20th 1924, the zloty (gulden) was adopted as the standard monetary unit, the zloty being divided into 100 grosch. (\$ 1 = 5.18 zloty).

An emissary bank, Bank Polski, standing under government control, was organized, its joint capital of 100 million zloty being fully subscribed in a comparatively short time. The banking law re-

quires that 30 % of the outstanding bank notes shall be covered by gold or gilt edged foreign securities and the balance by promissory notes or mortgage bonds. The security in gold has been much greater, however, amounting in October 1924 to 72 %, and to 52.89 % at the end of the same

year, the amount of currency and bank notes in circulation being 674 million zloty. At the end of its first year, the bank will probably be able to pay a dividend of 12 %. The usual bank rate for Poland is 10 %, with 12 % for loans against collateral and 8 % for discounting foreign bills. The rates charged by private banks are almost the double.

The crisis brought about by the financial reform has naturally left its mark on the economic life of Poland, although probably to a lesser degree than in other countries. The present conditions seem promising, although it may be too early to make a definite statement in this direction. As last years crops were below the average, the outcome of the present crops are expected to play an important role. A decided improvement,

however, is already noticeable in certain industries, one of the most important causes being the repeal of the eight-hour law within the metal industries and the mining districts of Kattowicz and Sosnowicz. This repeal, which is to be enforced for six months, will undoubtedly be of great importance for these industries in their efforts to meet foreign competition.

The plans for sanitation include the raising of a 50 million dollar loan, for which negotiations with the United States are now being carried on. The fact that the assumed revenue for 1924 was 10 % less than the actual revenue, while the expenditures did not overrun the calculated total, may be taken as proof that the countries finances have now been stabilized.

Thus, in the budget for 1924, the expenditures amounted to 1,852,327,000 zloty, while the revenue was 1,547,714,000 zloty.

The financial year, however, showed the following results: total expenditures, 1,629,276,000 zloty, and total income 1,703,158,000 zloty, showing that the government revenue has exceeded the expenditures.

The national debt at the beginning of 1924 amounted to 1.74 billion gold francs, 0.23 billions being placed within the country. The remainder — 1.51 billions — is in the hands of foreign creditors, the largest one being the United States of America. The debts to this latter are in the form of credit given for food supplies during the years 1919 to 1921, before the country had resumed its normal agricultural activities after the war. Next in order is France, which has advanced considerable credit for financing the military defense of the country.

The national debt amounts to approximately

80 gold francs per inhabitant, which cannot be considered exorbitant when compared with that of other countries.

Among the financial operations of the government may be mentioned the following: the raising of a loan in Italy of 400 million lire, for which the tobacco monopoly was given as security, and the leasing of the match monopoly to the Swedish match trust, for which the government received an immediate sum of 25 million zloty in addition to the regular yearly payments.

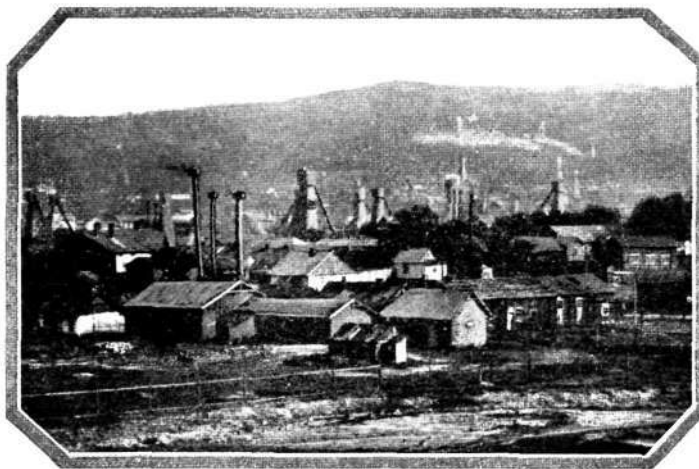
The commercial statistics for 1923 show an export surplus, but conditions were not quite so favourable during the past year, partly on

account of the increased purchasing power, and partly on account of the failure of the crops, Poland's agricultural products constituting the main articles of export. Other important articles of export are lumber and wood products, coal, petroleum and petroleum products.

Necessary articles of import are cotton

for the textile mills of Lodz, rich ores, coke, machinery, telephone material, electric cables, optical instruments, tools and food products, especially colonial produce.

Almost 50 % of the total area of the country had been under cultivation before the war and about 60 % of the population are farmers, proving beyond a doubt that agriculture is the most important means of livelihood. (About 14 % follow industrial occupations, while trade and commerce cannot claim more than about 8 %). These figures have naturally suffered a decrease during the war, but at least 92 % of the pre-war area is again being cultivated. Also, the live stock experienced a decided deterioration, both from qualitative and quantitative points of view. A



R 253

The Boryslaw Petroleum Fields.

decided improvement could be noted already in 1921, however, an improvement which has been steadily growing during the last three years.

Lumbering is of very great importance for Poland from a financial point of view, more than 23 % of the total area of the country being covered with forests, chiefly in the eastern and southern parts. The government is the largest forest owner, 31 % of all the forests being in its possession. The wood-products industries are of equal importance; 23 million cu. metres of lumber and finished products are produced each year by 1400 saw mills with a total of 2000 saw-frames, 200 planing and joining mills, 4 wood-pulp factories and 17 match factories. 1.8 million cu. metres of finished and 2.1 million cu. metres of unfinished wood products with a total value of 133 million gold francs were exported by Poland in 1923.

It may be mentioned in this connection that the sejm has decided to pass a new land reform law. As such a step can only be taken after a great deal of careful planning it may well be understood that the present government has taken all possible precautions in the solving of this problem.

In addition to the aforementioned wood-working industry, several other industries may well be expected to thrive and flourish on account of the rich natural resources of the country, such as coal, lignite, ores, petroleum and salt. The coal fields of Polish Schleswig cover an area of 4,000 sq. km. and are estimated at 50 billion tons, the yield being 36.5 million tons per year for coal and 200,000 tons for lignite. The yearly coke production amounts to 1.5 million tons. The coal mining industry alone employs 230,000 workers.

An area 400 km. in length and 20 km. wide on the northern slope of the East Carpathians is exceedingly rich in petroleum but has not yet been exploited to any great extent. The wells already drilled have given a very abundant yield. The yearly production amounts to about 7 million tons, this entire amount being refined within the country. Only the refined products, such as benzine, kerosene or coal oil, gasoline, paraffin and oils are exported, the country's own consumption amounting to about one half of the total production. Natural gas is also of the utmost importance for the country, about 400 million cu. metres being consumed annually for heating and lighting purposes. These districts

also contain layers of mineral wax, yielding abt. 800 tons per year. Not less than 22,000 workers are employed in these various industries.

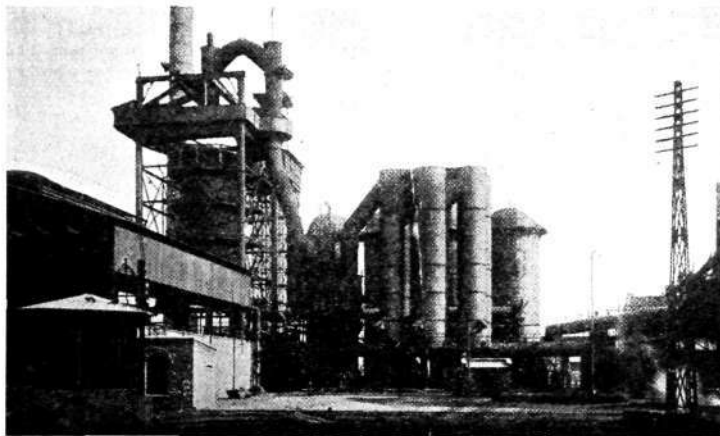
The iron ore resources of Poland are estimated at 1.5 billion tons, about 500,000 tons being mined yearly. Zinc and lead ores are also of great importance, and about

120,000 workers are employed in the mining and metallurgical industries.

Another branch of the mining industry is the extensive and century-old salt mining in Galicia. The mines of Wieliczka — many of them with shafts almost 300 metres in depth — are especially well known. The yearly production amounts to about 300,000 tons.

The farming industry of Poland is also able to make good use of large quantities of a natural soil fertiliser termed kainit (yearly production abt. 60,000 tons) of which large deposits are to be found in the northwestern Carpathians.

Among other industries for which the necessary raw material is obtainable within the country may be mentioned 14 cement factories whose



R 254

Iron-works in the Sosnowicz Coal District.

output during 1923 amounted to 5 million bbls., 81 glass factories employing 12,000 workers and exporting 35 % of their total production, and stone quarries (marble from Kielce and granite).

The above gives a vivid idea of the great possibilities which exist for the development of the industries of Poland, especially when considering the fact that only a small percentage of the country's rich natural resources has as yet been developed.

A large amount of farming produce is consumed by the country's 76 sugar refineries. Sugar beets are cultivated over an area of 141,000 hektars, sufficient for a yearly production of 375,000 tons of sugar, 12,000 tons being exported.

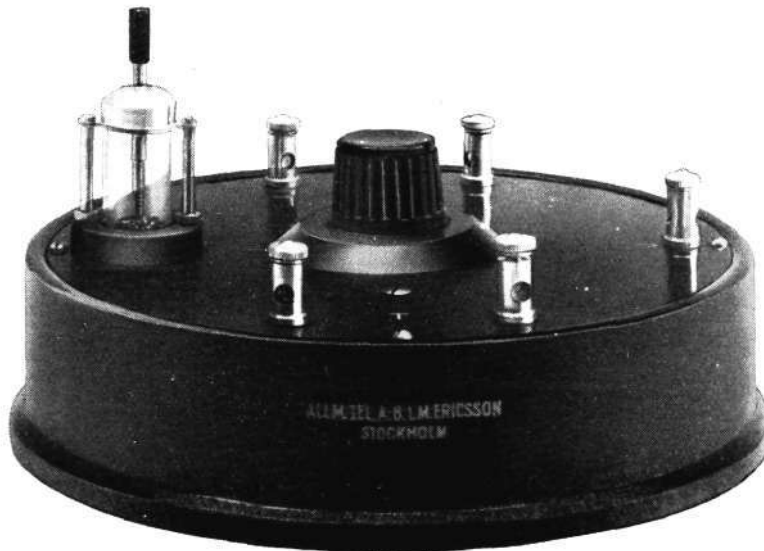
The extensive textile industries, on the other hand, must purchase the necessary cotton from other countries. In 1914 the 1,166 textile factories

within Congressional Poland employed a force of 150,000 workers. The factories in other parts of the country numbered 260, with about 13,000 workers. Most of these factories were destroyed during the war, but already in 1923 500 mills giving employment to 135,000 workers were again in operation. 129 of these factories produced articles of cotton, 246 produced articles of wool, and 67 were dyeing establishments. The production amounted to 24,000 tons of woollen goods, 72,000 tons of cotton goods and 1,600 tons of linen goods.

The quality of Poland's textile products is second to none, wherefore they are well able to take up competition with goods of other manufacture and are constantly acquiring new markets.

Kg.

CRYSTAL RECEIVER



TYPE DF 100

28'—

A MOST
ATTRACTIVE
AND EXTREMELY
EFFICIENT SET
FOR THE
BROADCAST
BAND

ALLMÄNNA TELEFONAKTIEBOLAGET L. M. ERICSSON
STOCKHOLM

Swedish Telephone Activities in Poland.

As the result of an international competition held by the Russian Government in 1901, the Cedergren Telephone Company of Sweden was successful in obtaining the concession for the operation of the telephone net of Warsaw and surrounding districts. This public competition consisted of two separate contests, the first one being solely for the purpose of determining the technical and economic ability of the various competitors. Those who were fully able to meet the rigorous requirements of this first contest were then permitted to take part in the second one, carried out on the basis of minutely specified stipulations for the operation of the net, the determining factor being the lowest average yearly subscription rate for a subscriber's set connected directly to the main exchange. The Swedish concern submitted a bid of 69 rubels (abt. 131 Swed. cr.) for the yearly subscription rate, and was successful in obtaining the concession for a term of eighteen years. According to the contract an agreement with the Russian Government was to be arrived at three years before the expiration of the concession, whereby the Government should either take over the net or prolong the concession.

Should it be found impossible to arrive at an agreement, the net should remain in the possession of the operating company, this latter being then required to remove all of its plant.

The Telephone net of Warsaw — previously owned by the International Bell Telephone Company and built according to the local battery system — was very small and the equipment in poor condition at the time the Cedergren company took charge of it. The Swedish company, however, built an entirely new and modern plant according to the common battery system, at the completion of which the net expanded with surprising alacrity so that in 1914, at the outbreak of the Great war, the number of subscribers amounted to 33,000. In 1915, at the occupation of Warsaw by the German army, all private telephone traffic

was inhibited, this state of affairs being enforced — in spite of the company's protests — during the whole time of occupation, i. e. until the end of 1918. The telephone net was used by the German military authorities for military purposes only. As soon as the Germans had evacuated the territory, the Cedergren company again took possession of its property and resumed opera-



R 258 The Telephone Company's Building in Warsaw.

tions to as great an extent as was then possible. It was then ascertained that the Germans had removed all bronze wire from the net, thereby putting a great number of subscribers' lines out of commission. A large amount of other equipment had also been carried away during the German occupation.

The first Polish administration, which was socialistic, remained in power for such a short time that negotiations were never taken up with the same. This was done with the following Paderewski administration, however, but did not lead to any result as it, also, remained but for a short time.



R 259

Map of Poland.

(The zones operated by the new Telephone company are indicated by shaded circles.)

The Great war and the ensuing occupation of territory had prevented all negotiations with the government concerning the fate of the telephone net at the expiration of the concession. Thus, the company's position as against the new Polish Government was such that it owned and operated an extensive and valuable telephone plant in the city of Warsaw without having the necessary concession therefore.

Under Wito's administration, former chief engineer Tolodsku of the St. Petersburg telephone net was appointed Postmaster General, but remained in office for only a short time. His successor Steslowicz retained this office during the remainder of Wito's administration as well as under the following one, led by Ponikowski. Steslowicz was very desirous of coming to terms with the Swedish company, although he very

naturally did his utmost to promote the interests of his country at the same time. Representatives, not only from the Postal Department, but also from the Treasury Department, the Department of Commerce, the Office of Works, the Attorney General and the magistrate of Warsaw took part in the lengthy proceedings which now followed, the Swedish company being forced to accept as a basis for the negotiations the fact that the existing financial conditions in Poland did not permit the taking over of the telephone net on the basis of a cash settlement. The only solution was to obtain a new concession, whereby the company through its own efforts might receive interest on and pay off the invested capital. The terms stipulated by the Postal authorities for the granting of such a concession, however, included the rebuilding and operation of the telephone nets in Lodz, Lemberg, Lublin, Bialystok, the petroleum district of Boryslaw and the coal fields of Sosnowicz, these nets having been destroyed during the war. Also, the government wanted to be a stockholder in the enterprise.

An agreement was finally arrived at whereby a new Polish company was formed in which one half of the stock and the technical and administrative leadership was retained by the Swedish company, a substantial interest being obtained by the government. The telephone net of Warsaw was then sold to this company by the Cedergren Telephone Company, government bonds redeemable after 25 years being received in payment therefore. The joint capital of the new company was paid up in the following manner: the abovementioned telephone nets valued at approximately 3,000,000 Swedish crowns were handed over to the company by the government, the Cedergren company contributing the necessary capital — amounting to abt. 3,500,000 crowns — for the rebuilding of the same. In addition, about 500,000 crowns were invested in the enterprise by private Polish interests, thus bringing the joint capital up to abt. 7,000,000 Swed. crowns, or 10,000,000 Polish zloty. The Polish company obtained a concession for a period of 25 years, at the expiration of which the government shall redeem all shares not in

its possession at a rate of 110 %. The government may take over these shares sooner, if it so desires, but at a somewhat higher rate.

The appraisal of the Warsaw net was a very difficult proposition, not less than four consecutive commissions having taken part therein. The evaluation of the net was also made the subject of public discussion in the Polish press.

The solution finally arrived at in regard to the Polish telephone problem has shown itself to be very expedient and to bring good results. Private initiative has thereby come by its rights, an economically sound administration with moderate subscription rates having been established. On the other hand, the government has secured effective control over the company's activities together with a share in the profits.

The new Polish company, which is called Polska Akcyjna Spółka Telefoniczna, took up its activities on July 1st 1922.

The number of telephone instruments connected up with the various nets was

on December 31st 1922	38,964
» » 1923	40,937
» » 1924	45,321

and these nets are now experiencing a rapid growth.

The populations of the principal cities in the various zones of operation at the beginning of the current year were as follows:

Warsaw	981,176 inh.	Tustanowicz	13,299 inh.
Lodz	451,813	» Sosnowicz	. 86,698 »
Pabjanice	29,699	» Dabrowa	39,840 »
Zgierz	21,116	» Zawiercie	28,708 »
Bialystok	76,971	» Bedzin	28,076 »
Lemberg	219,193	» Czeladz	17,260 »
Drohobycz	26,733	» Lublin	94,498 »
Boryslaw	16,346	»	

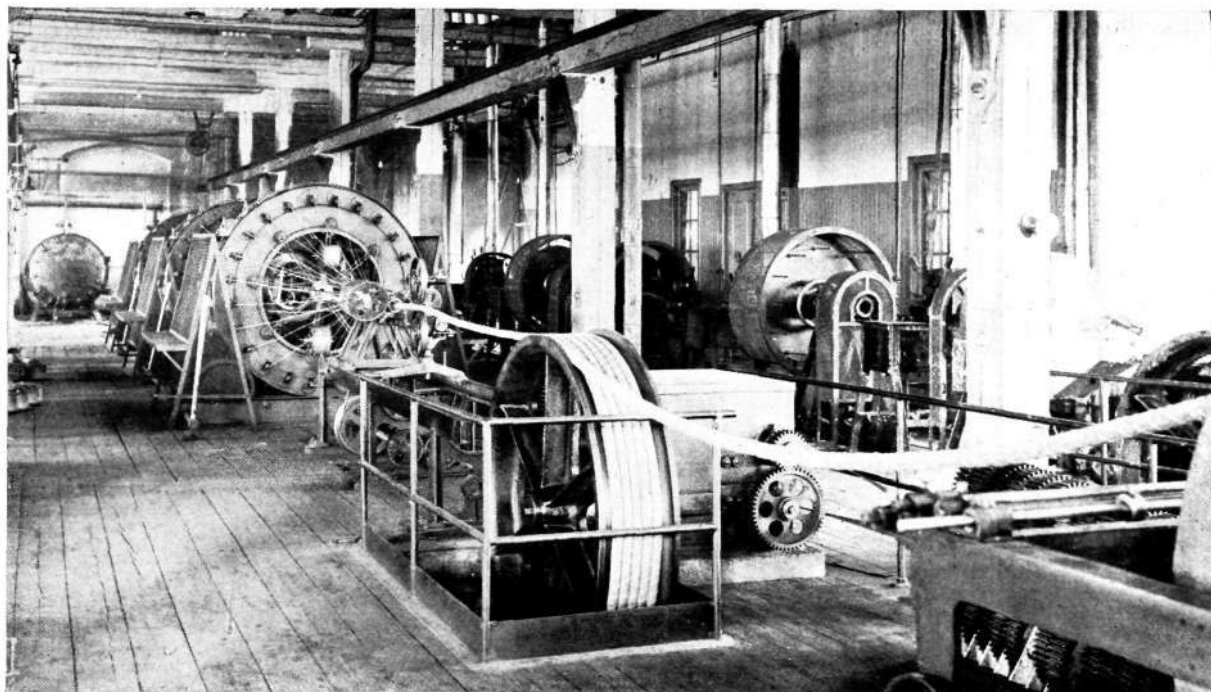
A most satisfactory cooperation with the Polish authorities and with the government representatives in the board of directors of the company has been established. The new company has fulfilled all its obligations towards the Swedish company, whose activities have been taken over by Allmänna Telefonaktiebolaget L. M. Ericsson after the liquidation of the Cedergren Telephone Company. *Wtz.*

The L. M. Ericsson Cable Works at Älvsjö, Stockholm.

The manufacture of cables and similar products was not taken up by the L. M. Ericsson company and included among its activities until at a comparatively recent date.

sary to devise some means whereby such material could again be obtained at reasonable prices.

The equipping of the cable works took a much longer time than had been anticipated, as the



R 237

Fig. 1. Cable Manufacture.

In 1916 Aktiebolaget Stockholmstelefon, a subsidiary concern of Allmänna Telefonaktiebolaget L. M. Ericsson, began to make plans for the erection of a cable factory for the main purpose of supplying the great quantities of cable and telephone cords required by this company, A.-B. Stockholmstelefon being at that time owners of the fast growing private telephone net in Stockholm and outlying districts. The Great War, together with the insufficient production of existing cable factories, was responsible for such an unheard-of rise in prices that it became neces-

sary to supply the necessary machinery were unable to make deliveries within a reasonable time. Also, it was found impossible to obtain professional men of sufficient competency in the manufacture of this kind of material. For this reason, the company itself was forced to make the necessary machinery and to select men out of its own force and train them for this kind of work. Naturally, a great many obstacles had to be overcome and mistakes were unavoidable in the beginning. On the other hand, the problem in hand had to be



R 238

Fig. 2. The Cable Works

studied in the most thorough manner possible, whereby an invaluable experience in the manufacture and operation of cable machines was obtained. Later on, when severe competition necessitated the manufacture of high class and yet low priced products, this experience proved to be most useful.

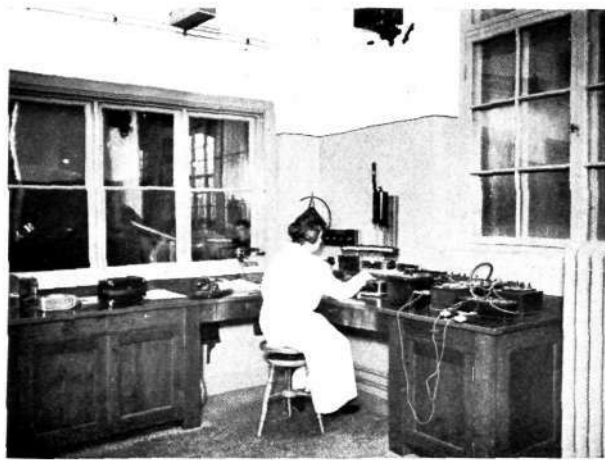
In 1918 Aktiebolaget Stockholmstelefon sold its telephone net to the Royal Swedish Telegraph Office. The number of subscribers in this net amounted by this time to 110,000. After the sale of its telephone net, Aktiebolaget Stockholmstelefon continued its activities under the name of Allmänna Industriaktiebolaget H. T. Cedergren, and some time

thereafter was merged into the head concern, whereby the cable works with their various manufactures became a part of L. M. Ericsson's activities.

The cable works are located in Älvsjö, one of Stockholm's suburbs, lying on the Southern Trunk Railway. The estate of Långbro, with an area of about 430 acres and lying in the immediate proximity of the cable works, is owned by the company, and affords ample room for a practically unlimited expansion

of the works, for homes for the employees, etc.

The community of Älvsjö, whose population amounts to about 10,000 inhabitants, has also a

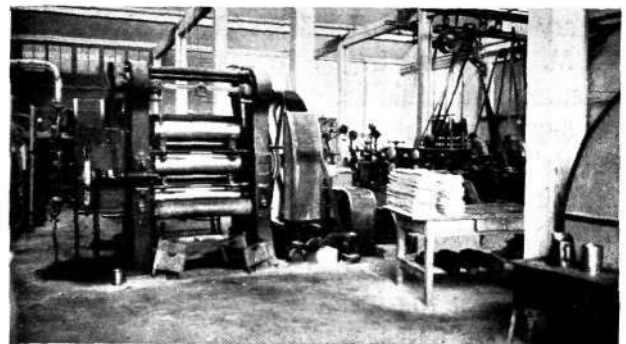


R 246

Fig. 3. A Corner of the Test Room.



R 240 Fig. 4. Paper and Cotton covering Machines.



R 241 Fig. 5. Manufacture of Rubber Insulated Wire.

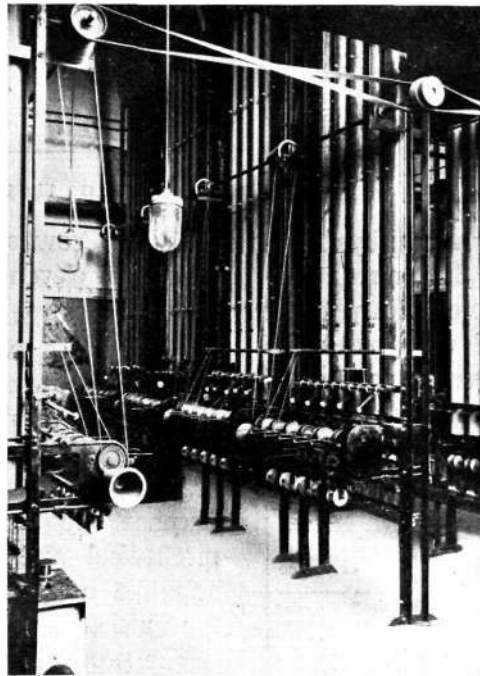


Fig. 6. Another View of the Works.

R 239

few smaller industries, but the cable works is its only really important manufacturing concern.

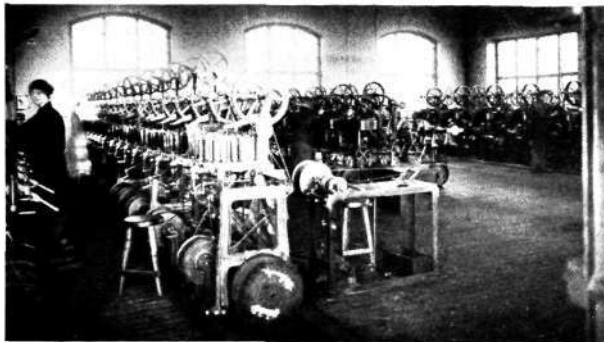
The works have successively taken up the manufacture of different lines of products belonging to the class of insulated electric conductors. A start was made with telephone and bell wire for indoor use and cotton insulated cable for indoor plant. Later on, the manufacture of dry core lead covered cable, switchboard cords, receiver cords, rubber insulated wire, enamelled wire and silk insulated wire was taken up. During latter years, duplex cable for long distance lines as well as for indoor plant has been manufactured.



R 247 Fig. 7. Manufacture of Enamelled Wire.

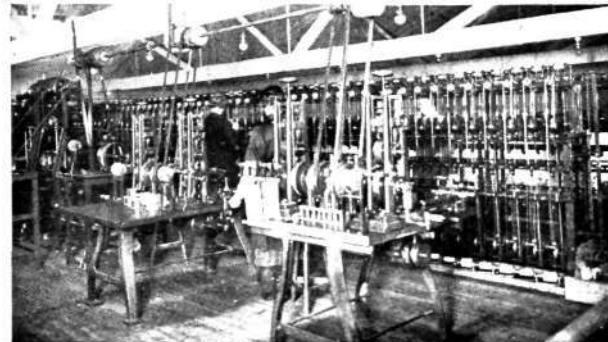
This type of cable, which must pass very severe tests for capacity and line resistance, has given excellent results.

The first of the factory's products were put on the market in 1918. The sales during this year amounted to 441,053 Swedish Crowns. The corresponding figure for 1919 was 2,833,884 Cr., for 1920 1,806,970 Cr., for 1921 1,370,150 Cr., for 1922 1,511,951 Cr., for 1923 1,627,246 Cr. and for 1924 2,295,058 Cr. These figures, however, are not altogether comparable on account of the successive decrease in prices for wire and cable products. The financial crisis which occurred after the Great



R 242

Fig. 8. Cord Manufacture.



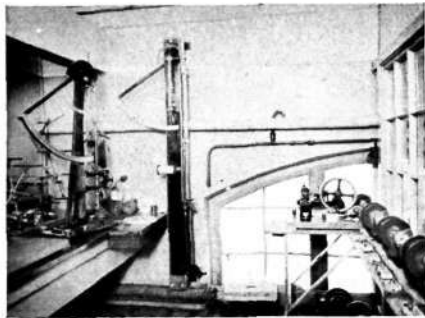
R 243

Fig. 9. Manufacture of Tinsel Cord and Silk Insulated Wire.

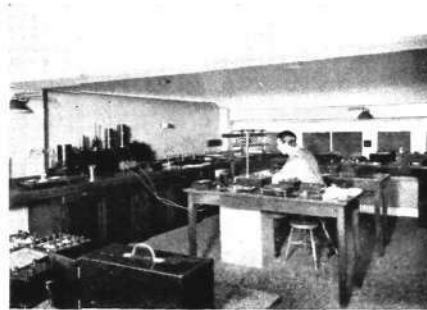
War was responsible for a marked decrease in consumption, and the ensuing sharp competition forced prices down to a minimum. Also, the fall in prices of raw material played a very important part. As a matter of fact, the present prices amount to only about 20 % of those of 1918, 25 % of those of 1919, and so forth. A true comparison of the output during various

A decrease in sales occurred in 1920, chiefly due to a strike which lasted from the beginning of the year until March 8th.

The most interesting information in this table is undoubtedly that given in the last column, which shows the successive increase in efficiency. While the value of material produced per employee in 1918 did not amount to more than



R 244 Fig. 10. The Mechanical Laboratory.



R 245 Fig. 11. The Electrical Laboratory.

years, therefore, can only be arrived at by reduction to the price level of 1924. Such a reduction has been made in the table here below, which also gives the total length of wire and cable manufactured each year, the average number of employees (including officials, engineers and foremen), and the average value of production per employee during each year.

Year	Value of material manufactured and sold, reduced to the 1924 price level	Total length of wire and cable manufactured	Average number of employees	Average value of production per employee
	Swed. Crowns	Metres		Swed. Crowns
1918	88,211.—	8,000,000	70	1,260.—
1919	780,471.—	30,459,976	202	3,860.—
1920	686,648.—	30,512,353	159	4,318.—
1921	1,027,613.—	32,845,674	121	8,492.—
1922	1,436,354.—	65,533,223	140	10,250.—
1923	1,562,156.—	88,895,997	160	9,770.—
1924	2,295,058.—	138,982,574	160	13,800.—

1,260.— Crowns, in 1924 it had increased to practically eleven times this amount.

An increase in efficiency and a consequent lowering of prices were not the only aims of the company, however. Steady efforts have also been made to raise the quality of the finished products, this being the only sure means of acquiring and holding new markets. For this purpose the company has installed chemical, mechanical and electrical laboratories for the scientific testing of raw materials as well as of the finished product.

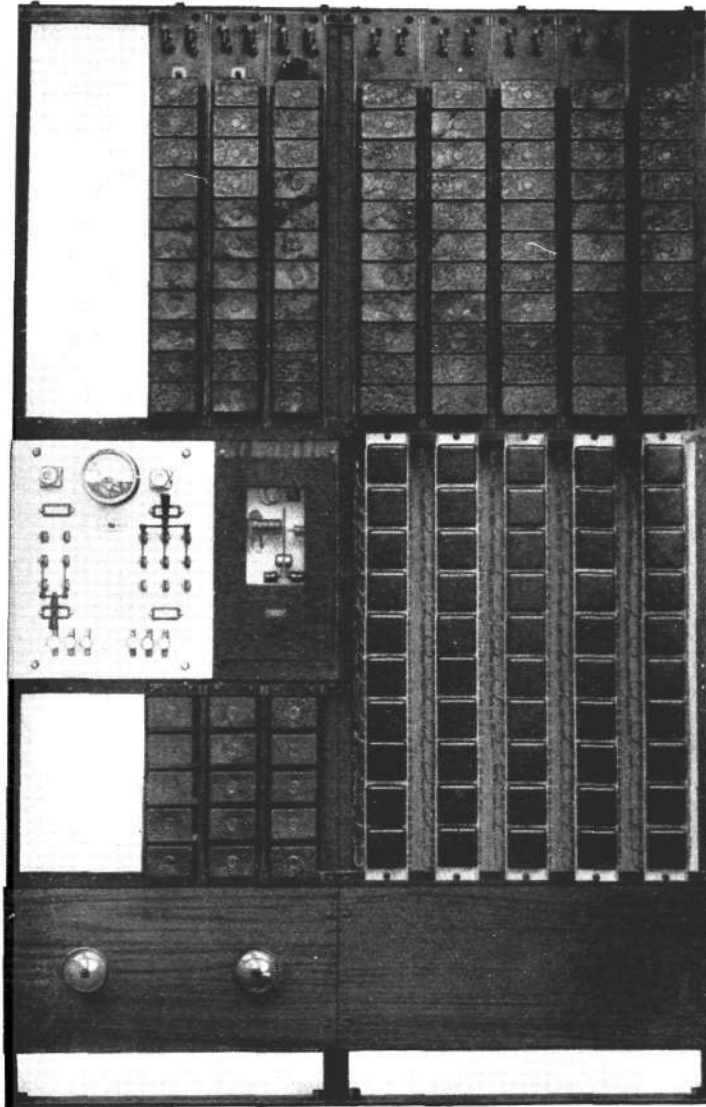
The products of the Ericsson cable works are now being shipped to nearly all parts of the world. A very large part of this production, amounting in 1924 to 25 % of the entire output, is consumed by the L. M. Ericsson works in Stockholm.

G. O.

CONTENTS OF THIS NUMBER: Automatic Voting. — The Calcutta Telephone Exchanges. — The Madrid Exhibition of Telephone and Kindred Appliances. — The New Poland. An economic survey. — Swedish Telephone Activities in Poland. — The L. M. Ericsson Cable Works at Älvsjö, Stockholm.

L. M. Ericsson

SMALL
AUTOMATIC TELEPHONE SWITCHBOARDS
FOR
LOCAL EXCHANGES.



Type OL 500/50 for 50 Lines.

The switchboard here shown is intended for fifty lines and is furnished with equipment permitting twelve simultaneous calls. There is also a power board for two storage batteries (for charging with D. C.), pole changer for ringing signals, and fuses with alarm bell.

The rack is 225 cm. high and 145 cm. wide.

These automatic switchboards are suitable for large business enterprises, such as warehouses, banks, factories, mills, and for small municipalities, etc., and can be furnished for from ten to five hundred subscribers' lines, with a possible maximum of twenty four simultaneous calls.

PRINCIPAL ADVANTAGES OF
THE AUTOMATIC SWITCHBOARD.

1. Always ready for service, day and night.
2. Independent of the services of an operator.
3. Quickly accomplishes connections and the clearing of lines.
4. Conversations secret.
5. Occupies but little space.
6. Enables expansion in stages of 10 lines.
7. Existing apparatus unaltered with increased capacity.
8. Only two wires per telephone set.
9. Gives distinct calling and busy signals.

ALLMÄNNA TELEFONAKTIEBOLAGET L. M. ERICSSON,
STOCKHOLM.

The L. M. Ericsson Review



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ONE OF THE OPERATING ROOMS AT WARSAW

ENGLISH EDITION

THE L. M. ERICSSON REVIEW

ENGLISH EDITION.

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Modernization of Plants operated by The Polish Telephone Company.

The building and reconstruction work now being carried on by the Polish Telephone Co. (Polska Akcyjna Spółka Telefoniczna) constitutes the most important step towards the modernization of Polish telephone equipment. The concession granted this company by the Polish government stipulates that all nets operated by the company shall be completely modernized before July 1st, 1927.

On December 31st 1924, 45,321 telephone instruments were connected up to the various nets of the Polish Telephone Company. As the total number of instruments in the whole country at that time did not amount to more than 109,000, we find that about 40 % of the service is being handled by this company.

The following nets are now being operated by the Polish Telephone Company.

Warsaw and surrounding district within a radius of 8 km.



R 278

Fig. 1. The New Exchange at Lublin.

Lodz and surrounding district within a radius of 20 km.

Lemberg and surrounding district within a radius of 8 km.

Lublin and surrounding district within a radius of 8 km.

Bialystok and surrounding district within a radius of 8 km.

Boryslaw and surrounding district within a radius of 20 km. (the oil fields); together with that portion of the coal district formerly under Russian rule and consisting of Sosnowiec and surrounding district within a radius of 20 km.

The Polish Telephone Company took charge of these nets on July 1st 1922, on which date the concession for operating the same became the property of this company. The concession

for Warsaw had previously been owned by the Cedergren Telephone Co., and the others by the Polish government.

The terms of the concession stipulate that the following nets shall be either modernized or entirely rebuilt for a certain minimum number of lines, as follows:

Lodz (city proper)	4,500 lines
Lodz (surrounding district)	1,000 »
Lemberg	4,000 »
Lublin	1,500 »
Bialystok	2,000 »
The oil fields	2,000 »
The coal district	2,000 »
Total 17,000 lines	

All of these nets shall be equipped with like material and be constructed according to the same methods as have already been so success-



R 273 Fig. 2. Cord Plug, full size.

fully used in Warsaw, Stockholm, Moscow and other places.

The common battery system with two-wire multiple and pair cord service is being applied to all the larger exchanges.

The cord plugs used at these exchanges have a diameter of only 3.5 mm., fig. 2 giving a full size illustration of one of them. A person never having handled these plugs may find them ridiculously small and unpractical; the efficiency of the service as well as the long life of the cords, however, has given ample proof of the opposite.

The 2-point multiple jacks are mounted in 60 or 100-line strips. Five such strips form a jack-block of 300 or 500 lines respectively.

By reason of the unusually small diameter of the plugs, the multiple naturally takes but little space, and the total multiple capacity of 30,000 lines can be conveniently reached by one operator. Fig. 4 gives a view of such a multiple extended for 36,000 lines.

The local jacks have three contacts, the third one being for the subscriber's service meter. Each line is equipped with such a meter, these

latter usually being placed above the multiple, as shown in fig. 5.

Symbols used on diagram.

- R_1R_2 — Combined line and cut-off relay.
- AL — Call supervision lamp.
- LJ — Local jack.
- M — Subscriber's meter.
- MJ — Multiple jack.
- R_3 to R_8 — Cord circuit relays.
- CL_1 — Clearing lamp for calling cord circuit.
- CL_2 — Clearing lamp for ringing cord circuit.
- PCL — Supervisory lamp for clearing signals.
- PRL — Supervisory lamp for ringing signals.
- P_1 — Answering cord.
- P_2 — Ringing cord.
- K — Speaking and ringing key with pump.
- R_9 — Test relay.
- R_{10} — Connecting relay for ringing circuit.
- R_{11} — Control relay for ringing circuit.

All relays in speaking circuits are sheathed to prevent cross-talk.

A subscriber A calls the exchange by removing his handmicrotelephone, closing the following circuit:

1. Negative, R_2 , L_1 , A , L_2 , R_1 and positive.

The same circuit passes through both coils R_1 and R_2 . Since R_2 has the greater number of windings, it attracts the armature, closing the following circuit and causing the lamp AL to glow:

2. Negative, R_1a , AL and positive.

The operator answers the call by plugging P_1 into LJ and pressing the key K over to speaking position, thereby closing the following circuits:

3. Negative, R_3 , P_1b , L_1 , A , L_2 , R_1 and positive, and
4. Negative, R_4 , R_1a , L_2 , R_1 and positive.

R_3 and R_4 energize and are connected in parallel with R_2 , reducing the current in R_2 and increasing the same in R_1 . The armature is released by coil R_2 and attracted by R_1 , causing the lamp AL to cease glowing.

The pressing of the speaking and ringing key

to the speaking position brings the operator's headgear in circuit over the contacts Ka and Kd and the operator answers the call.

The operator tests the desired line of subscriber A^1 by placing the plug sleeve P_2b against the jack spring L_2^1 .

If the line is busy, the following circuit is closed:

5. Negative, R_2^1 , L_1^1 , A^1 , L_2^1 , P_2b , Ki , Ke , R_9 and positive.

R_9 energizes, closing contact R_9a , over which the operator receives a busy tone indicating that the line is busy.

The operator plugs in the calling cord P_2 in the multiple jack MJ^1 and presses the key K over into ringing position.

The following circuit is then closed:

6. Negative, R_{10} , Kh , P_2b , L_2^1 , R_1^1 and positive.

R_{10} energizes, an induction current being sent out over the following circuit:

7. Induction coil, $R_{10}a$, R_{11} , Km , P_2a , L_1^1 , A^1 , L_2^1 , P_2b , Kh , R_{10} and negative.

R_{11} energizes and the calling lamp receives current over the following circuit:

8. Negative, $R_{11}a$, PRL and positive.

Circuit No. 6 keeps the armature of relay $R_1^1R_2^1$ attracted against the coil R_1^1 and prevents the magneto current from causing a flickering of the calling lamp for subscriber A^1 . The ringing signal continues for a period of about three seconds, after which the key K automatically returns to its normal position, thereby closing the following circuit:

9. Negative, R_7 , Kf , Ki , P_2b , L_2^1 , R_1^1 and positive.

R_7 energizes and is held over R_7b .

The called subscriber A^1 answers by removing his microtelephone.

This causes the closing of the following circuit:

10. Negative, R_8 , Kg , Kk , P_2a , L_1^1 , A^1 , L_2^1 , R_1^1 and positive.

Relay R_8 energizes. The relay R_5R_6 is constructed so that current through both coils is necessary to attract its armature.

The subscribers replace their microtelephones after the conversation is ended.

This causes a breaking of circuits Nos. 3 and



R 275

Fig. 3. The Temporary Exchange at Lemberg. Note the Subscribers' Meters over the Local Multiple.

10 in the respective instruments and a consequent de-energizing of R_3 and R_8 .

The de-energizing of R_3 causes the following two circuits to be closed:

11. Negative, R_4a , R_3a , CL_1 and positive; and
12. Negative, R_4a , R_3a , R_6 and positive.

The de-energizing of R_8 causes the following two circuits to be closed:

13. Negative, R_7a , R_8a , CL_2 and positive; and
14. Negative, R_7a , R_8a , R_5 and positive.

This results in the lighting of the clearing lamps CL_1 and CL_2 , and the energizing of relay R_5R_6 . The energizing of R_5R_6 causes the super-

visory lamp *PCL* to glow and one call is recorded by the service meter *M*:

15. Negative, R_6d , *PCL* and positive.

16. Negative, R_6c , P_1a , *M* and positive.

The clearing lamps keep on glowing until the operator disconnects, even if the subscribers *A* or *A*¹ should again remove their microtelephones, as R_5R_6 is held directly over contacts R_5R_6a and R_5R_6b .

The operator takes down the connection, thereby breaking all circuits.

Toll traffic.

The above described switching process applies to local calls. Exchanges with more than 1000

are equipped with clearing relays and 12-volt supervisory or clearing lamps which receive their current either from the public power net over a transformer or from a common battery. The central exchange as well as the private exchange receives a clearing signal as soon as the microtelephone of the extension instrument is replaced on the cradle.

The cord switchboards are of L. M. Ericsson's standard type with pair cords. The main advantage with these boards is that all component parts are very easily replaced; also, they need only be equipped with the exact number of lines and cords required for handling the existing traffic, a subsequent increase in traffic being taken care of by mounting additional standard units in the board.

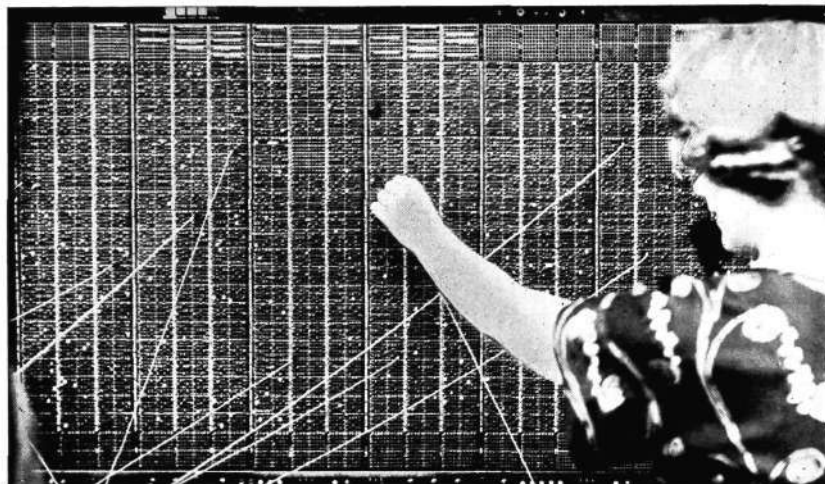
The telephone instruments are of the type which has become so popular in Stockholm, Warsaw, Moscow and other cities, a few minor changes having been made, however, so as to permit the common use of a greater number of parts in both the table and wall instruments for the sake of simplifying maintenance.

Method of building the nets.

The L. M. Ericsson system for cable distribution — fully described in the previous issue of the «Review» — is being used for the local telephone nets.

In all the larger cities, the cables — where possible — are laid in underground cement conduits. Within the more central parts of the cities, the individual subscribers' lines are carried in 2-conductor lead covered cables which are fastened to the outside walls of the buildings.

In the residential and other districts, where the subscribers are more thinly distributed, aerial cables supported by poles or on the tops of the houses are more generally used. Here, the open lines consist of bronze wire 1 mm. in diameter or, where an insulated line is required, of so-called



R 274

Fig. 4. Part of a Multiple with a Capacity of 36,000 Lines.

lines are equipped with a junction switchboard for making connections with the toll exchange. This board has provisions for disconnecting a subscriber's line from the local exchange during a toll call.

Private exchanges and subscribers' instruments.

The private exchanges are operated according to the common battery system with a current of 12 volts' tension. For two, four and eight lines, a cordless switchboard with keys is used, exchanges with from 12 to 100 lines being equipped with switchboards of the cord type. The switchboards are equipped with indicators for incoming calls, the 2-line boards having clearing indicators as well. All other boards

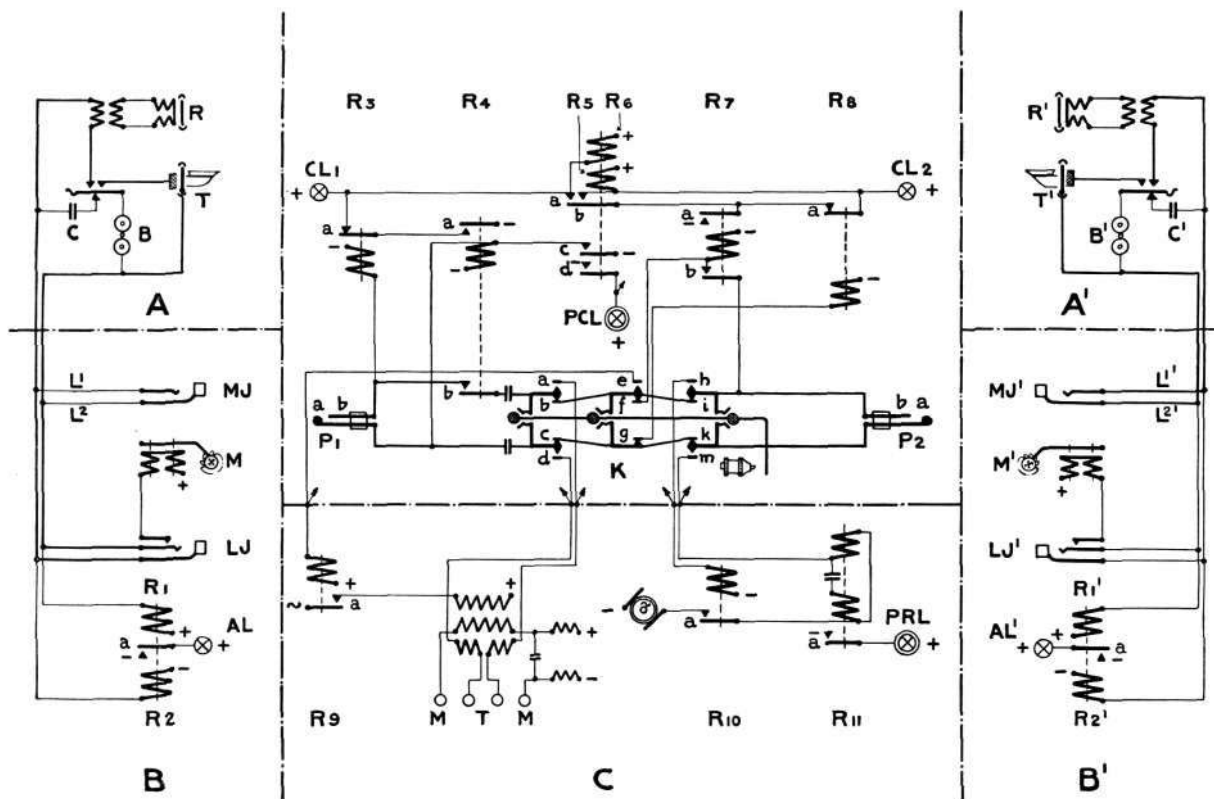
Hackethal wire. The open lines usually terminate on a chimney bracket or small roof standard for two lines, from where they are led down into the garret of the building by means of rubber insulated wire. Here they are connected to 2 or 4-conductor lead covered cables which are run down to the subscribers' instruments.

ductor cables have conductors with a diameter of 0.7 mm.

Extension of the plants.

Lodz.

In this city, the C. B. exchange which was taken over by the Polish Telephone Company had been recently built by Siemens for a capa-



R 272

Fig. 5. Schematic Diagram for C. B. System with Pair Cords and 2-Wire Multiple.

Iron wire 3 mm. in diameter is used for rural lines. When the number of lines exceeds twelve pairs, overhead cable is used, all poles being impregnated.

In the larger cities belonging to the Lodz, the oil, and the coal districts, all junction line cables are double wound and either laid in conduits or carried overhead on poles.

All cables are of Ericsson's standard make. For all main cables as well as for primary and secondary distribution cables, conductors with a diameter of 0.5 mm. are used, while the junction line cables and the 2 and 4-con-

ductor cables have conductors with a diameter of 0.7 mm. The equipment at this exchange was in good condition, but subscribers' meters were lacking. The modernization of this exchange, therefore, was restricted to the installation of subscribers' meters for all the lines, but an extension for another 2000 lines will probably soon be a matter of necessity.

On the other hand, the outside net was in an exceptionally poor condition. A cement conduit line led from the main exchange to a few street distribution cabinets in the central part of the city. The cables which were run through these conduits for the service of two city blocks with

underground distribution were in a deplorable condition and the same could be said concerning the bare wires which were bunched on pole lines in the streets of the city.

After the old net had been put in a state of temporary repair, extensive operations for the rebuilding of the net were started in the spring of 1923, this work being scheduled for completion by the end of 1925.

The new conduits are figured for a capacity of 45,000 lines and run out from a building-lot purchased for the erection of a new exchange. After the completion of the first extension, the

on account of the large amount of traffic and partly because some of the larger industrial enterprises of Pabianice and Zgierz have contracted for direct service with Lodz.

The usual type of P. B. X. switchboards are being installed in the smaller towns around Lodz, the lines being carried in small overhead cables supported by pipe standards on the roofs of the houses.

Lemberg.

The telephone net of Lemberg, which was built according to the methods used by the former



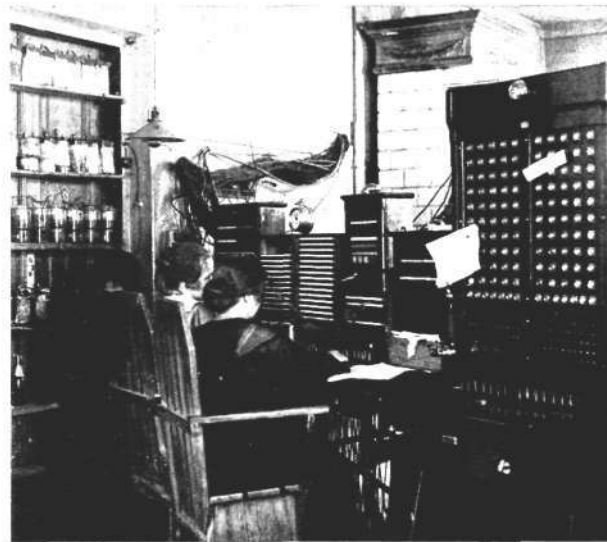
R 277 Fig. 6. Typical Placing of Distribution Cabinet in Warsaw.

main cables from the old exchange will have a capacity of 7200 lines, and will be distributed to 45 distribution cabinets. The cable net will be almost entirely underground.

Surrounding districts of Lodz.

New common battery exchanges for 500 lines have been installed in rented localities in the cities of Pabianice and Zgierz. The nets here are being built on the same efficient plan as in Lodz.

Cables for junction lines between these cities and Lodz will be laid in cement conduits during the present year. These cables will contain an unusually large number of lines, partly



R 276 Fig. 7. The Old Exchange at Bialystok.

Austrian telegraph authorities, had a capacity of 4500 lines and was in a fairly good condition. The only work necessary for its adaption to the common battery system, therefore, consisted in minor adjustments, the replacing of iron wire with bronze wire and the improvement of the lines leading in to the subscribers' instruments.

The main exchange, on the other hand, proved to be in an exceptionally poor condition. The insistent demands of the authorities as well as of the public resulted in the construction of a temporary C. B. exchange for 3000 lines, housed in the same building as the old exchange. This had been anticipated already before the conces-

sion had taken effect, so that L. M. Ericsson was able to deliver the necessary material already in the latter part of 1922.

The new exchange was ready for service in August 1923 and the connecting up of new subscribers could immediately take place. Almost all the available lines had been connected up by the end of 1924, and the exchange is now being extended for a total capacity of 6000 lines.

Building operations for the modernization of the cable net are to be begun during the present year in those parts of the city where the demand for new subscribers' stations is greatest. New main cables with a capacity of 2100 lines are to be run to these parts of the city from the present exchange.

Lublin.

In this city, a new 3-story building with facilities for housing a main exchange for 10,000 lines, offices, stock rooms and lodgings for the superintendent, has been erected on a newly purchased building-lot.

The new telephone exchange as well as an entirely new net for 1500 subscribers' lines will be put in operation during the present year.

Bialystok.

Rooms for housing the new exchange have here been provided in the old exchange building. The new exchange equipment is to be erected during the current year as well as an almost entirely new net for 2000 subscriber.

The petroleum fields.

A three story building similar to the one in Lublin has been erected in Boryslav, the principal city of this district. This exchange building has an operating room with accommodations for a maximum of 3000 lines. The initial capacity of the exchange is 1000 lines.

An entirely new net for 1000 subscribers' lines has been built independently of the old one. Contrary to the others, this net is built almost entirely with aerial cables carried on poles. Only in the side street where the exchange is located have cement conduits been laid. It was found impossible the place conduits in the main street on account of the great number of oil pipe lines,

but those parts of the main cables which had to be placed underground have been run parallel with the oil pipes and are protected by angle-iron.

As the buildings are of a too primitive type of construction to support any kind of a load, the distribution is accomplished by means of bare wires from distribution poles.

The coal district.

The three important cities of Sosnowiec, Bedzin and Dabrowa are located within this district.

The nets and exchanges which were here taken over by the Polish company were all in a deplorable condition.

The rental laws which were in effect after the war made it practically impossible to obtain any suitable premises for the new exchanges, causing serious delay in the work. The Sosnowiec exchange was put in operation in January 1924 and Bedzin in September of the same year. In Dabrowa, it was impossible to get the desired premises vacated until November 1924, so that this exchange is not yet completed.

Cement conduits have been laid between Sosnowiec and Bedzin for the cables carrying the junction traffic between these cities. A double-wound cable will be drawn through this conduit before the end of the year.

The table on the next page gives an idea of the scope of the above-mentioned work, partly at the completion of the first stage of the extension work, i. e. at the close of 1925, and partly of the end of 1924.

The connecting up of new subscribers was begun as soon as the new exchanges had been put in operation and all the old subscribers transferred. In Lemberg the net has experienced a steady growth with about an equal number of new subscribers each month. In Lodz and the coal district, however, where the general depression following the war was most keenly felt, the number of subscribers did not increase to any appreciable degree until during the latter half of 1924. The following figures give the number of old instruments replaced by C. B. instruments, as well as the number of newly installed C. B. instruments up to December 31st 1924, and include only those districts in which new common battery exchanges have been put in operation.

L. M. Ericsson

	Cem. Conduits		Undergr. Cable		Aerial Cable		Poles
	Conduits kilom.	Ducts kilom.	Cable kilom.	2-Conductor Lines kilom.	Cable kilom.	2-Conductor Lines kilom.	Number
<i>Lodz:</i>							
Dec. 31st 1925	62.98	119.61	169.17	9,420.31	14.38	345.27	405
Dec. 31st 1924	35.98	66.81	104.25	5,723.67	3.81	202.56	205
<i>Lemberg:</i>							
Dec. 31st 1925	5.20	23.03	14.02	1,400.05	6.01	266.97	180
Dec. 31st 1924	—	—	1.26	95.40	2.64	76.32	120
<i>Lublin:</i>							
Dec. 31st 1925	8.53	20.49	27.79	2,018.00	5.70	119.00	115
Dec. 31st 1924	—	—	—	—	—	—	—
<i>Bialystok:</i>							
Dec. 31st 1925	10.09	21.33	26.81	2,293.70	8.45	172.50	175
Dec. 31st 1924	—	—	—	—	—	—	—
<i>The petroleum fields:</i>							
Dec. 31st 1925	0.05	0.35	1.35	264.20	50.28	1,561.00	710
Dec. 31st 1924	0.05	0.35	1.35	264.20	33.28	1,211.00	610
<i>The coal district:</i>							
Dec. 31st 1925	25.67	37.02	57.62	3,228.60	39.98	957.38	1,700
Dec. 31st 1924	20.31	29.41	30.77	2,076.25	31.65	807.03	1,300
Total Dec. 31st 1925	112.52	221.83	296.76	18,624.86	124.80	3,422.12	3,285
Total Dec. 31st 1924	56.34	96.57	137.63	8,159.52	71.38	2,296.91	2,235

	Number of Instruments replaced by C. B. Dec. 31st 1924	Number of newly installed C. B. instru- ments. Dec. 31st 1924
Lodz and surrounding district	115	2006
Lemberg.....	1414	1614
The coal district	328	649
The oil fields	210	—
Total	2062	4269

Simultaneously with the work executed in the provinces, extensive rebuilding and new construction work has been carried on in Warsaw, some of the more important items being mentioned in the following.

A five-story building with rooms for the main stock, the work shop and operators lunch room has been erected on the building-lot Zielna 37—39. Subscribers' meters have been installed for each subscriber's line at the central exchange. The

cement conduit lines have been increased with 9.59 kilometres of conduit, giving the ducts a total increase in length of 14.03 kilometres. 37.85 kilometres of cable, consisting of 3641.56 kilometres of two-conductor lines, have been added to the underground net. 14.57 kilometers of cable, containing a total of 365.26 kilometres of two-conductor lines have been added to the aerial net. These recent additions to the underground and aerial cable nets have in part been utilized for the modernization of 2870 subscribers' lines in the suburbs, the old lines consisting of bare wires which were led from from large distribution standards on the roofs of the buildings. Lastly, as many as 2800 new telephone instruments were connected up to the Warsaw net by the 31st of December 1924.

B. L—n.

Underground Cable Construction with Cement Conduits.

When cables first began to be used in the construction of city telephone nets they were always placed underground for the simple

in a trench which was then filled with earth — was resorted to.

The repair of old cables or the laying of new



K 16

Fig. 1. Laying a Conduit Line in Mexico City.

reason that their excessive weight precluded all possibility of supporting them on poles. At that time, the present day methods of laying cables in conduits were unknown, and the most simple method — i. e. the laying of the cable

ones, however, necessitated the tearing up of the streets, for which reason this system was eventually abandoned. It is still used, however, in localities where the streets are paved with very cheap material and where the subscribers are so

sparsely distributed or the concession is for such a short term that a more permanent and expensive system would not yield any interest.

With the advent of the modern dry-core lead covered type, however, it was found possible to run telephone cables overhead, supported by means of steel messenger wires. This method is not advisable in large and widespread nets, at least insofar as the main cables are concerned, for the reason that their number soon becomes so great that their running up on pole lines or over house tops is attended with serious difficulties.

In Stockholm, the telephone very soon became a popular means of communication and statistics show that in 1885 not less than 4978 telephones were connected up to the city net, amounting to 232 telephone instruments per 10,000 inhabitants. Actually, this was a greater number than in any other European city; compared with the number of inhabitants, it constituted a world's record. Naturally, many other larger cities have since surpassed Stockholm as to the actual number of instruments, but this city has retained a leading position in regard to the density of its telephones with over 25 subscribers per 100 inhabitants.

The rapid development experienced by the Stockholm net soon required the early solution of problems which arose as to the practical and economical running of the subscribers' lines. For the purpose of remedying existing conditions, Stockholms Allmänna Telefonaktiebolag (The Stockholm General Telephone Co.) in 1889 sought the permission of the city authorities for the laying of underground cables. This permission was not granted until 1891, and then only with much hesitancy and on very stringent terms, as no method was then known for the laying of such cables without tearing up the street pavement.

In 1890, H. T. Cedergren, engineer and managing director of the above company, caused a conduit of concrete to be manufactured, this

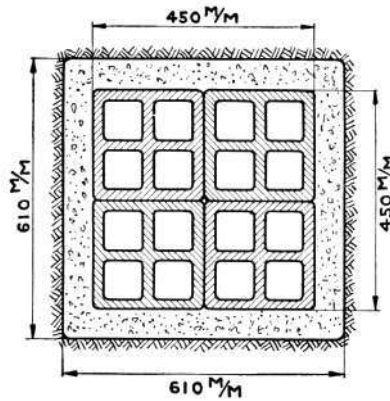
same design — with only a few minor changes and modifications — still being used by the Ericsson concern for all underground cable construction. It has also served as a pattern for several other telephone companies. It was several years, however, before the city authorities were convinced of the great advantages of this system and the extensive construction work for the building of Stockholm's underground cable plant did not gain any appreciable headway until 1895.

A conduit system for telephone cables cannot be termed efficient unless it fills the following requirements.

- a. It shall permit all necessary cable work to be accomplished in a simple and efficient manner without interfering with street traffic.
- b. It shall possess the necessary strength to withstand mechanical injury by tools used in roadbuilding or other similar work.
- c. It shall possess the necessary strength to withstand heavy traffic loads.
- d. It shall be absolutely non-conductive for electric currents, thus protecting the cables from corrosion by vagrant earth currents, danger from this source being greatest in cities with poorly constructed electric tramway nets.
- e. Gases which may cause dangerous explosions shall be prevented from entering the ducts.
- f. It shall be waterproof.
- g. It shall be moderate in price.

Before we go on with our description of the Swedish system of underground construction, we will, for the sake of comparison, touch on conduits of iron, wood and vitrified clay or terra-cotta tile.

Iron pipes were used as cable conduits at a very early date. Corrosion by rust, however, soon makes it well nigh impossible to even withdraw a cable without damaging the lead sheathing; iron pipe conduits, therefore, were abandoned after a very short time.



R 294 Fig. 2. Cross Section of Conduit composed of Four 4-duct Vitrified Clay Tile Conduits.

Conduits of impregnated wood construction have been used to some extent in the United States, in cities where the otherwise customary

vantages, however. In the first place, they cannot be made watertight, and the cable, therefore, is not protected from damage by electrolysis. Also,



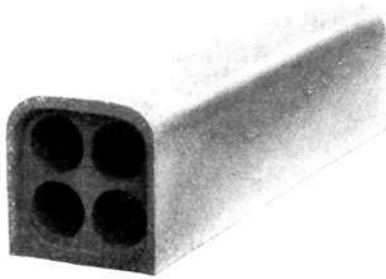
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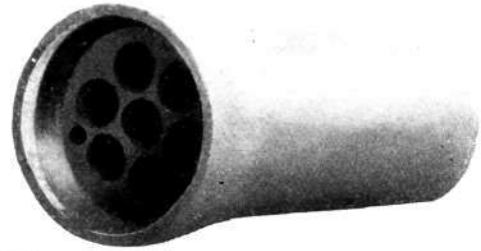
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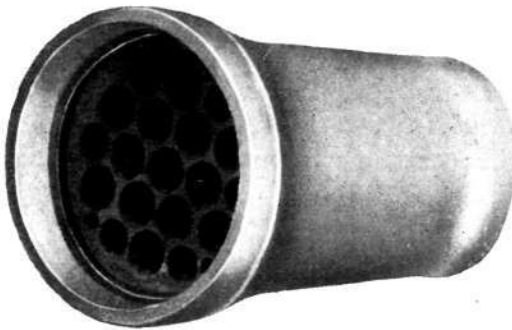
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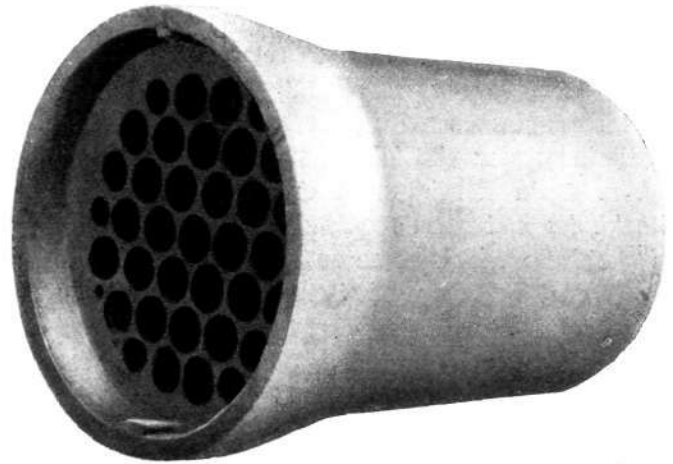
K 20



K 21



K 22



K 23

Fig. 3. Cement Conduits.

vitrified terra-cotta tile construction has proved unsuitable on account of the settling of the ground or because of the constant vibrations occasioned by the heavy traffic.

Wooden conduits have a great many disad-

the conduits and manholes easily become water-filled. Furthermore, gas may easily gain access and cause explosions. It may be well to mention here, that electrolysis is often responsible for the formation of oxihydrogen gas, the

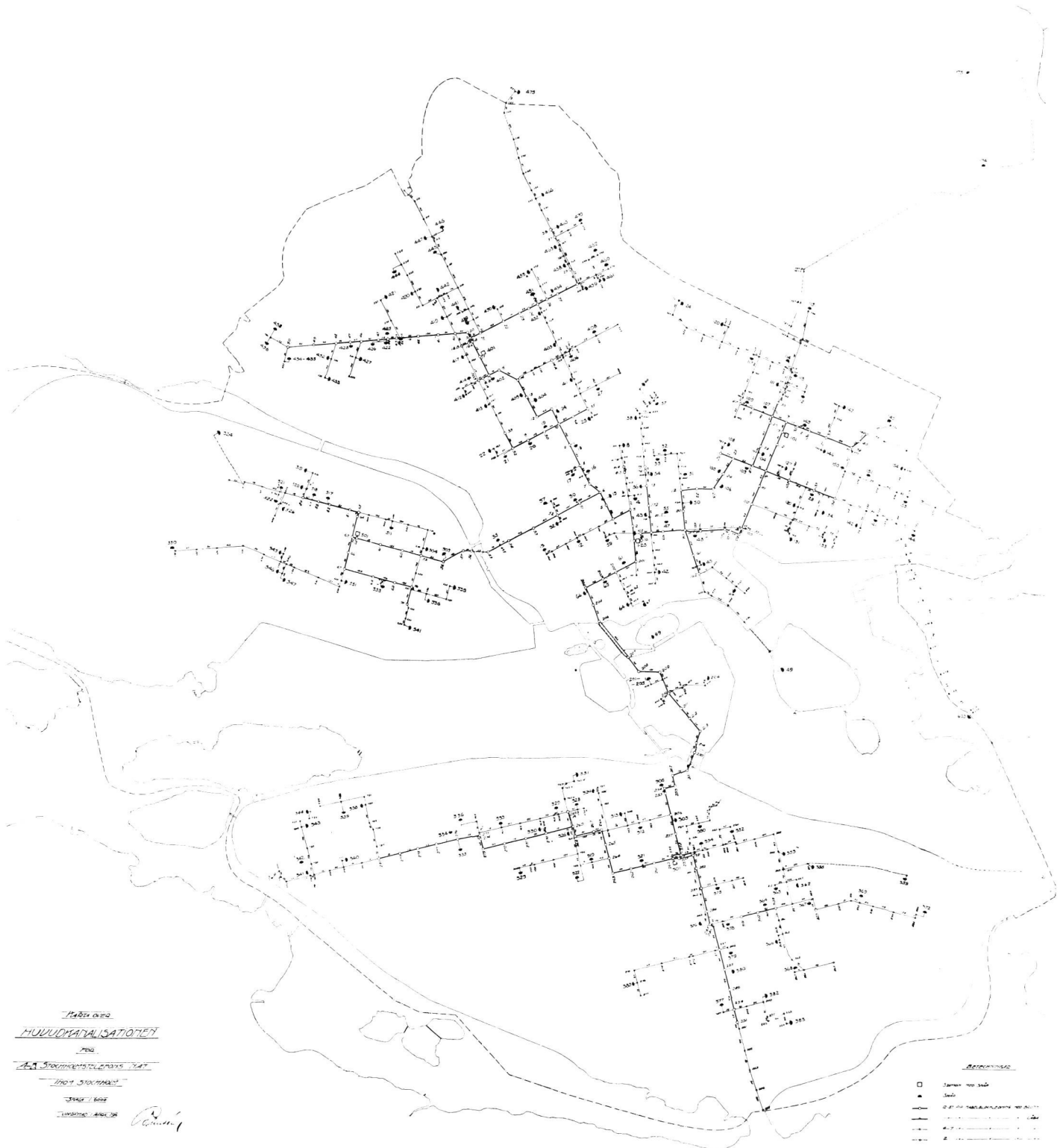
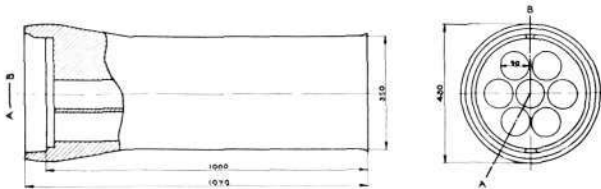


Fig. 4. Plan showing Extension of the Stockholm Underground Net in 1916

presence of which may result in very serious explosions. Another disadvantage is that their length of life is comparatively short.

Vitrified terra-cotta tile, on the other hand, has been very extensively used for this purpose. Tile conduits are made with square ducts and generally have the cross-section shown in fig. 2. They are seldom made with more than 6 or 8 ducts, however, on account of their fragility. When a greater number of ducts are required, two or more conduits are placed side by side.

Tile conduits are laid on a well smoothed bed of concrete, and the joints are wrapped with strips of cloth dipped in asphalt. The conduits are then covered with a layer of concrete — on both sides and top — from 8 to 10 centimetres thick.



R 295 Fig. 5. Details of 7-duct Cement Conduit.

On account of its rigidity, this system is not the most suitable for localities where frost, earthquakes, etc., cause upheavals or settling of the ground. The least settling of the ground will cause the conduits to crack, thus often damaging the cables or even making it impossible to run new cables through the ducts.

Fig. 2 shows a section through a 16-duct conduit built up of four 4-duct vitrified tiles.

The manufacture of tile conduits requires specially constructed machinery as well as ovens for glazing. As a result, the manufacture must take place in special factories, often necessitating long and expensive transportation with attendant breakage, all of which greatly increases the first cost.

The Swedish conduit system.

In fig. 3 are shown the seven different types of conduits which have been used by the Ericsson concern in the construction of underground cable nets. As may be seen, the conduits are

manufactured with 1, 2, 3, 4, 7, 19 and 37 ducts. The reason for adopting such odd numbers of ducts is merely that the cross section is thus best utilized. As a matter of fact, we find that these same figures also represent the standard numbers of strands in steel wire cables, etc.

The mix used in the manufacture of these conduits consists of one part cement and three parts sand. The effective length is 1 metre for all types.

An important feature is that these conduits can be made without the use of any special machinery. This makes possible the manufacture of the conduits in the immediate neighbourhood in which they are to be used, thus effecting a considerable saving in freight and transportation.

Collapsible steel forms are used, into which the fairly stiff cement mix is well tamped. The outer form, together with the cylinders which form the ducts, are then removed, the conduits being protected from the sun and kept moist by sprinkling during the early part of the curing process.

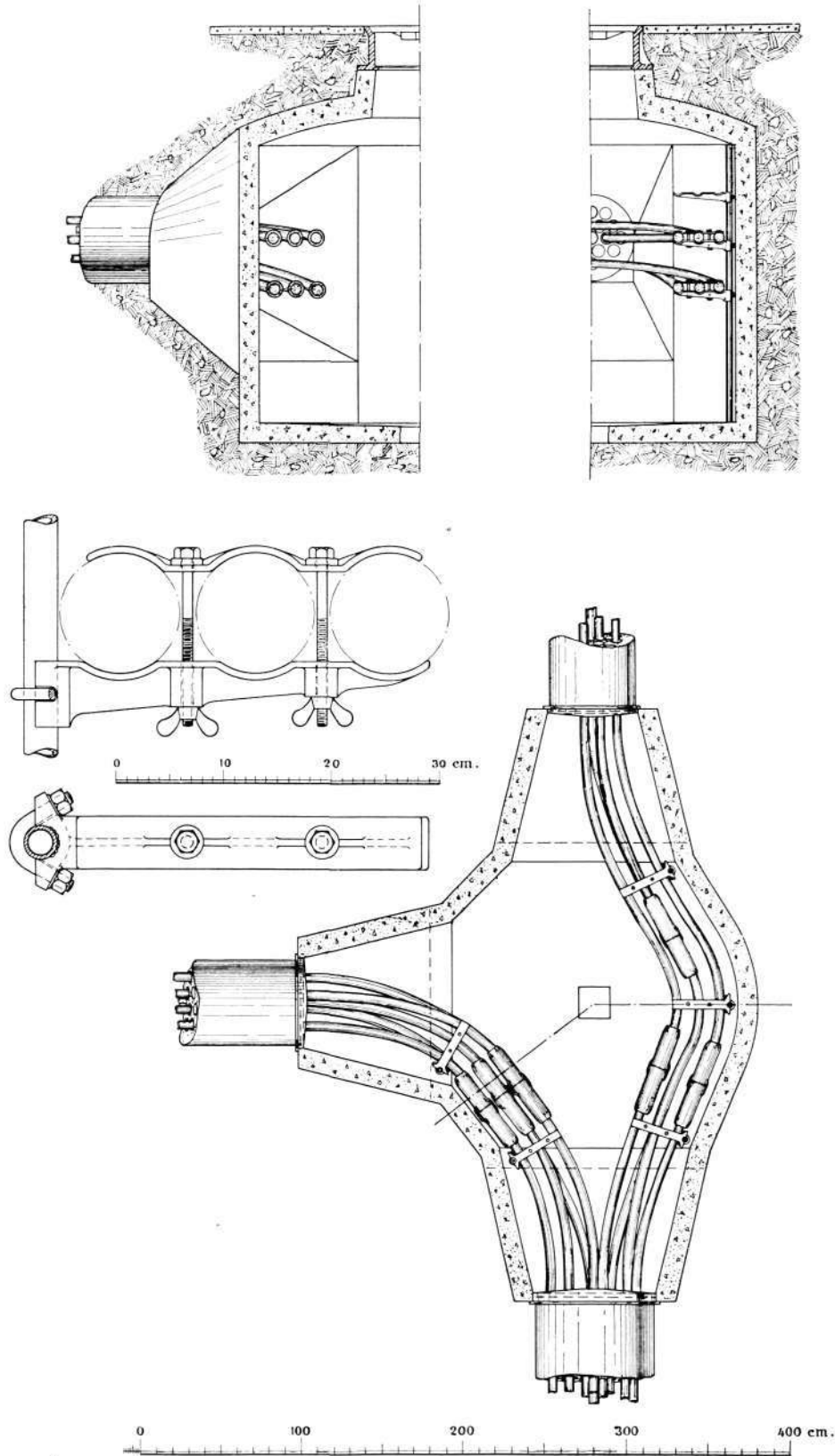
A thin coating of asphalt is applied to the walls of the ducts to make them perfectly smooth and reduce friction to a minimum, thus protecting the lead sheathing from abrasion when running the cables through the ducts. The asphalt also helps to make the conduits waterproof.

The main difference between this type of conduit and other types, however, is that the joints have a certain amount of elasticity. This is attained by filling the joints with a warm mixture of two parts asphalt and one part mastix, the ducts being temporarily plugged with hemp yarn to prevent the mixture from entering and filling them up.

Table of weights for cement conduits.

Number of ducts	1	2	3	4	7	19	37
Dia. of ducts in mm.s	100	100	90	90	90	6 @ 75 13 @ 90	6 @ 65 31 @ 90
Weight in kgs.....	38	50	55	70	130	260	465

Where possible, conduits should always be laid under the foot pavement or sidewalk and



at a depth of from $\frac{1}{2}$ to 1 metre, measured from the top of the conduit.

A manhole in which all cable splices and branchings to side streets are made is built at every street crossing. When the length of a city block exceeds 125 to 130 metres a manhole is usually placed in the middle of the block too, as it would otherwise be very difficult to run the heavier cables through the ducts.

The manholes are made entirely of concrete. A 1:5:7 mix is used for the floor and side walls, while the vaulted roof is reinforced and poured with a 1:3:3 mix. The manhole covers may be made of either reinforced concrete or cast iron.

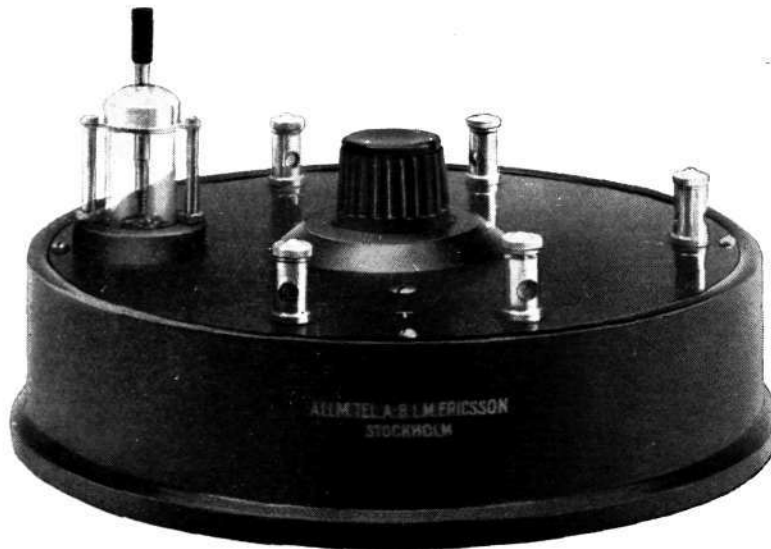
The duct openings in the manholes are provided with protective iron shields, these shields being furnished with hooks of malleable iron for holding the pulley through which the pulling rope is run. The shields also prevent the thin partition walls between the ducts from being broken through when running cables into the ducts.

The manholes are built in three standard sizes, one for 19 to 37-duct conduits, one for 7-duct conduits and one for 3 to 4-duct conduits. Fig. 6 plainly shows the construction of one of the largest size manholes. The method of supporting the cables on specially constructed cast iron brackets is also shown. For 1 to 2-duct conduits, the manholes are generally replaced by small so-called splice boxes.

The space around the cables at the duct openings is well sealed with oakum and so-called cable putty, thus protecting the lead covering from injury by the iron shields. The cable putty consists of 2 parts linseed oil, 1 part vaseline, 1 part paraffin and 1 part rosin; these ingredients are melted together, after which powdered chalk is stirred into the liquid mixture. The putty is to be slightly warmed before use. The sealing also prevents gas from entering the ducts, and the openings of all the empty ducts should be tightly sealed for this same reason.

B. K.

CRYSTAL RECEIVER

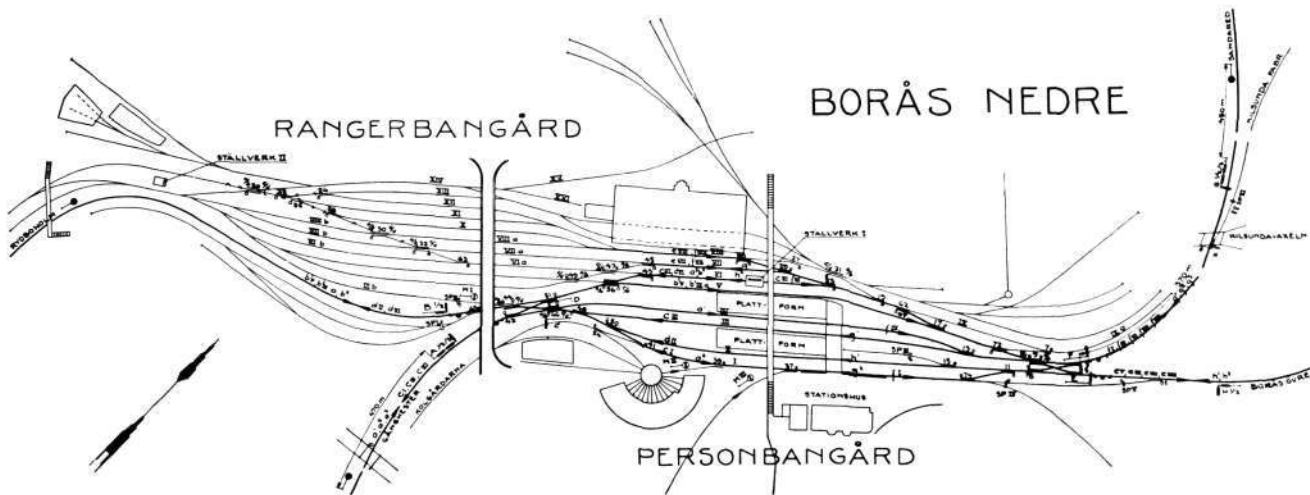


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28/—

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The Electric Interlocking Plant at the "Borås Lower" Station.

The city of Borås, in the Swedish province of Västergötland, has long been an important centre for the flourishing industries of the surrounding country. Three quarters of a century ago, when the small home industries or home slojd — as they are called in Sweden — were at their height, the roads were the only means of communication. Soon after, however, the larger industries began to make their appearance, and with them the railways.

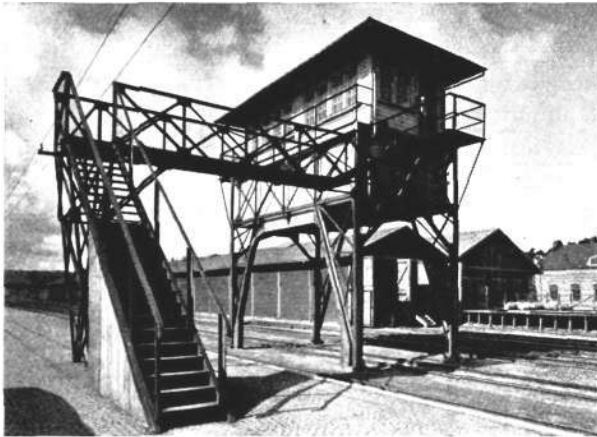
At the present time we find Borås furnished with excellent railway communications. To the North we have the Borås—Herrljunga Railway; to the West, Gothenburg is reached by means of the Göteborg—Borås Railway, while the Varberg—Borås Railway runs in a southwesterly direction to the city of Varberg. The most recent, but by no means the least important, is the Borås—Alvesta Railway, towards the southeast. All of these railways terminate in the Borås Lower Station, thus making it a very important multiple junction. Two years ago, the great increase in traffic necessitated the rebuilding and enlarging of this station. The passenger station was furnished with wide platforms between tracks

II and III and between tracks IV and V — see above track plan — and the shunting station was furnished with a double incline, thus simplifying the numerous switching operations occasioned by the interchanging of cars between the various railways.

The only satisfactory way of making efficient use of the station area and of handling incoming and outgoing traffic with perfect safety was by installing an interlocking plant, the choice lying between a mechanically or an electrically operated system. An electric plant was finally decided upon, after exhaustive investigations had proved this system to be the most suitable under the existing conditions.

Signalbolaget (The Signal Co.) was entrusted with the task of installing the plant, of which the electrical devices and cables were furnished by L. M. Ericsson, and the semaphores, skotch blocks and other mechanical details were furnished by the Avos Company of Örebro.

The plant comprises two interlocking machines, the one for the passenger station and the other for the double incline of the shunting station.



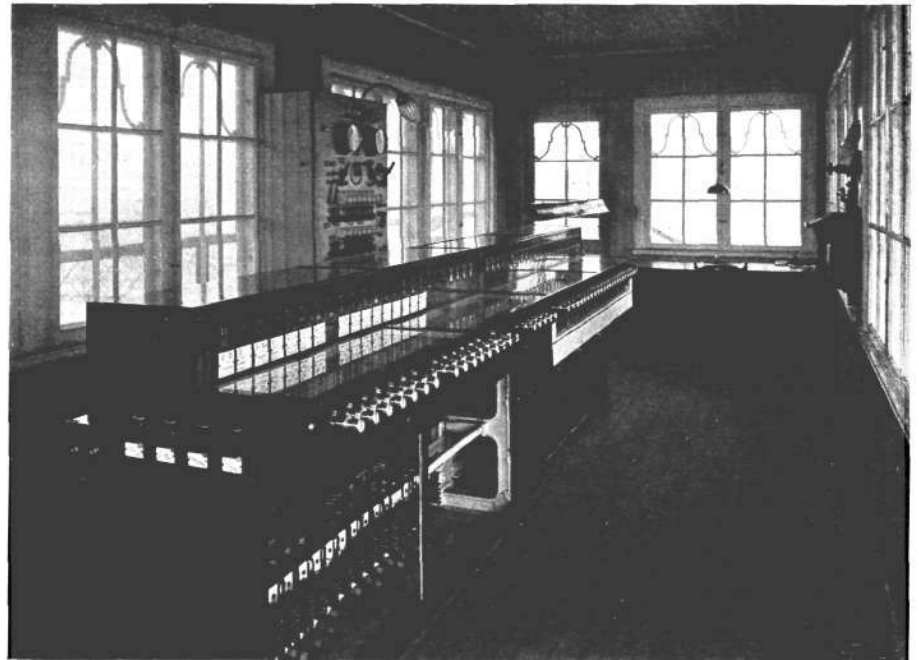
R 281

Fig. 1.

The Passenger Station.

On account of the restricted space, it was found necessary to place the signal tower for the passenger station on a structural steel construction bridging track VI, as shown in fig. 1. The interlocking machine, shown in fig. 2, is 3.9 m. in length and is furnished with 16 signal levers, 21 point and skotch block levers, 6 point locking levers, 1 lever with control lock, and 1 crossing gate lever. 8 incoming and outgoing signals, 3 shunt signals, 30 points, 2 skotch blocks and 1 pair of crossing gates are controlled by the aid of the interlocking machine, while 10 points and 3 skotch blocks are directly locked and 1 point and 1 skotch block are locked by means of the lever with control lock, also by the aid of the interlocking machine.

The number of track combinations is 25, distributed over tracks I to VIII; tracks I to V being for passenger trains and tracks VI to VIII for freight trains. All of the tracks are blocked from the office of the station master, in which 25 block field instruments are placed.



R 282

Fig. 2.

The station master gives the interlocking machine operator permission — by means of these block field instruments — to clear a certain track. The incoming or starting signals cannot be set from the interlocking machine without such permission having been given and not until all points released by the station master have been set.

The station master's office also contains track circuit locking with release for incoming trains. The circuit for an incoming track is automatically locked after the track is cleared and it is impossible to lay over any of the points in this track until the track circuit has been released by the station master after the train has arrived and has pulled up at the station.

Track circuit locking for outgoing tracks has also been arranged for. In this case, however, the track circuit is released by the outgoing train when its last axel passes a suitably placed insulated rail provided with a rail contact.

The incoming semaphores for two of the railways are three-armed ($A^{1/2/3}$ and $I^{1/2/3}$), and two-armed ($B^{1/2}$ and $H^{1/2}$) for the two others. Three of the incoming semaphores are furnished with distance signals. The starting semaphores

are one-armed, only one having been erected for each railway, i. e. semaphores *C* and *D* at the west end and *E* and *F* at the east end of the station. A great saving has thus been accomplished, as otherwise one semaphore would be required for each track from which a train starts, such a semaphore being two-armed for a track used by two railways. Any danger that a wrong outgoing track be cleared is entirely eliminated, however, as all tracks are blocked from the station master's office, as previously stated.

Those points which may be set from the interlocking machine are, generally speaking, such as are necessary for the clearing of the tracks; this latter can thus be conveniently accomplished from the signal tower. These points, however, may also be set locally, thus avoiding the necessity of constantly having a man stationed at the interlocking machine during switching operations. For this purpose, a system devised and patented by L. M. Ericsson's has come into use. The lever in the interlocking machine with which a certain point is controlled is furnished with a solenoid, this latter being connected to a pedal contact on the point in question. When the

point is to be set, the pedal contact is actuated. This brings the solenoid in circuit and actuates the lever in exactly the same manner as if done by hand. A diagram of this arrangement is given in fig. 3, the solenoids being visible under the axel contacts shown in fig. 4, which gives a rear view of the interlocking machine with panels removed.

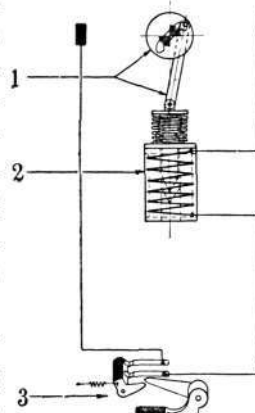


Fig. 3.

After a track has been cleared, the point lever is locked in position by means of the cross locking gear and the circuit between the solenoid and the pedal contact is broken, thus giving a two-fold safeguard against the local setting of a point.

A point with skotch-block in the incoming track from Sandared, situated about 700 metres from the signal tower and leading to a factory side-track, is locked by means of the lever with control lock in the interlocking machine. When a train is to be directed onto this side-track, a point lock key is detached from the interlocking machine and brought along on the train for the un-

locking of the point and skotch block leading to the side-track. When the train returns to the station, the point and skotch block are again locked, thereby releasing the key and leaving the point and skotch block locked in the correct position for through-traffic on the main track. The key is then returned to and inserted in the interlocking machine. As long as the key is removed from the interlocking machine, there is no possibility of setting signals to clear for incoming or outgoing trains to and from Sandared.

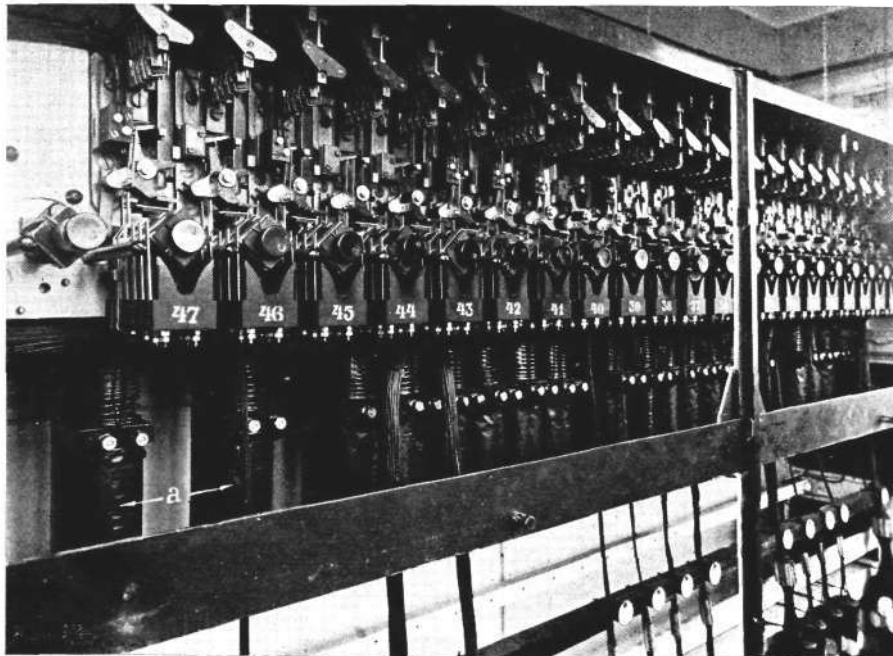
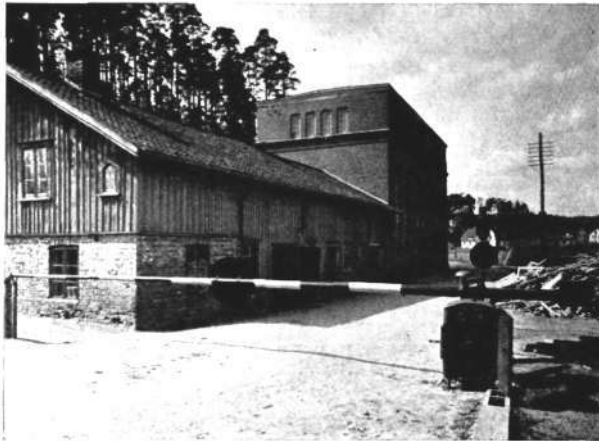


Fig. 4.



R 284

Fig. 5.



R 285

Fig. 6.

The crossing gates which are electrically controlled from the interlocking machine are placed at a grade crossing situated between the semaphore and the distance signal for the incoming track from Gånghester, about 600 metres from the interlocking machine. One of the gates with the electric driving mechanism is shown in fig. 5. The gates are constructed in accordance with the specifications contained in the Swedish statute-book, number 318, concerning warning signals and safety devices, etc. at grade railway crossings. The warning lanterns are furnished with electric lamps, control lamps being mounted in the interlocking machine. The lanterns are dark when the gates are up, but are put in circuit as soon as the gate lever in the interlocking machine is set for the lowering of the gates and the driving mechanism starts functioning.

The Shunting Station.

The interlocking machine for this station is of the smallest standard size — length 1.35 metres — and is placed in a low signal cabin, shown in fig. 6. It is mounted with 7 point levers for controlling the points in the double incline and two

locking levers for the locking of two points. Also, the interlocking machine is equipped with 2 co-operating levers for communication with the interlocking machine at the passenger station, as it is necessary to lock some of the points controlled by the shunting interlocking machine when admitting trains from the East over passenger tracks VI and VII.

The points of the double incline have also been arranged for local setting by means of pedal contacts, as previously described. This arrangement has been resorted to so as to permit switching over these points without having to use the double incline and its interlocking machine, which is to advantage under certain circumstances.

The points controlled by the interlocking machine have been equipped with arrangements for preventing a too early setting of the same. This is accomplished by means of a locking magnet on the lever combined with an insulated rail at the point in question.

The Power Plant.

The electric current required for the interlocking plant is supplied by three Nife storage batteries, each with a capa-



R 286

Fig. 7.

city of 34 amp. hours. During the same day, one of the batteries supplies current of 130 volts' tension for the motors at the points and signals, a second battery supplies a 30-volt current for the relays, control magnets, electromagnetic clutches for the signal driving mechanisms, etc., while the third battery is being re-charged. On the following day the batteries are switched about so that 30-volt current is taken from the battery which furnished a 130-volt current on the preceding day, the 30-volt battery is being re-char-

ged, while the freshly charged battery is used for supplying a 130-volt current. The batteries are thus switched about once every day, or oftener, if required. The batteries are charged from the public net — 220 V. A. C., 50 periods — by means of a transformer. The power plant is housed on a lower floor of the signal tower, the switch-board, however, being placed in the same room as the interlocking machine (see fig. 2).

E. G. W.

New Automatic Equipment for Stockholm and Gothenburg.

A contract for the furnishing and installation of equipment for a new full automatic telephone exchange in Stockholm has recently been signed between L. M. Ericsson and the Swedish Telegraph Administration. The order includes as well all necessary equipment for junction traffic with the existing manual exchanges. The new plant will be completely equipped for 20,000 lines from the very start, this number being the largest ever installed in any single full automatic exchange in Europe.

This exchange will include subscribers in the more central parts of the city, i. e. the oldest part of Stockholm — quaintly called »the city between the bridges» — and the lower »Norrholm», thus replacing the old exchange for manual distribution — located near the wharf — which, at the time of its construction, was the first of its kind.

»North Vasa», the first automatic exchange to be built in Stockholm, was put in operation in February 1924, at which time it had a capacity of 5000 lines. This exchange is now being extended, whereby its capacity will be increased to 10,000 lines.

According to a statement made by Mr. Lignell of the Royal Telegraph Office it is the intention of this department to gradually introduce machine switching over the whole city of Stockholm, and it is estimated that this city will be giving automatic service to all of its 110,000 subscribers by 1935.

Next in order will be the Kungsholm exchange, with 15,000 lines, and later on four more exchanges.

In a coming issue, »The L. M. Ericsson Review» will publish some descriptive information concerning these installations and the junction traffic with the manual exchanges.

The Telegraph Administration has also decided to introduce automatic switching in Gothenburg and has contracted with L. M. Ericsson for the delivery of the necessary equipment for an automatic exchange of 12,000 lines, constituting the first stage in this work. The order also includes all necessary equipment for junction traffic with the existing manual exchanges.

The traffic from the automatic to the manual exchanges will be handled by special B-positions with call indicators. Incoming junction traffic to the automatic exchange is arranged in two different ways, depending on whether the call originates at a common battery or a magneto exchange. For C. B. exchange calls, the service is handled over semi-automatic B-positions while the junction lines from magneto exchanges terminate in manual positions with multiples for the automatic lines.

The Gothenburg automatic plant is intended for 115,000 lines of which 80,000 will have 5-digit numbers and 35,000 6-digit numbers.

Secret Intercommunication System with Key Switching.

As has been pointed out in this journal (see article on Private Automatic Exchanges, Vol. II, Nos. 1 & 2) it is advantageous, under certain conditions, to use intercommunication telephone systems, one of the most important conditions being that the plant shall be restricted both as to the number and the length of the lines, i. e. the distance between the various telephones must not be too great. One advantage that this system possesses in common with the automatic systems is that it is always ready for use, even outside of office hours; in other words, it is independent of the service of an operator.

For plants where these conditions exist, the intercommunication system possesses decided advantages from a technical as well as economical point of view. ^{R 262}

Also, intercommunicating telephone sets have been manufactured and sold by the L. M. Ericsson works at Stockholm for quite a number of years, the various types — both secret and non-secret — being designed for the selection of a desired line by means of a rotary switch. These instruments are very extensively used by the Swedish Telegraph Administration for installations which are connected up to the public telephone net.

In many countries, however, a certain prediction has been found to exist for intercommunication sets with keys for the selection of a desired line, such a telephone instrument necessarily requiring as many keys as there are lines

in the system. For this reason, the L. M. Ericsson works in Holland have taken up the manufacture of such telephone instruments, the accompanying figure giving a view of one constructed for five internal lines and two exchange lines.

The seven keys on the sloping front panel are for the internal and exchange lines, the exchange lines being also equipped with lamps which denote if the line is busy. On the top of the instrument and to the right is a ringing key whereby the line which has been connected is called up, and to the left is a release key to be used when, during a standing call over an exchange line, one again wishes to connect up with the waiting exchange line after having made a temporary internal call.



The apparatus has been constructed with a view towards meeting the following requirements:

1. It shall be possible to make both internal and exchange calls from the same telephone instrument.
2. The telephone instrument shall be equally suited for use in connection with either a magneto, common battery or full automatic exchange.
3. Conversations shall be strictly secret, i. e. during a conversation over an internal and an exchange line, it shall be impossible to listen in over any other telephone instrument in the system.
4. After a call has been established over an

exchange line, it shall be possible to get in communication with another internal telephone without breaking the exchange connection.

5. When making a call, it shall be possible to remove the microtelephone from the cradle either before or after the manipulation of the keys.
6. If the desired line is idle, the line key shall remain depressed; otherwise it shall immediately return to its normal position.

It has been possible to obtain the above characteristics by the aid of keys provided with electromagnetic holding. The inside wiring of the instrument is such that the holding coils of the keys cannot be put in circuit unless the desired line is idle. For this purpose a relay with two windings is used which can energize and thereby connect up a line only when it is idle. This relay is constructed so that both its windings are connected in series before the connecting up of a line, whereas its armature is held by the winding with the lower resistance. It is therefore impossible for the relay of an engaged telephone instrument to energize when this telephone is called from some other instrument.

Private internal calls.

These are made in the following manner:

The key of the desired line is depressed. If the line is disengaged, the key will remain in its depressed position. If, on the other hand, the line is busy, the key will return to normal.

After having ascertained that the desired line is disengaged, a ringing signal is sent out to the called number by depressing the ringing key placed on the top of the instrument.

The removal of the microtelephone may take place either before or after the keys are actuated.

At the end of the conversation, the microtelephone is replaced on the cradle, thereby automatically causing the line key to return to its normal position.

When a conversation is ended, it is possible to make a new call immediately without first

having to replace the microtelephone; simply press the key of the desired line and the previously depressed line key will be automatically restored to normal.

When answering a call it is only necessary to remove the microtelephone, after which the conversation may immediately take place.

Calls over a public exchange line.

These are made in the following manner:

The key of the desired line is depressed. If this line is disengaged — which is ascertained by the fact that the key remains in its down position — and is connected up with a local battery exchange, this exchange can be called only by also actuating the ringing key. If, on the other hand, the public exchange is built according to the common battery system, the call is completed after the pressing down of the line key and the removal of the microtelephone.

The key of an engaged exchange line will return to normal after having been pressed down. A lamp which is located beside the key will start glowing as soon as the key is depressed, thereby denoting that the line is busy. This lamp ceases to glow when the key is released.

With a magneto system it is necessary, at the end of a conversation, to give a clearing signal by pressing down the ringing key before the microtelephone is replaced. With a common battery system, it is only necessary to replace the microtelephone, thus automatically releasing the line key.

During a central exchange call, it is possible to make a temporary connection with another internal telephone instrument without having to break the exchange connection. Such a connection is made by first pressing down the key of the desired internal line, after which the ringing key is actuated. Meanwhile, the called subscriber on the public net remains connected, but is blocked and unable to listen in on the internal conversation. When this latter is finished, the release key is depressed, thereby disconnecting the internal line and automatically reconnecting the waiting exchange subscriber.

Incoming exchange calls.

All incoming exchange calls are received by a certain predetermined apparatus, from which they are distributed to the respective internal telephones. The person who first receives the call, in turn calls up the wanted party who is then requested to depress the key for this exchange line. This key is held in its down position until the lamp, which glows simultaneously with the pressing down of the key, again ceases

to glow. The release key on the receiving instrument is then depressed, whereby the exchange line key on this instrument is released and returns to normal. In this manner it is possible to distribute incoming calls over any desired internal line.

Quite a number of incommunication telephone plants built according to this system are now in operation in Holland and are giving satisfactory service. *Ntz.*

News Items concerning Automatic Installations by L. M. Ericsson.

Angora, the new capital of Turkey, and situated on the plateau in the interior of Asia Minor, is now experiencing conditions of rapid development. The change from the position of a comparatively insignificant provincial town to that of the country's capital city has caused Angora to enter on a new phase. The importance attached to a city which is the seat of the government as well as the place of residence of the president has brought about a great advancement in every respect, modern means of communication occupying one of the foremost positions. The stately edifice of the new post office, for instance, — in which the new automatic telephone exchange will be housed — was opened to the public on June 1st.

On May 28th of this year, a contract was signed with L. M. Ericsson for the delivery of a full automatic telephone exchange for Angora with a capacity of 1000 subscribers' lines. It is estimated that this exchange will be in operation by May of next year, and provisions for a possible extension up to a capacity of 10,000 lines will be made.

The new outside plant which is now nearing completion consists of underground cables, nearest

the exchange. Further distribution is accomplished by means of aerial cables, with open wire construction in the more distant zones.

The contract for this work has been obtained through the offices of »The Swedish-Oriental Trading Company» of Constantinople, L. M. Ericsson's representatives in the Orient.

The previously ordered manual exchange, mention of which was made in Vol. I, Nos 11 & 12 of this journal, has not yet been put in operation and, by reason of this new order for an automatic exchange, will now be erected at some other place.

Information has recently been received from Rotterdam that the automatic exchange No. 2 has now been opened for traffic. The initial capacity of this exchange is 4000 lines, giving Rotterdam a present total of 9000 lines with full automatic service.

L. M. Ericsson has also received information from Parkview and Rosebank, suburbs of Johannesburg in South Africa, as well as from Verona, that their new automatic exchanges have been opened for the use of the public. *G. G.*

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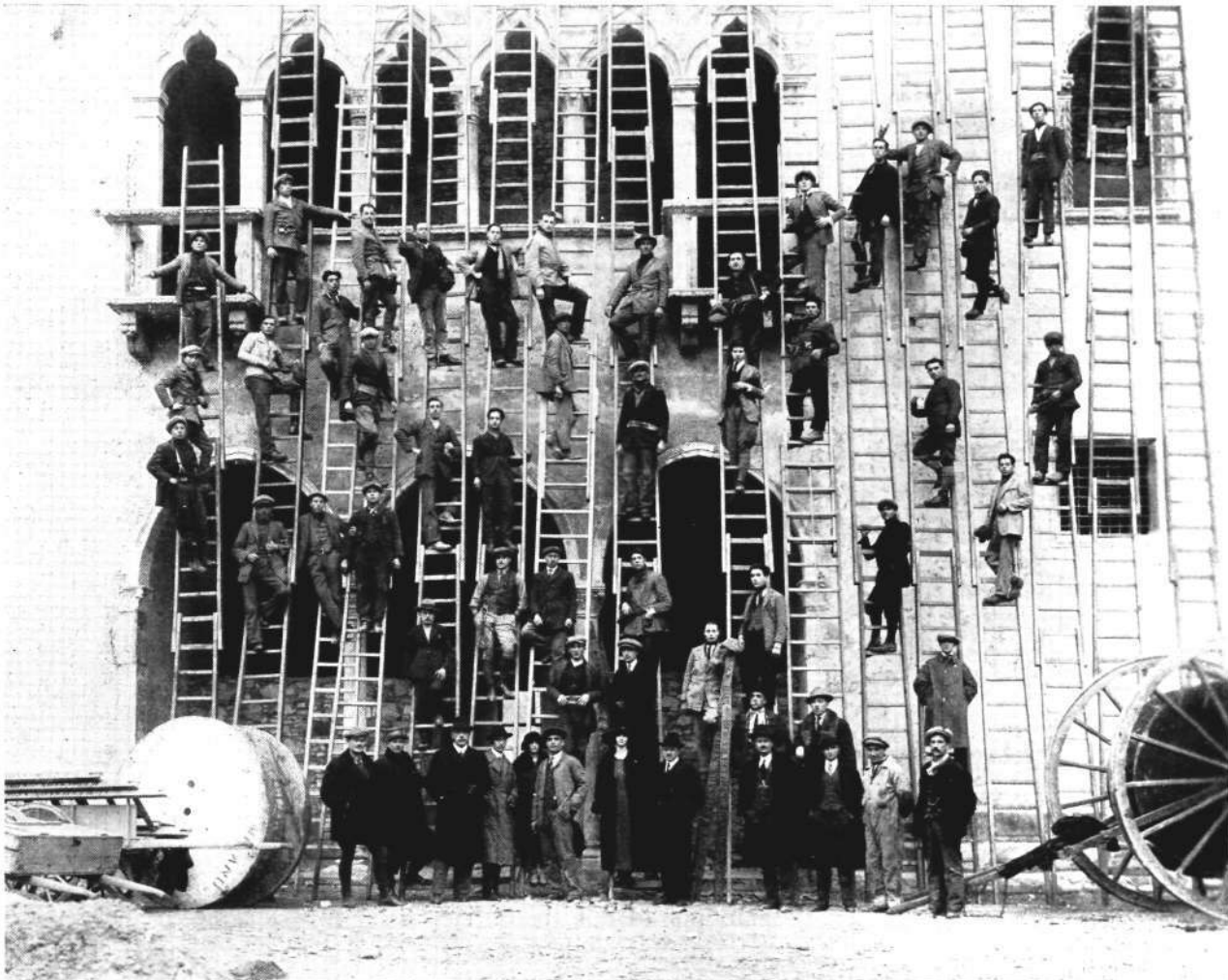
The L. M. Ericsson Review



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VERONA ERECTION FORCE WITH LADDER EQUIPMENT.

ENGLISH EDITION

THE L. M. ERICSSON REVIEW

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JOURNAL OF

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TORSTEN AF GEIJERSTAM, Editor.

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The Verona Telephone Plant.

As previously mentioned in this journal, the telephone plant installed by L. M. Ericsson in Verona has recently been opened for the use of the public. As this is the first plant in Italy — comprising both exchange and outside net — to be constructed according to the Ericsson system for cable distribution, we will here give a short description of the same.

The old historical city of Verona — situated on the Adige river at the foot of the lower Alps — has now a population of about ninety thousand inhabitants. The city has been forced to concentrate itself within the city walls, the erection of buildings outside of these walls having been forbidden until quite recently. Thus, the outside net is situated almost entirely within these walls, only three small distribution areas being located outside the same.

The exchange building is located in the centre of the city, just behind the old Roman amphitheatre.

The automatic exchange has been built for 1000 metallic circuit lines, but the outgoing lines from the main distributing frame number 1500. These lines, whose added length amounts to 1410 kilometres, are brought together in four main cables, three of which have a capacity of 400 pairs, and the fourth 300 pairs. These cables

are laid in cement conduits, manholes being placed at suitable points. The main cables branch out into ten 100-pair and ten 50-pair primary distribution cables. The usual method of splicing has been resorted to, the cable splices being located in the above mentioned manholes. The primary cables terminate in twenty jumpering cabinets, five of which can accommodate 300 lines and fifteen 100 lines, the total capacity on the exchange side being 3000 lines. The 1500 exchange lines are here distributed by means of 1900 lines — with a sum total of 617 kilometres — in the secondary cables which vary in size up to 100 pairs, to 185 distribution brackets with a capacity of 12 pairs of insulators and five 10-pair distribution boxes each. (See distribution diagram in fig. 1. This diagram is simplified as compared with the one shown in conjunction with the article on this subject in Nos. 1 & 2 of the current year).

The advantages of this system are apparent if we make a closer study of one of the cabinet areas, for instance that illustrated in fig. 2. Cabinet No. 8 is a 300-pair cabinet, to which at present are connected one 100-pair cable, one 50-pair cable, one 20-pair cable and one 10-pair cable, i. e. a total of 180 subscribers' lines. Thus

the area is cabled for 180 lines, while the capacity of the primary cable is only 100 lines. At some future date, when the number of subscribers within this area exceeds one hundred, additional main and primary cables must be laid to take care of this increase. The main and primary cables, therefore (which, on account of their length, are

one to follow a subscriber's line from the main distributing frame through the jumpering cabinet to the 10-pair distribution box and the insulator pair on the distribution bracket (these cards are also used as a trouble record). The second set of cards contains an index of all the terminals on both sides of each jumpering cabinet with

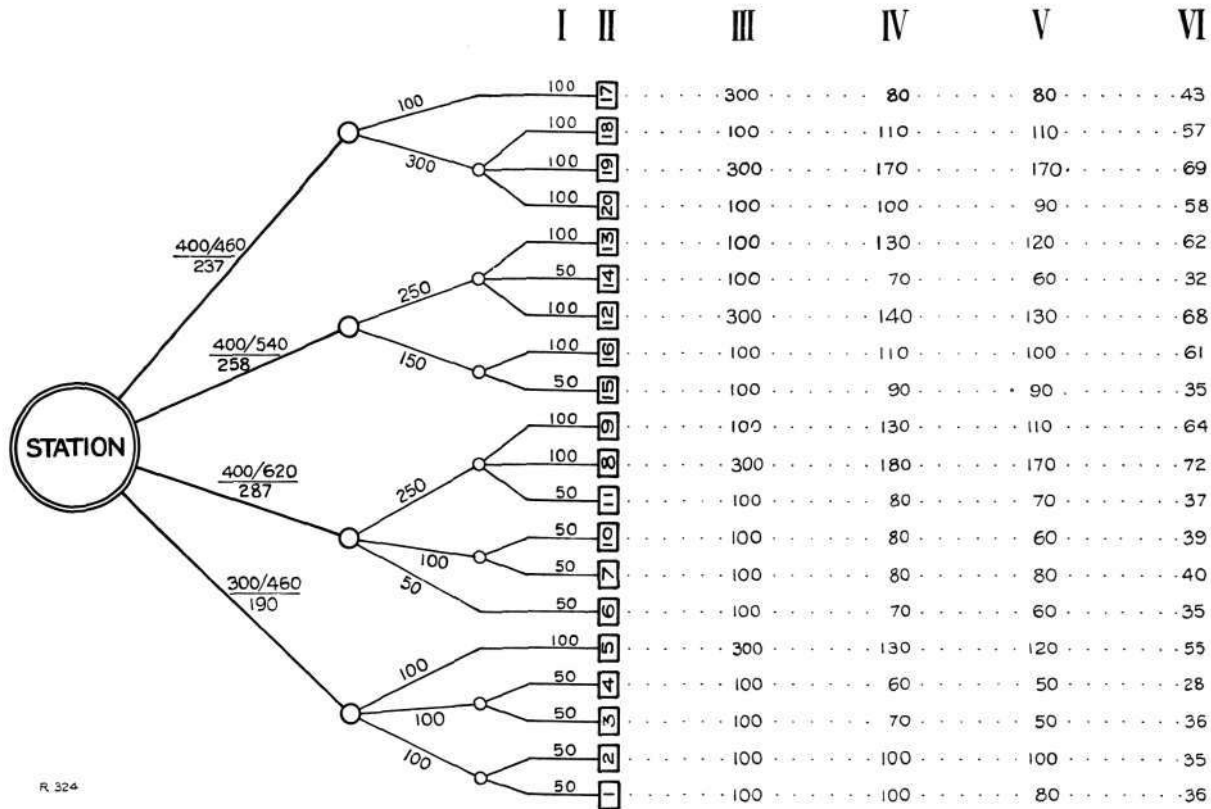


Fig. 1. Distribution Diagram for Verona.

Description of designations:

$\frac{400/460}{237}$ indicates that the main cable in question is a 400-pair cable and is connected up to a jumpering cabinet with a capacity of 460 lines on the subscribers' side, of which 237 are connected up to subscribers' instruments.

I. Main cables with branch splices.

- II. Jumpering cabinets with numbers.
- III. Capacity of jumpering cabinets on exchange side.
- IV. Present number of outgoing distribution lines.
- V. Number of lines mounted on distribution brackets.
- VI. Number of connected subscribers' lines in each cabinet area.

much more expensive than the secondary cables) are not laid until actually required, this work being made comparatively easy by the type of cement conduits used.

For the purpose of avoiding difficulty in identifying a subscriber's line when seeking faults or for making changes in the connections, a double card index is kept. The first set of cards enables

information as to which subscriber is connected up to each of the terminals.

The main cables are for the most part laid in 2-duct cement conduits whose total length amounts to approximately 1700 metres, with a total of twenty-two manholes. These latter are of a decidedly original design, as shown in fig. 3. They are built of curved cement blocks and

reinforced with vertical steel bars. The reinforcing bars are then bent together over the manhole and the top or roof of the same is poured in concrete. The manholes are 2 metres long by .9 metres wide, the entrance hole being covered by either a concrete or cast-iron cover. Sleeves for holding the cable supporting brackets are slipped over the reinforcing bars. These brackets are of an entirely new design, the cable being hung in a supporting loop which is rigidly fastened to the bracket bar, without any danger of deforming the cable.

The secondary cables are all aerial, and are placed along the house fronts under the eaves, as is customary in Italy, the buildings not being of a solid enough construction to bear the weight of roof standards. The messenger is supported on iron brackets fastened in the masonry, as shown in fig. 4. There are a couple of exceptions, however, the cables which cross the Adige being armoured and laid in the bridges, while some other cables have been laid in asphaltum filled troughs of wood.

The large 300-pair distribution and jumpering cabinets are placed on the street level over concrete wells. The city ordinance stipulates that they must not project more than ten centimetres beyond the building line, and this has necessitated the cutting of niches in the walls to receive the cabinets. The streets of Verona are very narrow and anything which may be a hindrance to traffic is not tolerated. The 100-pair distribution boxes are placed on the walls of the houses five metres above the street level. This is well illustrated in fig. 4.

Fig. 6 shows the construction of the distribution brackets, as well as the method adopted for

open wire distribution. The incoming 10-pair cable terminates in a 10-pair distribution box, the vulcanized wire connection being carried up through an iron pipe and under the U-section of the bracket, passing out through holes fitted with insulating bushes opposite the respective pairs of insulators. This construction provides the vulcanized wire with absolute protection against rain wherever it comes in direct contact with iron. The construction of the distribution box also permits 1-pair cables to be connected

up and run directly to subscribers' stations in the immediate neighbourhood. The open wire line, consisting of bronze wire 1.25 mm. in diameter, is carried along the house fronts on special insulator brackets for from one to four lines. On the last bracket nearest the subscriber a 1-pair terminal box is mounted to which the bronze wires are directly connected, a 1-pair cable leading from the box in to the subscriber's telephone, all intakes of either bronze or vulcanized wire thus being avoided.

Most of the outside erection work, as already mentioned, took place on

the walls of buildings, a large number of ladders being required for this purpose. A light and at the same time strong extension type was adopted, with which tops of five-story buildings could easily be reached. The illustration on the title page of this number shows the erection force and their ladder equipment in front of the old Castel Vecchio.

All outside cable has been furnished by Pirelli, the largest being for 400 pairs, as previously mentioned. The conductors are of copper and have a diameter of .6 mm., being wrapped with double layers of paper insulation. The lead

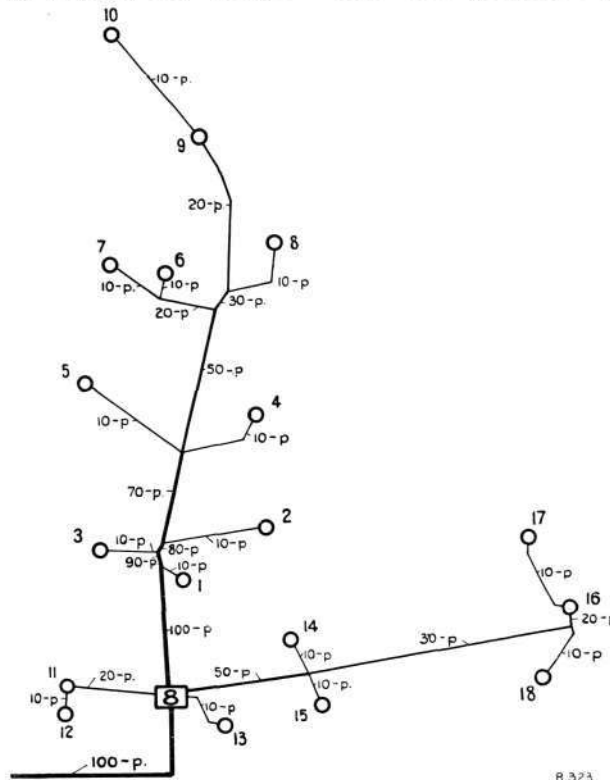
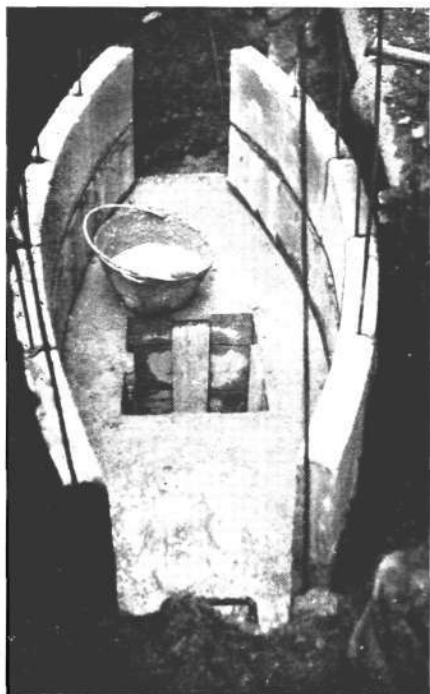


Fig. 2. Cable Distribution within a Cabinet Area.

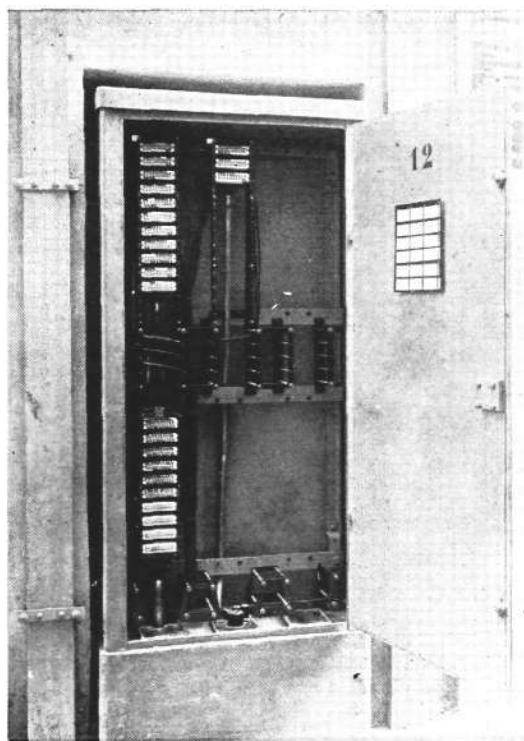
R 323



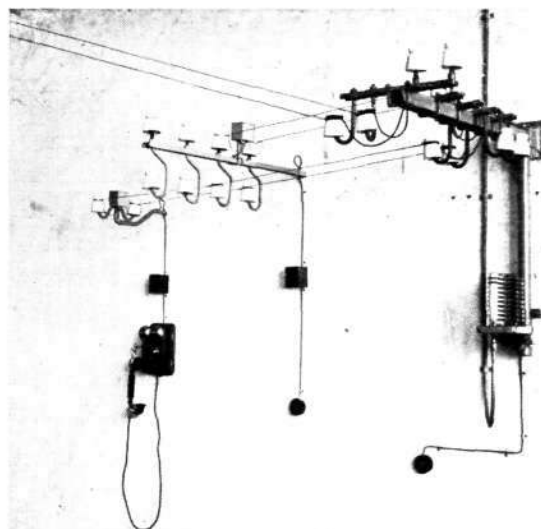
R 309 Fig. 3. Manhole under Construction.



R 310 Fig. 4. 100-pair Distribution Box mounted on Wall of Building.



R 308 Fig. 5. 300-pair Jumpering Cabinet.



R 312 Fig. 6. Transition from Cable to Open Wire Line.

sheathing of the main cables has been provided with ground connection at several points to avoid electrolysis of the same by light and power currents.

The one thousand lines of the exchange are arranged according to the ten thousand system, i. e. with first group selectors. The calculated number of required selectors, i. e. line finders and group selectors, is thirty-four per five hundred subscribers and the most recent traffic reports have proven this number to be adequate for the existing traffic conditions. According to these reports, the mean number of calls per subscriber and day is ten with a concentration of $\frac{1}{8}$ and conversations of two minutes' duration. This gives 1250 speaking minutes per five hundred subscribers, which, in turn and according to the method described in Nos. 5 & 6, Vol. I of this journal, gives a required number of selectors of thirty-four with a grade of service of 2 $\frac{0}{100}$.

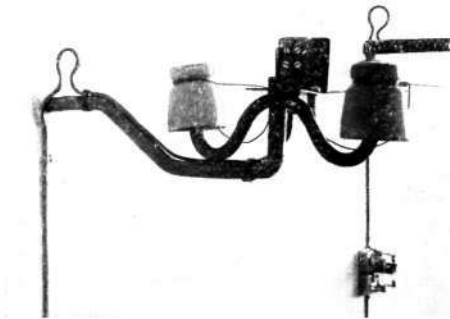
The racks are made to accomodate forty line finders corresponding to an increase from 1250 *Sm* to 1550 *Sm*, or of about 25 %.

Semi-automatic positions with push button keyboards have been provided for handling the traffic to and from the toll exchanges, the toll operator receiving information over an order wire as to which junction line shall be connected up for a given call.

There are still a number of local battery lines in Verona's immediate surroundings. These all terminate in a manual switchboard equipped with a calling dial enabling the operator to connect up the subscribers to any desired number on the automatic net. For outgoing calls, the automatic subscribers can reach this board by dialling a special one-digit number.

The exchange equipment, including a main distributing frame for 1000 lines but excluding a register control desk and the above mentioned manual board, covers a space of not more than 16 sq. metres, and could therefore easily be placed in a room measuring 6 by 5 metres.

E. A. E.



R 313 Fig. 7. Transition from Open Wire Line to Subscriber's Intake.

The Special Service Bureau for the "Rikstelefon" Exchanges in Stockholm.

Since June 1915 the Stockholm »Rikstelefon» exchanges (the Rikstelefon comprises only those exchanges originally built by the Government and not those purchased from private telephone companies) have been provided with a special bureau or office whose function it is to give subscribers various forms of service to which they ordinarily are not entitled.

The following different categories of commissions are executed by this special service bureau.

1. Reference,
2. Reference with notes,
3. Communications,
4. Wakening,
5. Time giving,
6. Supervision.

In the following we will give a detailed description of these various kinds of service. Since it is well known that reference service is usually given by the aid of pegs, we will commence by making clear the difference between reference service with pegs and reference service through the special service bureau.

Reference service with pegs.

Let us assume that a subscriber — Dr. X, for instance, with the telephone number 145 87 — is having dinner at the home of Dr. Y with telephone number 111, he can then, with the kind permission of his host, call up the telephone exchange and request reference service for number 145 87 to number 111. At the exchange, all of 145 87's multiple jacks are then fitted with reference pegs inscribed with the number 111, white galalite pegs being commonly used for this purpose. All calls to number 145 87 will then be connected to number 111 by the telephone operators. Upon his return home, Dr. X calls up the exchange over his own telephone instrument and informs the operator of his return,

after which the reference pegs are removed. It is not difficult to realize the advantage afforded Dr. X as well as the calling subscribers by this temporary reference service. The advantages are even more apparent if the reference service covers a more extended period, for instance if Dr. X has been away on a vacation instead of at a dinner. In such a case the pegs are not inscribed with the number 111 but with the letters Vf (= »vaktföreståndaren», or chief reference operator) or Nb (= »nummerbyrå», or number bureau). The operators connect all calls for No. 145 87 to the chief reference operator or to the number bureau who inform the calling party that Dr. X is on his vacation at such and such a place, and that his practice is being taken care of until August 1st by Dr. Y; telephone number 111. The subscriber must then disconnect and put in a new call for No. 111.

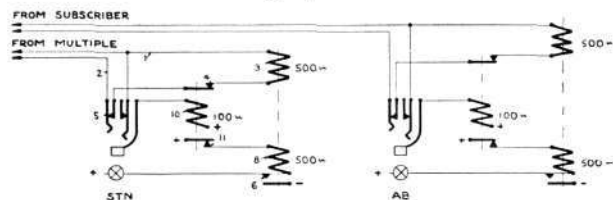
Reference service through the special service bureau.

The reference service with pegs did not necessitate any changes whatever in the arrangement of the lines for number 145 78, but the pegs prevented the operators from connecting any calls to this number at the same time as the inscription on the pegs reminded them to connect up the incoming calls to number 111, Vf or Nb. At a small exchange, reference service can very well be arranged with pegs; it becomes troublesome, however, if there is a large number of multiples as, for instance, at the Stockholm Central exchange where some numbers are multiplied 74 times. At such an exchange, therefore, instead of resorting to pegs the line is connected up with a special service bureau whose operators keep the line under supervision by means of extra signal arrangements, i. e. they keep their attention on and answer incoming as well as outgoing signals to and from this telephone in-

Exchange	Location	Number series	Number of Subscribers March 1, 1925	System
Central	Skeppsbron 2	0—17999	11171	Local bat.
Combined jack & indic. exch.	» »	20100—24999	2593	» »
C. B. North	Jakobsbergsgatan 24	30100—35099	2278	Com. bat.
Oestermalm	Karlaplan 2	70100—79899	5916	» »
North Vasa	Norrtullsgatan 47	80000—84999	3055	Automatic
Name-call exchange	Skeppsbron 2	Name call	1250	Local bat.
Total	—	—	26263	—

Note: There is a second special service bureau at the North exchange (Malmskillnadsgatan 30), especially for the use of the exchanges purchased by the Government from The Stockholm Telephone Co.

strument. This special service bureau is equipped for giving subscribers a number of different kinds of service besides »reference», of which mention will be made further on. The connections for reference service are made in the terminal strip. Normally, the outside line is here connected directly to the exchange line. A connection for obtaining special service means the



R 297 Fig. 1. Diagram showing Connection of L. B. Subscriber to Special Service Bureau.

breaking of the normal connection, the outside and the exchange lines instead being connected up with extra call indicators at the special service bureau.

The special service bureau and its scope.

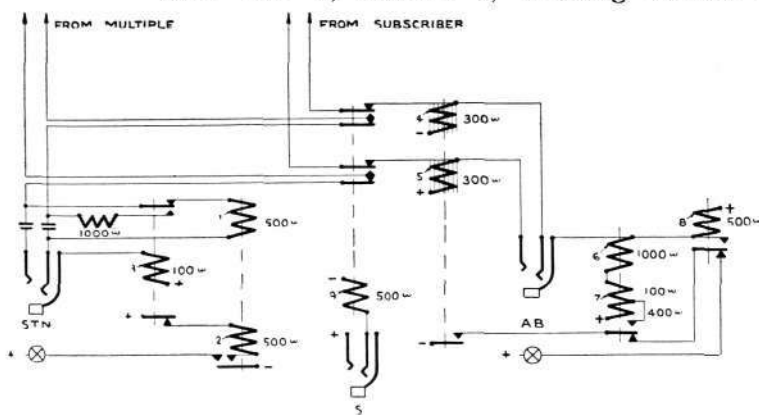
The bureau in question is open both day and night. It is located in a department of the Central exchange and gives service to all the Stockholm exchanges built by the Government. The above table shows the multiple capacity and number of subscribers at each of these exchanges.

Connection between local battery subscriber's line and the special service bureau.

The principle for a such a connection

is shown in the diagram in fig. 1. Both of the extra arrangements for signalling incoming calls are composed of a two-coil relay with supervisory lamp and answering jack. The left-hand arrangement is connected directly to the subscriber's line in the exchange multiple and is intended for receiving calls from the exchange, i. e. to the subscriber in question. The supervisory lamp and the jack over *STN* are called exchange lamp and exchange jack respectively. The right-hand arrangement is connected to the outside line and is for receiving calls from the subscriber. The supervisory lamp and the jack over *AB* are called subscriber's lamp and subscriber's jack respectively. As may readily be understood, signals on the exchange lamp are much more frequent than on the subscriber's lamp.

When a magneto signal is sent out from the exchange (call to the subscriber) a circuit is closed over line 1, call-coil 3, breaking contact 4,



R 296 Fig. 2. Diagram showing Connection of C. B. Subscriber to Special Service Bureau.

breaking contact 5 in the exchange jack and out over line 2. The relay energizes, closing a circuit over contact 6, the holding coil 8 and the breaking contact 11. A branch circuit over the exchange lamp is also closed, causing the same to glow. The operator plugs in the answering cord in the exchange jack, thus bringing her headgear receiver and transmitter in circuit. The third point of the answering plug is connected to negative, closing a circuit through the cut-off relay 10 over the test spring of the exchange jack. The

2. A magneto signal from the exchange is handled by the relay 1, 2 and 3 in the same way as for local battery subscribers. There is a C. B.-subscriber's relay (4 to 8) for calls from the subscriber. When the subscriber (manual or automatic) removes his micro-telephone, the subscriber's lamp (under *AB*) glows. The same circuits as with the usual C. B.-system are formed when the subscriber calls as well as when the operator plugs in the answering cord.

The insertion of a plug (either answering or

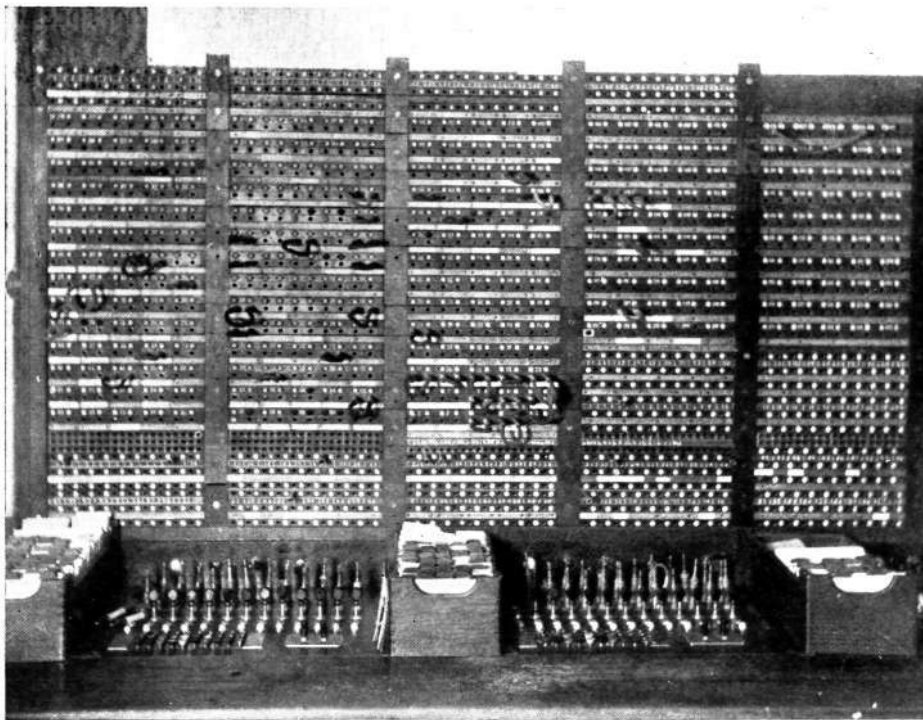


Fig. 3. Part of Special Service Switchboard.

cut-off relay energizes, breaking the circuit at 11 and at 4. Contact 11 breaks the circuit through the holding coil 8 and the lamp ceases to glow, while contact *A* cuts off the call-coil 3 from the circuit branch 2. In addition, the insertion of the plug breaks contact 5.

The subscriber's magneto signal is carried over the relay and the subscriber's lamp in a similar manner.

Connection between a common battery subscriber's line and the special service bureau.

A diagram of this connection is shown in fig.

ringing) in the exchange jack causes the usual incoming lamp at the exchange to glow. The circuit is closed over an induction resistance (D. C.-resistance = 1000 ohms) which bridges the gap between the *a* and *b* branches, the position of the combined speaking and ringing key being of no consequence in this case.

In addition to exchange and subscriber's relays, there is a combining relay 9 (see fig. 2). This relay energizes when a contact plug is inserted in the jack *S*, whereby the subscriber's connection runs straight through at the special service

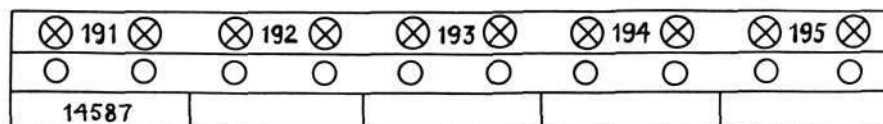
bureau in the same manner as when an L. B.-subscriber's jack is connected to the exchange jack by means of a 3-conductor cord. Relay 9 can be placed either at the exchange or at the special service bureau.

When a C. B.-subscriber is connected to the special service bureau for reference or reference with notes service, his telephone instrument is cut off from its regular common battery, as shown in fig. 2. Instead, current is fed to the subscriber's transmitter from the special service bureau battery, the regular common battery still being connected to the exchange line.

There are also two speaking lines for each exchange.

Each position is furnished with three speaking-line selectors. The operator connects up with an idle B-operator (there are two possibilities) by depressing the button of a certain speaking key. If the speaking key to Norra Vasa is depressed, an unoccupied junction line is also selected. The junction lines to the fourteen exchanges are to be found at the bottom of the vertical board, two for each exchange (four for Norra Vasa). Both junction lines to one exchange terminate at the special service bureau

L. B.



C. B.

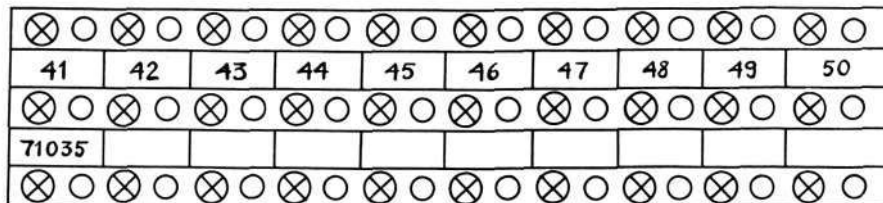


Fig. 4 (Scale 1:2). Grouping of Lamps and Jacks on Switchboard.

The special service switchboard.

This switchboard has six panels and four positions (see fig. 3). The illustration does not show more than five panels and two positions, however. During the busiest summer period all four positions are used, while in winter not more than three are required to handle this special service.

Each position is equipped with twelve pairs of cords, twelve combined speaking and ringing keys, twelve supervisory clearing lamps and twelve listening buttons which, aside from their ordinary function, serve to break the supervisory lamp circuits. In addition, there are two dividing keys (one for speaking and one for ringing), one sound amplifier key and a strip with speaking keys to all the existing exchanges. The speaking key strip is furnished with fourteen keys, each one corresponding to a certain exchange.

in jacks marked *A* and *B* respectively, and at the exchange in similarly marked plugs. All the jacks together form the multiple of the special service bureau. This multiple is not multiplied.

A large field with lamps, jacks and designations for the trunk lines to the terminal strips is located above the junction multiple. Lamps, jacks and designations for five local battery and ten common battery subscribers are mounted as shown in fig. 4. For the local battery lines, the topmost strip contains incoming supervisory lamps and permanent designations for the trunk lines to the terminal strip; the jacks are mounted on the intermediate strip, while the lower strip contains the designations for the subscriber's lines. When a subscriber is connected to the special service bureau for reference service his number is lettered on a piece of paper which

is then slipped into the designation strip. According to the illustration, subscriber number 14587 is connected up to the special service bureau, trunk line number 191 having been reserved for this purpose. The subscriber's lamp is to the left and the exchange lamp to the right of 191, while the corresponding jacks are situated under their respective lamps. For common battery lines, the topmost strip contains alternate lamps and jacks, these lamps not being used. The jacks are used for short-circuiting the subscriber's line. The second strip contains the permanent trunk line designations, the third strip alternate subscribers' lamps and jacks, the fourth strip temporary designations for subscribers' lines

part thereof: 1 Swed. crown, b) subscription for at least ten consecutive days at the rate of 10 Swed. crowns per month, no subscription being given for less than 10 Swed. crowns, however.

2. Reference service with notes. The bureau gives the references and information as stated above and also makes a note of the calling subscriber's number (or name) and of some short communication he eventually may wish to give. The bureau keeps these notes on file until called for by the subscriber for whom they are intended. Rates: a) for whole day or part thereof: 1.50 Swed. crowns, b) for a period of at least fifteen consecutive days at

Best d. 28/6	Nr. 14587
1924 kl. 18	Namn <i>Dr. Z.</i>
Sign <i>Gai</i>	Uppdrag: Hänvisning Telefonvakt
Börj d. 1/7	<i>Bordrest, vistas i Nolle.</i>
kl. 8	
Sign <i>Gai/Em</i>	<i>Vikarie till 1/8 Dr. Z.</i>
Slut d. 3/7	<i>telefon !!!</i>
1924 kl. 8	
Sign <i>Gai/Em</i>	
<small>Sthlms Tfnstn form. 3.</small>	<small>Rydheims tr., Huskvarna. 1923 22,000.</small>

R 288 Fig. 5. Order Card (size 84×124 mm.).

Ink.	Från 14587	Tidsb.	ll. m. m.
Förmedlingsbyrån			
Hänvisning			
Telefonvakt			
d. 1/7 - 31/7 1924			
Exp av	Dag	Per.	Kr. öre
<i>Gai</i>	<i>31/7</i>	—	<i>10</i> —

R 289 Fig. 6. Specification Card for Charges (size 52×76 mm.).

and the fifth or lower strip alternate exchange lamps and jacks. In fig. 4, subscriber number 71035 is connected up to the special service bureau by means of trunk line number 41. The subscriber's lamp and jack are the ones above 71035, the exchange lamp and jack being located below 71035. The jack immediately above the subscriber's jack is for short-circuiting purposes.

Types of service furnished by the bureau and rates for the same.

1. Reference service. The bureau refers calling subscribers to another number, or gives information as to the called subscriber's absence, when his return is expected, his temporary address, etc. The bureau does not make any note of the calling subscriber's number or business. Rates: a) for one whole day or

the rate of 20 Swed. crowns per month, no subscription under 20 crowns, however.

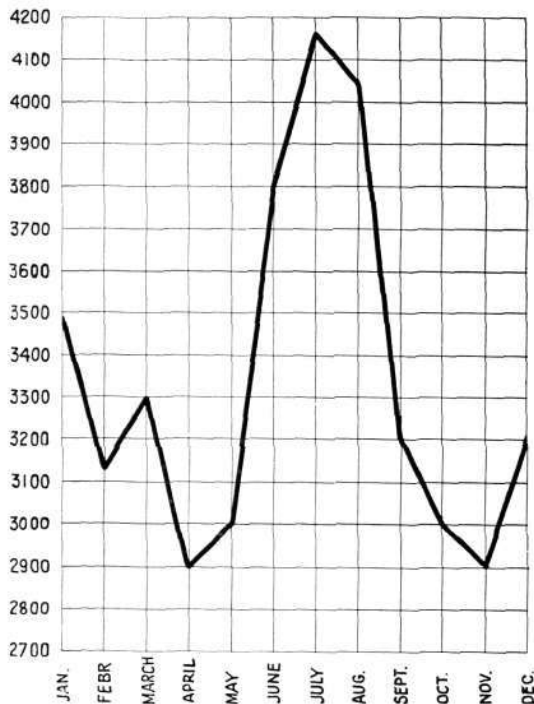
3. Communications. The bureau writes down communications of max. twenty words to be given certain calling parties. Rates: 0.50 Swed. crowns per communication, to be paid by the party giving the same. There is no charge, however, if the last mentioned party is connected up for service of the types mentioned under 1. or 2., nor if the party for whom the communication is intended is connected up for reference service with notes.
4. Wakening. The special service bureau calls up a given party at any desired time (the service is considered to have been given when the party answers) for a charge of 0.20 Swed. crowns for each call.
5. Time. On request, the bureau gives infor-

mation as to the correct standard time, for which a charge of 0.10 Swed. crowns is made for each time.

6. Supervision. Subscribers with exceptionally heavy traffic can be connected up to a special position where the operator answers and takes an order for a new call as soon as the clearing signal of the previous call has been given. Rates: 0.95 Swed. crowns per hour.

Giving of commissions.

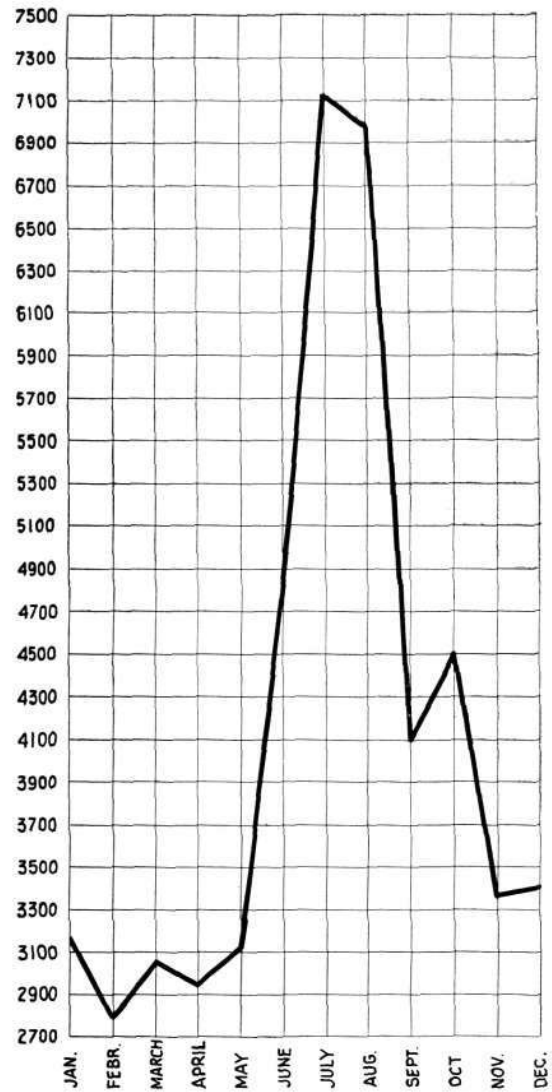
Commissions may be given and cancelled by calling the superintendent of the special service bureau. The subscriber puts in a »name-call» for this bureau and can give his commissions over the phone. If special service is wanted for a period exceeding seven consecutive days, a



R 291 Fig. 7. Number of Commissions handled during 1924.

written confirmation of the order is required. Experience has shown this to be necessary. All necessary information for executing the commission is written down on an order card by the superintendent. The order card is then fastened to the front of a leader card by means of a wire clip. The leader cards are made of thin fiber, each one having at the top the

number of a certain trunk line to the terminal strip. A glance at figures 4 and 5 will tell us that the order card in question evidently shall be placed in front of leader card no. 191. The leader cards are then arranged in order in



R 290 Fig. 8. Fees in Swed. crowns charged during 1924.

files and placed where they may easily be reached by the operators (see fig. 3).

Switching process.

The switching process is similar to that for a common pair-cord circuit. As an example, we will take a case of simple reference service for one month, i. e. the service subscribed to by

Dr. X during his vacation. At an incoming signal on the exchange lamp to number 145 87 (see fig. 4), the operator plugs up in the exchange jack and answers »145 87 reference; one moment, please». Having already observed — when plugging up the cord in the exchange jack — that the number of the trunk line is 191, the operator looks up leader card number 191 with the attached order card (see fig. 5) and gives the information »Dr. X out of town, staying in Mölle. Substitute until August 1st: Dr. Y, telephone number 1 11». As a rule, the calling party must put in a new call for number 1 11, but it is possible — when traffic is light — for the operator to make the necessary connections and relieve the calling party of this trouble. For this purpose, the operator depresses the speaking key for the desired exchange and says to the answering B-operator: »Special service 1 11», to which the B-operator replies: »A clear». The operator then inserts the calling plug into the corresponding A jack in the junction multiple and gives a ringing signal.

Lastly, we will describe a simple case of »reference with notes» service and also a slightly more complicated case of reference service.

Let us return to the case mentioned in the beginning of this article, where Dr. X is having dinner at the home of Dr. Y. We will assume that Dr. X does not wish to trouble his host with his telephone calls, or at least none but the most urgent, for instance from the hospital. In the first case, Dr. X puts in an order for »reference with notes» service. On his return, he calls up the bureau (the call comes in on the subscriber's lamp) and is informed as to which parties have called him up. For this type of service — where the bureau must make a note of the calling party's number and, eventually, his message — Dr. X is charged 1.50 Swed. crowns. In the latter case, the incoming calls are sorted, the hospital calls being connected up or referred to number 1 11, while the balance are given information according to Dr. X's orders, for instance: »Dr. X not at home, will return at 9 p. m.» This last commission does not require any annotations and comes under the heading

»reference service», for which a charge of 1 Swed. crown is made. This possibility of sorting out calls is often invaluable. For instance, if a subscriber with the number North 145 87 has advertised a flat for rent, but has forgotten to include the word »North» in the advertisement, the result will be that Dr. X receives any number of calls intended for North 145 87. On request, 145 87 is then connected to the special service bureau, where the calls are sorted for the regular »reference service» fee. Calls for Dr. X are connected up by ringing over the subscriber's jack, while other calls are referred to number North 145 87.

Charges.

The charges are computed by the chief operator when the commission has been carried out or, in the case of a continuous subscription, at the end of each month. A detailed specification of the charges is then handed over to the subscriber together with his regular telephone bill.

Comprehensiveness of the work.

The graph in fig. 7 shows the number of orders executed during the various months of 1924. The mean number per month was 3341, distributed as follows:

Reference.....	420	per month
Reference with notes	476	» »
Communications.....	4	» »
Wakenings	1,315	» »
Time giving	1,100	» »
Supervision	26	» »

The graph in fig. 8 shows the amounts charged during these same months. The mean monthly total amounted to 4103 Swed. crowns. The special service was heaviest during the months of July, August and June in the order named, without a doubt occasioned by vacation trips.

Note. A comparison of the curves in figures 7 and 8 shows a fall in the former and a rise in the latter from September to October. This is explained by the fact that the number of wakenings at 0.20 Swed. crowns each was greater in September than in October.

K. A. T. Gunnarson.

1st Controller, Royal Swedish Telegraph Dept.

The L. M. Ericsson Fire-Alarm System.

When contemplating the choice of a fire-alarm system, it is necessary for a community to take into consideration a number of local conditions, such as the size of the community, types of buildings, existence of exceptionally inflammable buildings or stores, the organisation of the fire-department, etc.

In communities where the fire risk may be considered about normal, public alarm boxes should be so located that the distance from any point in the community to the nearest alarm box does not exceed 250 meters. In thickly populated communities, or where inflammable plants are located, the alarm boxes should be even more closely placed.

The organisation of the fire-department is a matter of utmost importance for the choice of an alarm system, since it determines the manner of alarming and calling together the firemen. With respect to this matter the new Swedish statutes for fire prevention classify the fire-departments as follows: —

- a. *General fire-brigade.* This corresponds to the compulsory fire-brigade service. The engine-house has no one in permanent attendance, the members of the fire-department being called together by means of suitable signals at the outbreak of a fire.
- b. *Citizens fire-brigade.* The engine-house is generally under the constant supervision of fire-guards whose duty it is to call together the members of the fire-brigade and to make the necessary preparations for answering the alarm. The firemen are citizens in the community and are paid for their services, being required to take part in fire drills and to assist in extinguishing fires.
- c) *Professional fire-department.* The fire station is under constant supervision. The firemen

are permanently employed and have their quarters in the station building.

In many cities the fire-alarm system is also used by the police. In this case the alarm boxes contain a telephone instrument, enabling the policemen on duty — who have keys for opening the alarm boxes — to quickly get in touch with the fire-station or police headquarters. This is of great value for calling an ambulance in case of street accidents, for communicating with the police station, etc.

A modern fire-alarm system must meet the following requirements:

1. All lines and apparatus must be under constant control so that any trouble which arises may immediately be registered at the station, the most efficient method being by means of so-called *rest-circuit control*;
2. The signals transmitted by the alarm boxes shall be distinct and easily understood;
3. The manner of sending in an alarm shall be the most simple imaginable;
4. The system shall possess the greatest possible factor of safety for the correct reception of alarm signals even during the existence of various line faults;
5. In large systems where there is a possibility of several alarms being given simultaneously, these signals shall not interfere with each other;
6. All instruments and apparatus shall be well protected against atmospheric disturbances (lightning) and against high tension currents;
7. The system shall be easily manipulated and the apparatus for receiving alarms so arranged as to preclude all possibility of manual interference causing the incorrect reception of such alarms;
8. The batteries used for the alarm system

must never be used for any other purpose. The use of electric light current is to be avoided, if possible;

9. Due consideration must be given the question of maintenance.

A small and inexpensive plant suitable for a small rural community naturally need not meet all the enumerated requirements. For instance, the smaller a community, the smaller is the risk of several alarms being simultaneously given. One quality which the system at all costs must possess, however, is reliability.

It is now quite a number of years since the Ericsson company took up the problem of constructing fully reliable fire-alarm systems suitable for all categories of fire-fighting organizations and all sorts of local conditions. In this and following numbers of the »Review» descriptions will be given of the systems now most generally used.

FIRE-ALARM SYSTEM WITH RINGING GENERATOR.

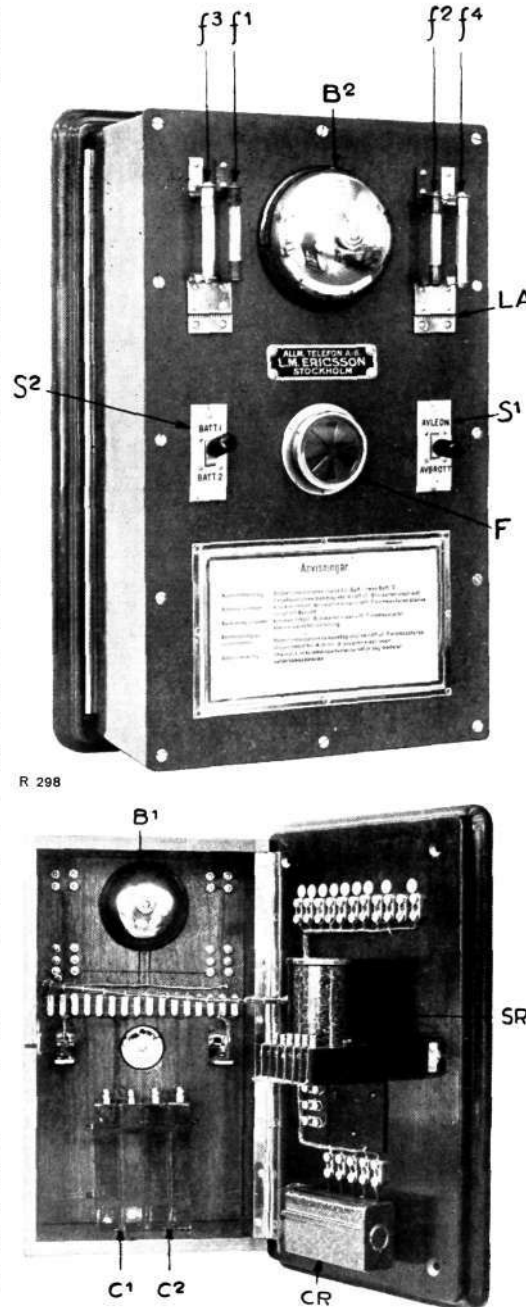
This system is especially designed for industrial plants and small communities. Fire-alarm boxes are set up at all points from which it may be desirable to turn in an alarm and alarm bells are placed at all points where the alarm is to be heard, i. e. in the homes of the members of the fire-department and of other persons whose presence is required. The alarm boxes and bells are connected in series on the

same circuit, consisting of one or more loops, the ends of which are connected up to an alarm board mounted in the home of the fire-chief or of some other member of the fire-department.

From five to ten alarm boxes and from twenty-five to thirty alarm bells can be mounted in each circuit loop.

The alarm box consists of a ringing generator enclosed in a cast-iron casing with door and glass window. The middle point of the generator winding is permanently grounded. An alarm is given by turning the generator handle which automatically springs out in position when the glass window is broken. The alarm box can be either with or without code signals. In the latter case the alarm consists of an uninterrupted ringing signal, while in the former case a series of long and short signals are transmitted corresponding to the code-number of the box from which the alarm is sent. This code signal is repeated several times during the sending of the alarm. The alarm boxes are constructed so that normally (i. e. when not in use) the generator with its earth connection is completely disconnected from the loop and the line terminals in the box are shorted. This protects the generator from the deleterious effects of unintentional contact with high-tension lines and of atmospheric disturbances.

The turning of the generator handle causes the generator winding to be automatically con-



R 299 Fig. 1. Alarm Board for Magneto System.
The board is intended for one loop with from five to ten alarm boxes and from twenty-five to thirty alarm bells.

ected up in series with the loop, causing the latter to be grounded through the generator. After the alarm has been given, the generator and its ground connection are automatically disconnected from the loop. The alarm bells ring as long as the generator handle is turned, giving either one long uninterrupted signal or several repetitions of the code-signal of the alarm box being used.

When the system is at rest, the loop with its alarm bells is closed over contact devices in the alarm boxes, a control or so-called rest-circuit passing over the same. This arrangement is called rest-circuit control. The alarm board automatically shows if the rest-circuit is passing through the loop with its bells, alarm boxes and station relays. This provides control over certain faulty conditions — such as broken lines, etc. — which may arise.

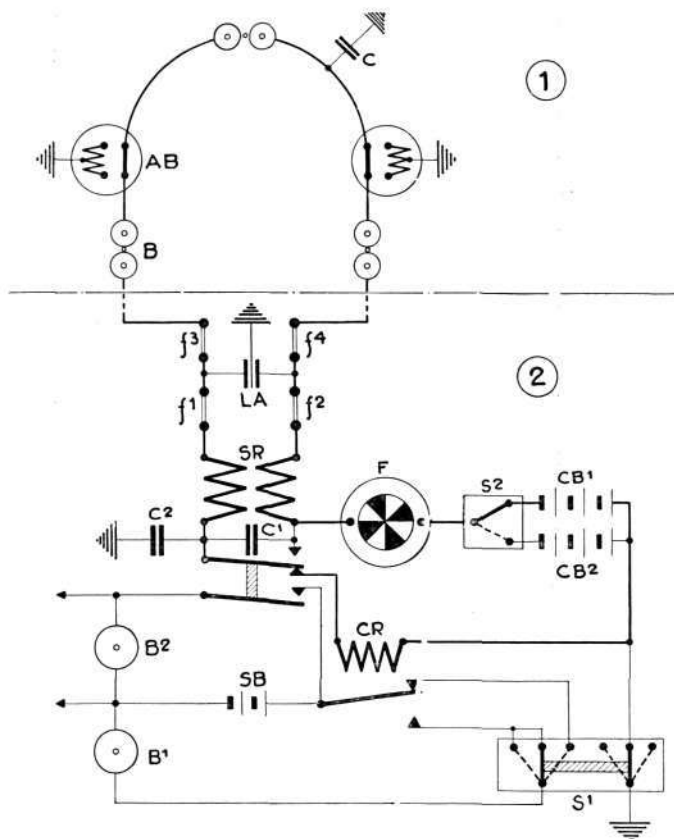
At certain points in the loop, condensers are connected up in parallel between the

loop circuit and earth. When an alarm is given from an alarm box or eventually from a special ringing generator at the station, two separate paths over which the current may reach the bells are obtained, the one purely metallic over the loop and bells, the other over the condensers with earth as a return.

These short cuts are of no importance when the line is unbroken but are absolutely indispensable when any kind of a break occurs, for through them it is possible to get an alarm signal through to most of the alarm bells. With three condensers in the circuit, for instance, it is possible to get a signal through to at least $\frac{3}{4}$ of the alarm bells.

A. Description of circuit over faultless line.

When the system is at rest a continuous rest-circuit of about 7 milliamperes passes from the rest-circuit battery over the battery switch, flash signal, right coil of signal



R 301 Fig. 2. Diagram for Fire-Alarm System with Generator Signalling.

Description of Diagram for Alarm Board with one Alarm Box Loop.

Designations.

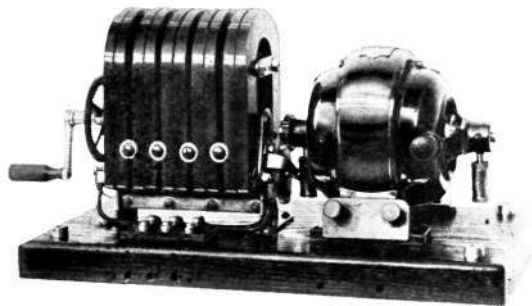
	1. Alarm box loop.
AB	Alarm box, with or without arrangement for code-signals (see fig. 4).
B	Bell (see fig. 6).
C	Condenser.
	2. Alarm board.
f_1 & f_2	Fuses, 0.15 amp.
f_3 & f_4	Fuses, 3 amp.
LA	Lightning arrester.

Designations

SR	Signal relay.
CR	Rest-circuit relay.
F	Flash signal indicator.
B_1	Trouble alarm bell.
B_2	Fire-alarm bell.
S_1	Trouble switch.
CB_1 & CB_2	Batteries for rest-circuit.
S_2	Battery switch.
SB	Signal battery.
C_1 & C_2	Condensers.

relay, alarm box loop, left coil of signal relay, rest-circuit relay and back to the rest-circuit battery. This causes the rest-circuit relay to energize and the indicator shows a white signal, thereby indicating that everything is in order. The generator relay is not actuated by this light current.

When an alarm is given from an alarm box, its generator is connected up in series with the alarm box loop. The signal relay energizes, causing the rest-circuit relay to de-energize and the alarm bell to ring and, eventually, give the code signal of the box in question. The trouble alarm bell on the alarm board rings simultaneously. An extra bell or a Morse telegraph instrument for printing the signal code number —



R 300 Fig. 3. Power Driven Generator with Arrangement for Hand Drive, for Alarming the Firemen.

if code alarm signals are used — can be connected in parallel with the alarm bell. The energizing of the signal relay causes a metallic circuit for the signal current to be closed, this circuit passing by both indicator and rest-circuit relay.

For the purpose of calling the members of the fire-department, a ringing generator at the station is connected in series with the alarm box loop. This generator is either hand or power driven, and has the same function as an ordinary alarm box.

B. Description of circuit with broken line or faulty rest-circuit batteries.

If a break should occur in the loop or the rest-circuit batteries become faulty, the rest circuit relay de-energizes, causing the indicator to show black and the trouble alarm bell to ring. The trouble switch must then be thrown over to the

position marked »break» (right hand position on diagram), at which the trouble alarm bell ceases to ring. The indicator still shows black.

After the trouble has been remedied, the trouble alarm bell will again start ringing and the indicator will show a white signal. The trouble switch is then brought to stand straight out after which the system is in normal condition again.

A broken battery circuit or too weak batteries does not prevent the reception of an alarm with either a broken or an unbroken outside line.

When an alarm is turned in over a broken line, the generator current passes from the ground connection of the alarm box — depending on the location of the break — through both or



K 27 Fig. 4. Fire-Alarm Box for Magneto System. A handle automatically springs out when the glass window is broken

only one of the halves of the generator coil and back to earth over the condensers on the line as well as in the alarm board. The current passes through both or only one of the coils of the signal relay, causing this latter to energize and the alarm bell on the alarm board to ring. The greater part of the firemen's alarm bells ring simultaneously, only those bells being deprived of current which lie between the break and the nearest condensers on both sides of the same.

C. Description of circuit with leak on the line.

If there is a leak on the line the rest-circuit passes from earth on the line through the indicator to the earth connection of the alarm board. The indicator still shows white, but the rest-circuit relay is short-circuited, causing the same to de-energize and the trouble alarm bell to ring. The trouble switch must then be thrown to the

position marked »leak» (left hand position on diagram), whereby the ground connection of the alarm board is broken and the rest-circuit again passes through the entire loop. The rest-circuit relay is again energized whereby the trouble alarm bell ceases to ring and the indicator still shows white.

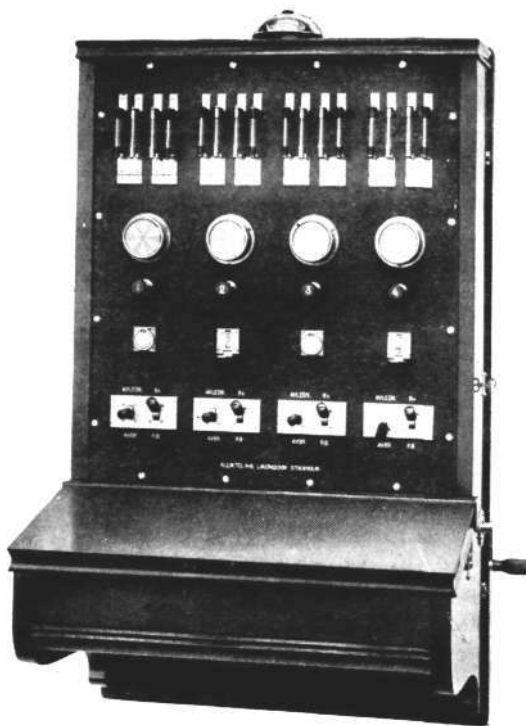
The trouble no longer exists if the trouble bell does not ring when the trouble switch is brought to stand straight out.

With a leak on the line and the trouble switch

ding on whether the leak is to the one or to the other side of the break.

Leak to the right.

If the indicator shows white and the trouble alarm bell rings, the trouble switch should be thrown to the »leak» position, as for a simple



K 28 Fig. 5 Alarm Board for Four Fire-Alarm Loops.



R 325



R 326

Fig. 6. Firemen's Alarm Bells.

in the »leak» position, an alarm signal will be received in the same manner as if no trouble existed.

If a break should occur before the leak has been remedied, the indicator will show black and the trouble alarm bell will ring. The trouble switch should then be thrown to the »break» position, after which the trouble bell will cease to ring.

D. *Description of circuit with simultaneous break and leak on the line.*

In such a case, the trouble alarm bell rings and the indicator shows black or white, depen-

leak. If, thereafter, the trouble alarm bell keeps on ringing and the indicator shows black, the trouble switch should be brought down to the »break» position, after which the trouble alarm bell will cease ringing and the indicator will still show black.

Thus, if the trouble alarm bell can only be silenced in the lower or »break» position of the trouble switch, it indicates that the trouble is not only a leak, but a break on the line together with a leak on the right hand side of the break, as shown in the diagram.

Leak to the left.

If the indicator shows white and the trouble alarm bell rings, the trouble can consist of either a simple break or a break together with a leak on the left hand side of the same. In this case the trouble switch should be brought down to the »break» position (as for a simple break), after which the trouble bell will cease ringing.

Thus, there is no difference in the throwing of the trouble switch for a simple break on the line or for a break and a simultaneous leak on the left hand side of the same.

The circuit closed on the sending in of an alarm from an alarm box may readily be traced on the diagram.

E. *Description of circuit when line is short-circuited.*

Trouble of this description does not cause any trouble alarm signal to be sent in to the alarm board.

Alarm signal from an alarm box within the short-circuited portion of the line.

1. The trouble alarm bell rings, because the line is grounded at the alarm box when an alarm is sent in (see description of circuit under C).
2. The firemen's alarm bells within the short-circuited portion ring as usual.
3. The alarm bells within that portion of the line which is not short-circuited usually give a weak signal.

Alarm signal from an alarm box not within the short-circuited portion of the line.

1. The alarm signal is received at the station in the normal manner.
2. The firemen's alarm bells not within the short-circuited portion ring as usual.
3. The alarm bells within the short-circuited portion of the line give a weak signal or none at all, thereby calling attention to the trouble in question.

F. *Description of circuit with break in ground connection of an alarm box.*

Trouble of this description does not cause any trouble alarm signal to be sent in to the alarm board.

1. With a faultless line as well as with a leak on the line, an alarm signal is received at the station in the normal manner.
2. When there is a break on the line, an alarm signal must find its way through the condensers which are located on both sides of the alarm box.
 - a. If there is no condenser between the break and the alarm box, no signal whatever will reach the station.
 - b. If one or more condensers are located between the break and the alarm box an alarm signal will reach a certain number of alarm bells, eventually also the alarm board.

A break in the ground connection of an alarm box is ascertained when a test alarm is turned in with one line branch disconnected from the alarm box. If no signal is received at the station, the ground connection is broken.

For larger plants, alarm boards are furnished which can accommodate three or four alarm box loops. These boards function in exactly the same manner as those here described for one loop.

Their construction differs from that of alarm boards for one loop in the following respects:

1. Each loop has its own rest-circuit control with battery. There is one spare battery for all the loops.
2. The rest-circuit relays are equipped with drop indicators which indicate from which loop an alarm comes in.
3. Trouble and alarm bells as well as the signal battery are common for all the loops.
4. A hand driven signal generator is mounted in the board, each loop being equipped with push button keys for connecting up the various loops to the generator. On receipt of an alarm from an alarm box in a certain loop, the firemen whose alarm bells are connected up to the other loops are alarmed from the alarm board. *A. P.—B. K.*

Notes of Interest concerning some of L. M. Ericsson's
earlier Types of Telephone Equipment.

A survey of the various stages of development through which the products of a concern have passed and of how the different models have sought to meet varying conditions and

THE HAND MICRO-TELEPHONE.

The fundamental idea of joining together a receiver and transmitter by means of a common handle originated with Messrs Anton Avén and



R 303 Fig. 1. The First Hand Micro-telephone.

requirements cannot fail to command a certain amount of historical interest.

A number of models of miscellaneous equipment, in many cases the only remaining evidence of the types which they represent, have, during L. M. Ericsson's well nigh 50-years' existence gradually accumulated in the model collections of the various factory departments.

It is our intention to collect what interesting facts may still be available covering some older types of construction and publish the same under the above heading, this present article being devoted to



R 302 Fig. 2. Trial Model with two Receivers.

Leonard Lundqvist, former engineers in the employ of The General Telephony Company of Stockholm.

The first experimental model was constructed by these gentlemen in 1884 and is still in existence. This very interesting model is shown in fig. 1 and now forms a part of the historical collection of the Royal Telegraph Department, where it may be found under number 2556.

The model is composed of a single spring contact transmitter and a horse-shoe magnet receiver of the type commonly manufactured by L. M. Ericsson at that time, attached together at

L. M. Ericsson

a suitable distance from each other by means of an iron wire around which two pieces of wood — each of a semicircular section — are tied with string so as to form a handle; the whole of a very simple and primitive construction, but so typical of the micro-telephone that it has remained practically unchanged, even though the separate parts may have undergone important changes.

The following letter from Mr. Lundquist may be of interest in connection with the origin of this model. He says:

»If I remember rightly, the idea was conceived while carrying on the work of adjusting the oldest type of single spring contact transmitters on the 50-line Ericsson switchboards with rigidly attached transmitters, this work being under my supervision for a number of years. Mr. Avén, who was operating engineer at that time, took hold of the idea, after which a practical model was constructed in the Ericsson shops in 1885.

Sincerely yours, *L. Lundqvist.*»

Stockholm, 13th September 1922.

Evidence to the effect that the year 1885 is correct is obtained from a letter dated April 10th, 1885, sent by L. M. E. & Co. to Mr. Victor Jacobsson in Norrköping, Sweden, which reads in part as follows:

»— — — and for this purpose we suggest a micro-telephone, intended for use with our multiple switchboards and which consists of a receiver and transmitter rigidly united by means of a common handle, enabling the operator always to have the same at hand in whichever direction she may turn while working at her position. The price of such an instrument will be about 55 Swed. crowns. Its connection to the switchboard is very simple and may be accomplished in a very short time. Necessary instructions for this purpose will be given when required.

Yours faithfully,

L. M. Ericsson & Co.

by A. B—m.»

Thus the fundamental principle of joining together a receiver and transmitter by means of a common handle was evolved, after which the original model was handed over to L. M. Ericsson for manufacture. Another model, consisting

of two receivers, was also made, this model being shown in fig. 2.

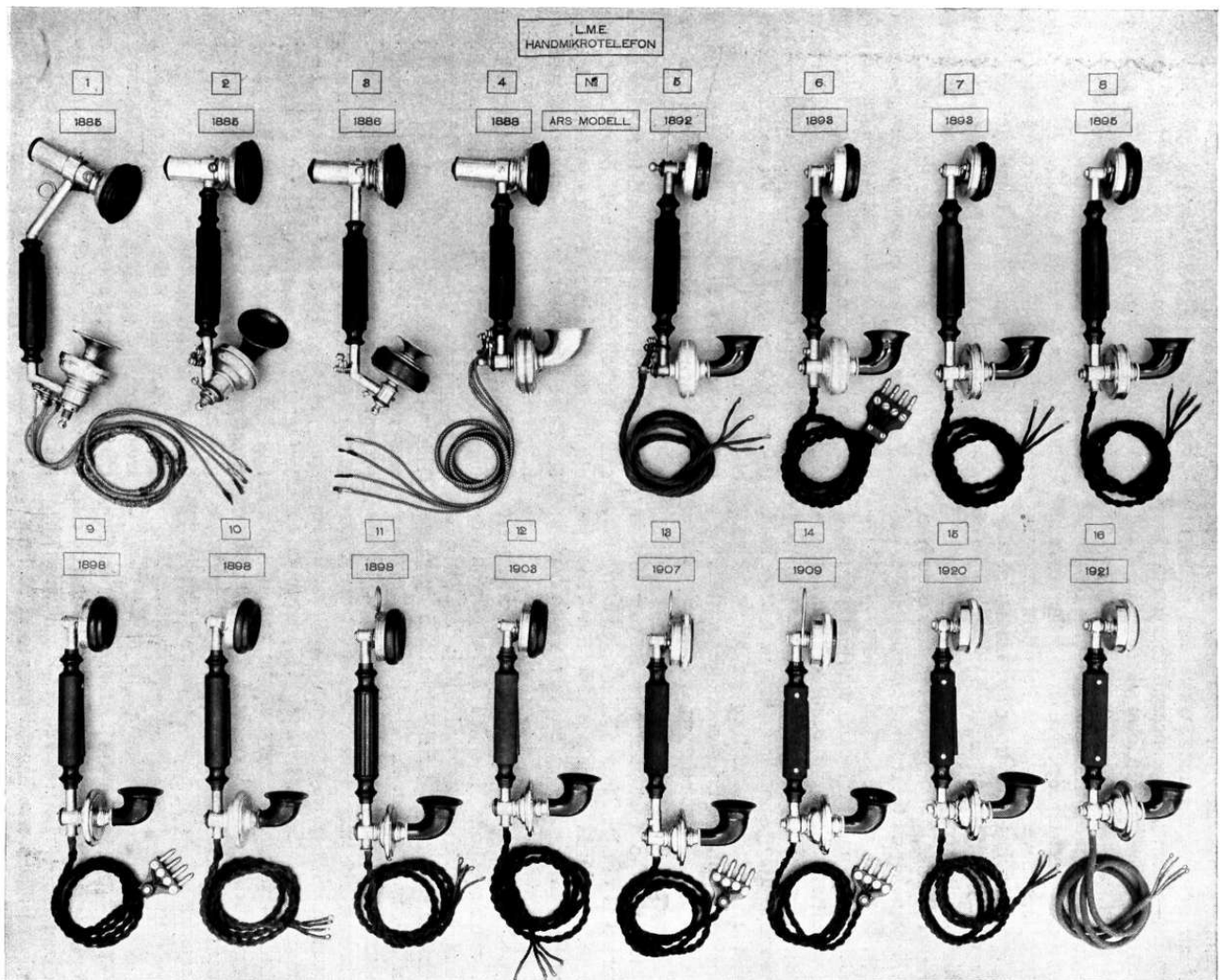
The construction of the single spring contact transmitter, however, required its being held in a horizontal position while in use. This was accomplished by bending the tubular stems in obtuse angles, see type 1, fig. 3. In type 2, the transmitter was placed so as to form an acute angle with the axis of the handle, this construction in later years being commented on by former shop superintendent C. J. Andersson as being: »Avén's idea of mounting the transmitter».

Very few micro-telephones were manufactured during the first years, as they were made chiefly for use with multiple switchboards, this being also clearly evident from the above quoted letter. Also their price — 55 Swed. crowns — was rather high compared with the monetary value at that time.

As new types of transmitters were evolved, the construction of the micro-telephone was suitably altered. Thus, we have models with carbon pencil transmitters and transmitters with small carbon balls placed between carbon diaphragms, this latter being represented by type 3. These types were all rather complicated, and it was not until the advent of the carbon granule transmitter that the manufacture of hand micro-telephones could be appreciably increased, thanks to the improved construction of the transmitter. This took place in 1888. Even this type (No. 4) was both heavy and cumbersome according to present-day ideas, however, chiefly on account of the long receiver with horse-shoe magnet. It was not until 1892 and 1893 that the outward appearance of the micro-telephone began to be more in conformity with that of the present-day type, both the transmitter and the receiver having been made appreciably smaller, the latter by the introduction of ring magnets.

The evolution of the hand micro-telephone is well illustrated in fig. 3, in which the more important types are shown. We will here give a short characterization of the various models.

No.	Year	Description
1	1885	Hand micro-telephone with single spring contact transmitter. Horse-shoe



L. M. Ericsson

Fig. 3. Evolution of the L. M. Ericsson Hand Micro-telephone, 1885 to 1925.

L. M. Ericsson

No.	Year	Description	No.	Year	Description
		magnet receiver, stem bent in an obtuse angle. Suspension eyelet and exposed terminal screws for cord connection.			of varnished silk gauze with the word: »Patent». Ring magnet receiver, partially protected cord terminals.
2	1885	Hand micro-telephone with single spring contact transmitter forming acute angle with handle. Horse-shoe magnet receiver, exposed terminal screws for cord connection. Made with both one and two battery switches in handle.	8	1895	Hand micro-telephone with carbon granule transmitter, heavy transmitter case of brass, ferrotype diaphragm with flat gold plate with tab, ridged carbon block (without holes), felt ring and one felt cylinder, six-pointed star shaped copper spring. Protecting diaphragm of varnished silk gauze, the words: »Made in Sweden by L. M. Ericsson & Co., Stockholm. Patented Oct. 29, 1895», stamped on the outside of the transmitter case. Ring magnet receiver, partially protected cord terminals.
3	1886	Hand micro-telephone with carbon pencil transmitter containing three carbon pencils. Horse-shoe magnet receiver, exposed terminal screws for cord connection. This type was also made with carbon balls between two carbon diaphragms.	9	1898	Hand micro-telephone with carbon granule transmitter, light transmitter case of brass, ferrotype diaphragm with flat gold plate and anchor plate, ridged carbon block without holes, felt ring and felt cylinder, protection of brass wire netting. Ring magnet receiver, partially protected cord terminals.
4	1888	Hand micro-telephone with carbon granule transmitter at right angles with the handle, large brass transmitter case, ferrotype diaphragm with flat platinum plate, ridged and drilled carbon block. Horse-shoe magnet receiver, exposed terminal screws for cord connection.	10	1898	Hand micro-telephone with carbon granule transmitter, light transmitter case of aluminium, carbon diaphragm with three notches, smooth carbon block, felt ring and 1+6 felt cylinders, protection of varnished silk gauze and brass wire netting. Ring magnet receiver, partially protected cord terminals.
5	1892	Hand micro-telephone with carbon granule transmitter, heavy transmitter case of aluminium, ferrotype diaphragm with flat gold plate, ridged and drilled carbon block, flannel ring and flannel cylinder with spiral spring. Ring magnet receiver and exposed terminal screws for cord connection.	11	1898	Hand micro-telephone with carbon granule diaphragm, light transmitter case of brass, carbon diaphragm, smooth carbon block, felt ring and 1+6 felt cylinders, protection of varnished silk gauze and brass wire netting. Ring magnet receiver, partially protected cord terminals.
6	1893	Hand micro-telephone with carbon granule transmitter, heavy transmitter case of aluminium, ferrotype diaphragm with cupped gold plate, ridged and drilled carbon block, flannel ring and flannel cylinder. Protecting diaphragm of varnished silk gauze with the word: »Patent». Ring magnet receiver, partially protected cord terminals.	12	1903	Hand micro-telephone with watertight carbon granule transmitter, light transmitter case of brass, carbon diaphragm with locking ring, grooved carbon block, star felt ring and two star springs. Protecting diaphragm of tinfoil. Ring magnet receiver, partially protected cord terminals.
7	1893	Hand micro-telephone with carbon granule transmitter, heavy transmitter case of brass, ferrotype diaphragm with cupped gold plate, ridged and drilled carbon block, flannel ring and flannel cylinder. Protecting diaphragm			

L. M. Ericsson

No.	Year	Description
13	1907	Hand micro-telephone with adjustable handle, transmitter same as for No. 12. Ring magnet receiver, partially protected cord terminals.
14	1909	Hand micro-telephone with capsule transmitter, removable capsule. Ring magnet receiver, inside cord connections.
15	1920	Hand micro-telephone with water-tight capsule transmitter. Ring magnet receiver, inside cord connections.
16	1921	Hand micro-telephone with water-tight capsule transmitter, spring-group switch in handle with several different connecting possibilities. Ring magnet receiver, inside cord connections with terminal block for clustered connections.

The above sequence covers only the common hand micro-telephone for subscribers' sets and switchboards. In addition, the types 14 to 16 are made in a number of varying styles with or without battery switch, with hygienic mouth-piece, etc.

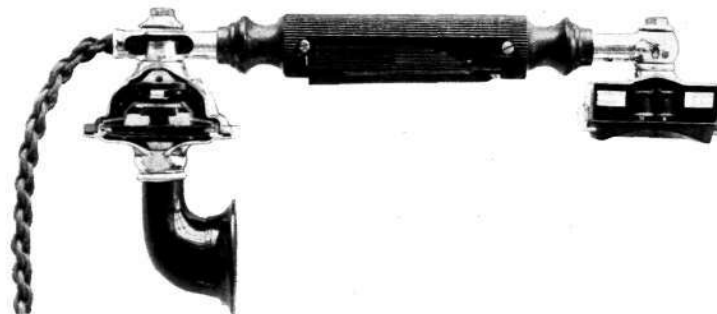
A number of other types have also been constructed for special purposes, such as for military use, for mines and for divers.

All in all, more than two million hand micro-telephones have been manufactured at L. M. Ericsson's Stockholm works. The following table gives the quota for each year, and also clearly shows the existing market conditions during the various years.

Year	Number of hand micro-telephones	Year	Number of hand micro-telephones
1885 to 1890	Only a very few manufactured	1907	80,201
1891		1908	44,952
1892	193	1909	43,842
1893	1,037	1910	68,322
1894	3,017	1911	69,251
1895	6,175	1912	76,277
1896	9,279	1913	86,880
1897	21,661	1914	64,224
1898	27,977	1915	83,485
1899	52,180	1916	117,574
1900	51,442	1917	127,293
1901	54,749	1918	79,069
1902	45,632	1919	69,904
1903	67,872	1920	67,965
1904	69,355	1921	72,682
1905	77,460	1922	26,883
1906	83,489	1923	37,257
	86,210	1924	53,387

The micro-telephone soon earned a very deserved popularity and is now being used in a majority of countries. In England, towards the end of the nineties, telephone instruments equipped with micro-telephones of Ericsson's manufacture were extensively used, and although the Post Office later on introduced other types, the hand micro-telephone has retained its popularity, and an increased tendency to return to the same has been apparent of late.

G. C.



R 304

The latest Model, showing Interior Construction.

CONTENTS OF THIS NUMBER: The Verona Telephone Plant. — The Special Service Bureau in Stockholm. — The L. M. Ericsson Fire-Alarm System. — The Evolution of the Hand Micro-telephone.

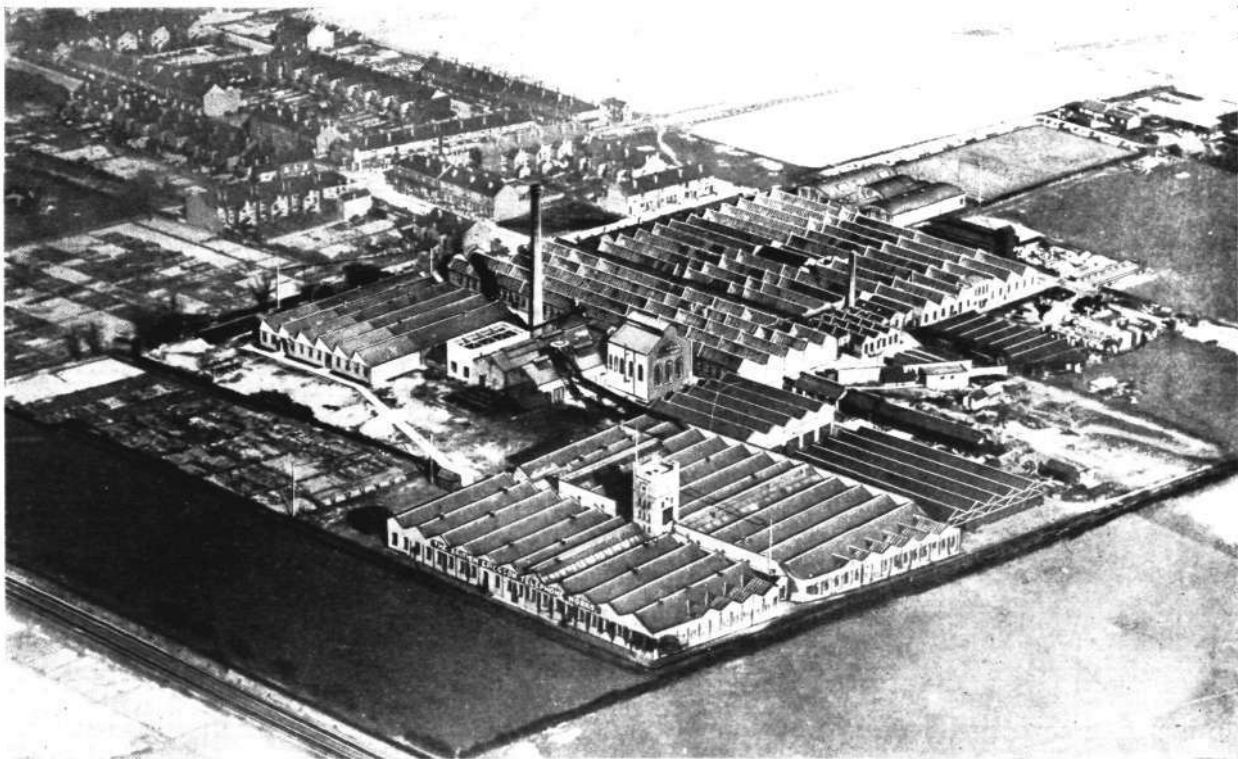
The L. M. Ericsson Review



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Nos. 9 & 10.



R 314

BIRD'S-EYE VIEW OF THE BRITISH L. M. ERICSSON MFG. Co.'s TELEPHONE WORKS
AT BEESTON, NOTTINGHAMSHIRE.

ENGLISH EDITION

THE L. M. ERICSSON REVIEW

ENGLISH EDITION.

JOURNAL OF
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TORSTEN AF GEIJERSTAM †

We regret to announce that since our previous issue the editorial staff of this journal has suffered a severe loss by the sudden and untimely death of its editor, Torsten af Geijerstam. Born February 13th 1889, Mr. Geijerstam has served on the engineering staff of the Ericsson company since 1911, after graduating from the Royal Institute of Technology, Stockholm. In Mr. Geijerstam's death we have lost a capable and energetic man, and — in our technical branch — an extremely valuable engineer. These qualities, together with an engaging and generous personality, will cause him to be kept in deep and grateful memory by all those who had the pleasure of knowing him personally.

A few Illustrations from the Works of The British L. M. Ericsson Mfg. Co.

Of the branch companies of the Ericsson concern, the British company now occupies one of the most prominent positions. The L. M. Ericsson Review is in a position to reproduce a few photographs from its modern and well organized factory and we are indebted to Mr. Allan F. Wood, the works manager at Beeston, for the accompanying descriptive matter.

»Already in the early stages of the development of the Ericsson concern a number of circumstances made it necessary to establish representation in England, and in 1898 a branch office was opened in London for the purpose of acting as a sales office for the Swedish factory, so as to make possible better connections between the Stockholm office and its British customers, both in England and her colonies. This branch office soon proved inadequate, however, the British market requiring a factory of its own, and thus, in 1903, The British L. M. Ericsson Manufacturing Co. was floated. In this connection, the factory of the former National Telephone Co. at Beeston, Nottinghamshire, was acquired (The National Telephone Co. had previously held concessions for telephone plants in England, but was woundup when the State took charge of the telephone service), but it was decided that the head office be located in London

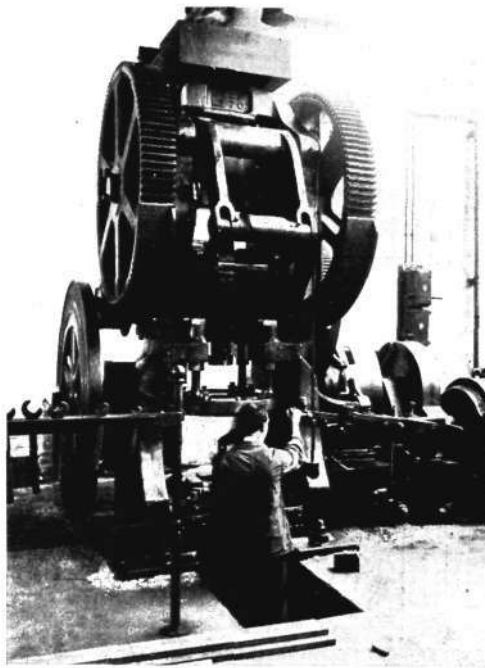
to act as a connecting link between the city and the factory on the one hand, and between the Swedish factory and certain branches of the English market on the other.

The factory which had been acquired was very small, the entire grounds having an area of not more than two acres, about half of which was covered by the existing buildings. The number of men employed in the factory at this time amounted to 130. Models and methods of manufacture were obtained from the Stockholm works, and the factory developed at a very rapid pace.

The bird's-eye view on the title page as well as the plan here reproduced give an idea of the area which our Beeston works now cover. The total area is now nineteen acres, the buildings covering about seven acres, thus leaving ample room for such development as may be required by the increasing output. The power required is now about 500 B. H. P., or more than ten times that of its original requirements.

About 2000 hands now find employment in the Beeston factories, and the constant development in the field of telephony is a guarantee that our rate of growth will continue in the future.

At first, the manufacture followed very modest lines and only included telephones and telephone



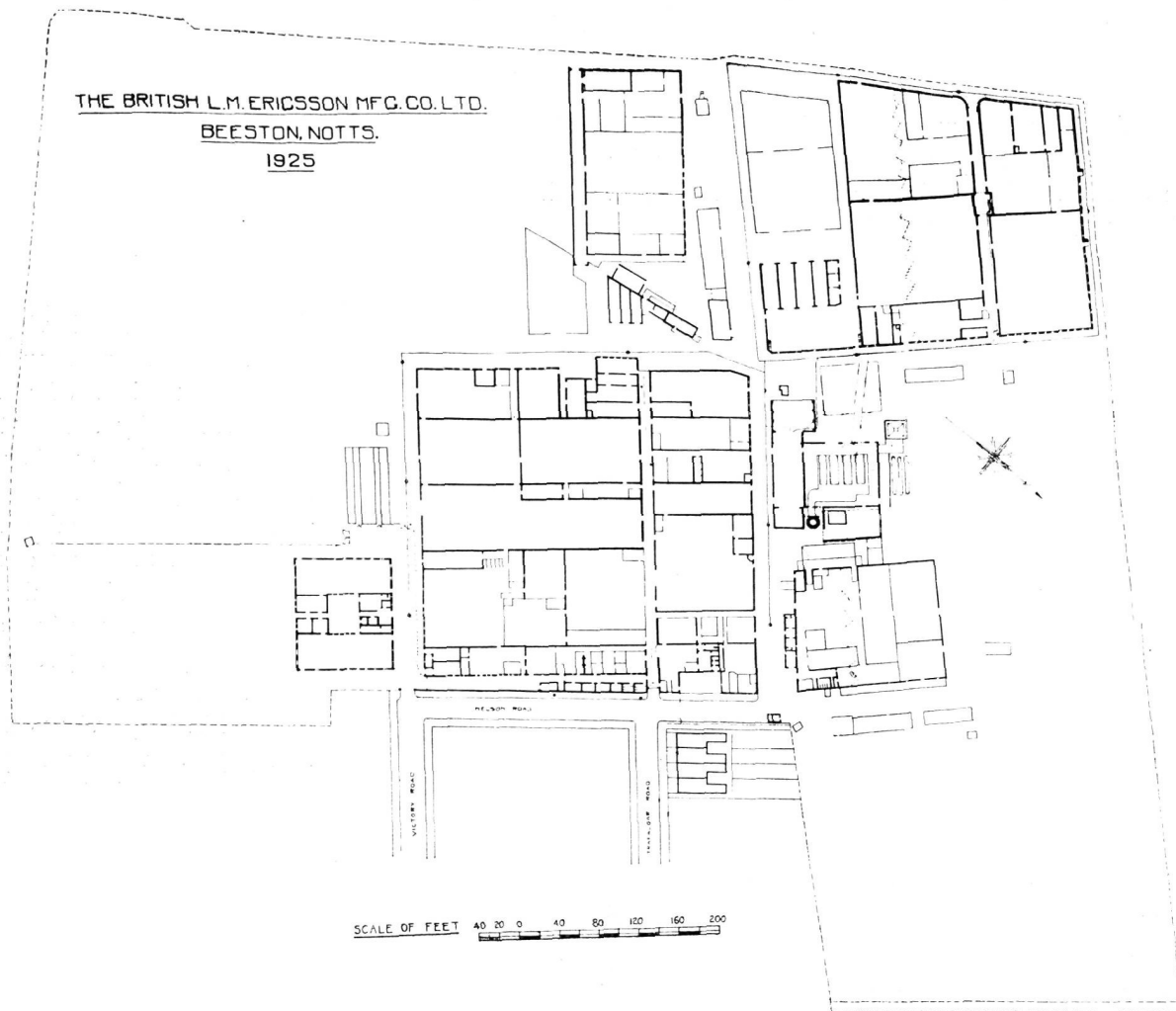
R 315

One of the Giant Presses.

parts to a very small extent. It has now expanded, however, embracing all that pertains to the art of telephony, i. e. telephone instruments of all kinds — not only the original Ericsson models with hand micro-telephones, but also the American candlestick type with fixed transmitter — and switchboards, from the smallest type for

tured by the hundreds of thousands, requires both special and varied plant for the machining of woods and metals as well as of insulating material, and the Beeston works are especially well provided in this respect.

As our organisation itself may be of interest, we will here give a short description of the same.



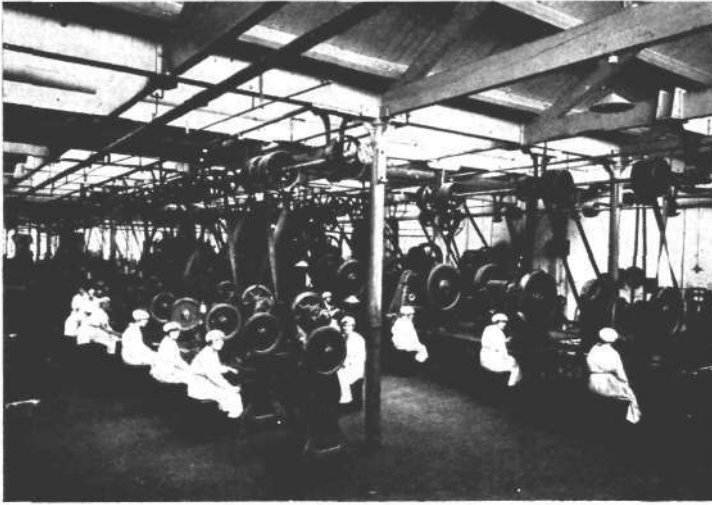
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Plan of the Factory Grounds at Beeston.

private exchanges to those for large public exchanges with a capacity of some thousand lines. Even the field of wireless telephony has contributed to the list, popular models of various types of receiving sets having been put on the market.

Manufacture of so highly specialized a nature, in which most of the accessories are manufac-

When an order from our London office reaches the factory, it goes first to the technical department for re-editing before being sent out to the shops. The technical staff must verify that the order is in accordance with the original inquiry as well as with that tendered; they also prepare all the necessary drawings and shop specifications. It may be of interest to mention that even



R 317

A View of the Press Shop.

the smallest part manufactured in our works has a drawing of its own. If an order should include new parts, not only are the necessary drawings for these special details prepared, but also designs and working drawings for new tools which may be required. The factory is provided with a large and well equipped tool making department as well as a special tool designing department.

An order for a large telephone exchange requires very careful preparation, involving specifications covering the various elements, together with drawings and



A Portion of the Automatic Screw Machine Shop.

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R 319

The Apparatus Assembly Shop.

diagrams, before it can be sent out to the shops.

A well equipped research department and technical laboratory is provided for the inspection and control of all incoming material. Such material is required to pass certain definite tests before it is approved for use in the factory. Steel and other metals, for instance, are subjected to various tests as regards magnetism, strength, etc. The very fine wire used for winding coils, etc. is carefully checked as regards resistance as well as insulation and when one realizes that this factory uses from two to three tons

of such wire per week — varying in thickness from .05 to .5 m/ms and insulated to withstand a pressure of 500 volts — the importance of these tests is evident. This department collaborates with the purchasing department and the stores with respect to raw and partly prepared materials.

The Beeston works have always kept accurate costs records, thereby making it possible to determine not only the exact cost of manufacture but also the cost of a given order over a certain period. After an order has passed the technical

department it is sent on to the costing department, which prepares the shop orders and issues instructions for the quantities to be made and the material to be purchased. Piecework prices and all similar details are also accurately calculated by and issued from the costing department.

All these careful preparations and calculations would be of little value, however, if the shops were not organised and equipped to an equally efficient degree. A special efficiency department establishes working methods and organises the collaboration between the various shop de-



View of Coil Winding Shop.

R 320



R 321 View of Automatic Dial Assembly Department.

partments, etc.

It is hardly necessary to say that all Ericsson products are subjected to rigorous inspection and individual tests before leaving the factory, not even the smallest screw being permitted to escape this final inspection.

A short description of the factory itself may not be out of place. The buildings are on the one floor principle with what is commonly known as saw-tooth roofs and with cement floors. The shops are amply dimensioned and roomy, allowing the placing of machines and workbenches at suitable distances from each other.

Heating and ventilation is taken care of by a hot air system, the air being washed and screened before it is passed into the shops. In some departments, where the nature of the work makes it necessary, the air is changed by artificial means as often as from three to six times an hour. There is also a special exhausting plant for those shops where the manufacturing processes cause heavy or noxious fumes to form or where it is necessary to remove waste material. Thus a 50 h.p. motor is required to exhaust all the shavings and sawdust from the wood-working department.



A View of the Switchboard Assembly Shop.

R 322

For the welfare of our shop employees a number of arrangements are provided as, for instance, a self-contained canteen which is capable of providing dinners for one thousand persons each day at one sitting. There are also two rest rooms and an ambulance room under the supervision of a resident nurse. Although serious accidents are of rare occurrence, the Company provides a motor ambulance for use in emergency cases.

Large recreation grounds afford the opportu-

nity of indulging in all sorts of sports, such as football, cricket, lawn tennis and croquet, while a social committee arranges concerts and dances during the winter.

We have attempted, with these few lines, to give our readers an idea of the size and organisation of the British Ericsson Company and of the high standard of our production, and hope that we may be considered a worthy part of the Ericsson Concern.»

A. F. W.

List of Ericsson Automatic Telephone Exchanges, Working and under Construction.

This list includes all exchanges built according to the Ericsson automatic system, either in operation or in course of construction, the figures here below giving ample evidence of the remarkable success already experienced by this system, considering the very short time that it has been in use.

	Number of lines		Date of opening	Ultimate capacity
	Working	under constr.		
<i>Sweden:</i>				
Stockholm, Norra Vasa	5,000	—	Jan. 1924	250,000
» Jericho	5,000	—	Nov. 1925	
» Kungsholmen	—	20,000	—	
Gothenburg	—	15,000	—	110,000
	—	12,000	—	
<i>Norway:</i>				
Hamar	1,200	—	Aug. 1923	5,000
Kristiansund	1,500	300	Dec. 1923	5,000
<i>Holland:</i>				
Rotterdam, West	5,000	—	May 1923	80,000
» North	4,000	—	March 1925	
<i>France:</i>				
Dieppe	800	—	Sept. 1924	1,500
<i>Spain:</i>				
San Sebastian	—	5,100	—	26,000
Mira Cruz	—	110	—	
Pasajes	—	250	—	
Renteria	—	200	—	
Hernani	—	180	—	
<i>Italy:</i>				
Verona	1,000	1,000	April 1925	10,000
Brescia	—	2,000	—	5,000
Naples	—	2,000	—	80,000
<i>Poland:</i>				
Cracow	—	5,000	—	60,000
<i>Turkey:</i>				
Angora	—	1,000	—	10,000
<i>China:</i>				
Shanghai, East	700	—	May 1924	50,000
»	300	—	Sept. 1924	
<i>Mexico:</i>				
Mexico City, Colonia Roma	—	5,000	—	60,000
<i>South Afrika:</i>				
Johannesburg, Rosebank	400	—	Oct. 1924	1,000
» Parkview	400	—	Dec. 1924	1,000
»	100	—	—	1,000
Total	25,400	69,140	—	754,500

A Talk on Telephone Directories.

TELEPHONE DIRECTORIES IN GENERAL.

Citing the fact that I have busied myself to some extent with the revising of the Swedish State Telephone directory, the editor of The L. M. Ericsson Review has begged me to write a general survey of the different types of directories used in various countries, as well as a few more general points of view on the directory problem.

I have agreed to do this, although not without hesitation. In the first place, the task with which the directory committee of the Swedish Telegraph Department has been entrusted — the work of this committee being my main source of information — is not yet completed, and secondly, this problem takes on varying aspects in different countries and under different administrations, making it practically impossible to draw up any common line of action. The telephone directory problem is dependent on a large number of factors.

One of these is the occurrence of changes in the telephone net, whether they are about uniformly distributed over the whole year, or whether they occur in mass at certain definite times of removal. In the first case, it is of no real importance at what time of the year the telephone directory is issued, while in the second case it is apparent that the directory should be rushed out as soon as possible after that time when the greatest number of changes occurs, and should include as many of these changes as possible. Also, it is self-evident that changes of a revolutionary nature require the publishing of special editions of the directory.

This problem is also influenced by whether the directory is intended only for the local and suburban traffic, or if it is intended to include districts for rather distant toll calls. In the first

case the free local directory must needs be supplemented, partly by well organised sales of directories for districts with which there is considerable inter-traffic, and partly by increased enquiry service and an appreciable information service at the toll and ordering positions. In the second case, the gratuitously distributed directory swells out to volumes of greater bulk which are naturally more difficult to edit, but the additional work and cost thus spent on directories for »foreign» nets means publicity for the interurban net as well as less work at the order and toll boards, while it also appreciably lessens the inquiry service.

The directory problem is also intimately connected with the geographical lay-out of the telephone net. If each local area constitutes a clearly bounded and — to most of the subscribers — familiar zone, the local disposition is clearly the most natural. On the other hand, if the various local nets merge into each other — on account of their manner of development or, perhaps, because of other conditions of communication — with vague or actually obliterated boundaries, one has recourse to two expedients. The first is to combine the subscribers of all the exchange zones in one single succession, the name of the exchange being necessarily included for each subscriber, thus requiring more space. The second is to supplement the local directories included in one volume with an index of localities, the seeking subscriber being often required to ascertain to which exchange the subscriber sought for belongs and then to look him up in the corresponding section of the directory.

Another point to be considered is whether a

purely alphabetical registration can be adopted, or whether — as in Sweden — one must take into consideration a certain divergence in the spelling of homonymous names. And where, in the last instance, shall one draw a line? The problem of registration is essentially one of the most difficult as soon as it is found necessary to deviate from the purely alphabetical order.

When editing a directory, it is necessary to determine to what extent it may be suitable to include the subscribers' street addresses and also if it is necessary in regard to traffic interests, or wise at any rate, with the intention of making the directory a popular reference book, to include the postal addresses of the subscribers to the extent in which they differ from the telephone address.

Further, when working on the directory problem, one must hold a course between Scylla and Charybdis, represented on the one hand by the desire of the individual subscriber to be represented in the directory in the most explicit, publicity giving and attractive manner possible, and on the other hand by the necessity of concentrating the printed matter to a minimum of space and to exclude all advertising matter from the text proper, as well as of standardising the

same. Of a similar nature is the question as to whether information concerning telephone hours, other numbers to be called during certain hours, etc., shall be included and whether or not a fee shall be charged for the inclusion of such information. Another similar problem presents itself in the form of extensions, two or more titles, the insertion of a subscriber under different headings to facilitate seeking, and so forth. It is necessary to strike a middle course between the requirements of the traffic for a certain degree of explicitness and for a number of arrangements to make seeking easier, on the one hand, and the necessity of concentration, on the other. Standardized and easily understood abbreviations of titles, occupations, street addresses, etc. should also be mentioned in this connection.

Then we have the question as to whether the directory shall include a classified index or if such an index should be published separately, possibly in close co-operation with some independent publishing house, and as to whether all subscribers in business or practising a trade should be included, and also whether residence phones should be excluded, etc.



The Swedish Rikstelefon (State Telephone) Directory.

R 342

The size of the present directory is shown at the left, while to the right we see the same contents after the adoption of the proposed revision with changed column-width and standardized abbreviations.

Still another point for consideration is the one as to how the telephone company or administration shall formulate all the directions and communications concerning rates, traffic, use of directory, and so forth, which they may desire to impart by means of the directory, and which it is the duty of every subscriber to study and keep in mind. Here, if anywhere, is where the formulating art is put to a real test. The point is to choose a fascinating and attractive wording which catches and holds the attention of the reader, avoiding the dry and uninteresting mass of rules and regulations. One need only peruse some dozen directories from various countries and administrations to find both of these extremes well represented.

After all of these questions — together with quite a few others, such as co-operation with the directory enquiry bureau and the administrative department — have been satisfactorily solved, there yet remains the question of advertising, for it is now generally conceded — except by some few newspapers, who imagine the directory to be a dangerous competitor — that such an excellent medium of advertising must be well utilized for the purpose of serving commercial interests and at the same time effect a saving in the cost of the directory.

After this we come to the purely technical details such as choice of type, width of columns, size, quality of paper, the reduction of the cost of publication and distribution to a minimum together with the destruction of the old directories after they have been replaced by new ones. All these details are really very important. The typographical make-up, for instance, is without doubt of great significance for this, the most popular of reference books. The legibility of the figures demands at least as much care as the forming of the figures on a typewriter. The choice of paper means the co-operation of the paper mill in producing an attractive, white quality of sufficient strength to last — in spite of assiduous use — until the next edition and yet stay within reasonable economical bounds. As concerns the binding, the problem is to obtain extremely quick deliveries of hundreds of

thousands of volumes, sturdy enough to withstand constant use until the distribution of the next edition, and made so that an opened directory will lie flat and not close of itself.

Apparently, it is an unusually complicated problem to keep the great mass of subscribers furnished with up-to-date and rationally compiled directories at a reasonable cost, a problem requiring assiduous study and indefatigable vigilance. However, experience all over the world has shown how absolutely necessary care and sound judgement are in this work, not only for the sake of the telephone service itself, but also for the popularisation and spread of the telephone, to which is added the fact that the telephone administration in a community with a widespread net actually keeps the citizens supplied with an excellent and invaluable city directory as a gratis product of the ordinary telephone service. Should the telephone directory be combined with a rational business directory, it will, in addition, be of invaluable service to the commercial interests of the community.

And now, how has this important and interesting, yet so difficult problem been solved in various countries and by various administrations?

AN ILLUSTRATED REVIEW OF TELEPHONE DIRECTORIES.

Naturally, the writer would not for one single moment harbour the thought of putting graded evaluations on all the types of directories which, to a certain degree, have formed the basis for the research work of the Swedish directory committee and which will be made to pass a hasty review in the following, but he may be permitted to express his admiration for certain details which seem well worthy of consideration.

I will now beg my readers to kindly accompany me on a little tour of investigation through the latest editions of a number of directories collected from various parts of the old and new world. The material at hand is by no means complete, but plentiful and diversified.

L. M. Ericsson

First, however, I beg to present my readers with a few figures giving the dimensions and

concentration of text for the directories to be examined:

Directory	Outside width × height mm.	Approx. thickness mm.	Width × height of printed surface mm.	Width × height of column mm.	Number of columns per page	Number of lines per column	Approximate number of characters per line	Number of entries per column	Entries requiring more than one line %	Area of printed surface per entry sq. mm.
Chicago	232×279	33	209×265	52×264	4	120	49	112.2	7	123
New York	234×286	63	212×275	53×270	4	124	46	104.1	14	140
Altoona, Pa. ...	157×235	11	131×220	66×213	2	83	50	82.0	2	176
Denmark	182×261	62	158×240	53×227	3	100	41	63.9	32	198
Hartford, Conn.	233×280	12	201×264	67×267	3	89	50	87.8	2	201
Copenhagen ...	182×261	24	158×240	53×227	3	100	54	61.5	35	205
Belgium	155×231	33	132×204	66×202	2	75	50	65.4	12	206
England (provinces)	191×249	—	164×230	82×225	2	105	71	85.5	13	220
London	216×276	44	190×250	95×248	2	97	81	94.1	13	252
Holland	175×260	35	158×243	53×239	3	94	34	45.4	89	282
Sweden V.....	166×246	17	147×222	49×215	3	72	40	37.6	60	289
Sweden IV: 2...	166×246	15	147×222	49×215	3	72	40	37.3	70	291
Vienna	160×233	47	134×210	45×205	3	90	30	32.0	100	293
Sweden VI	166×246	12	147×222	49×215	3	72	40	36.3	61	299
France	181×269	—	157×254	79×248	2	81	54	63.3	26	315
Sweden I.....	166×246	21	147×222	49×215	3	72	40	33.6	78	323
Sweden II	166×246	18	147×222	49×215	3	72	40	32.3	73	336
Norway	184×254	—	150×230	50×225	3	75	35	34.1	84	337
Switzerland.....	182×267	—	149×242	50×230	3	70	34	34.9	85	344
Hamburg	222×299	12	200×270	50×265	4	102	37	38.3	100	352
Berlin	206×297	52	179×273	45×250	4	97	33	33.9	100	360
Sweden III	166×246	25	147×222	49×215	3	72	40	29.6	85	367
Sweden IV: 1...	166×246	39	147×222	49×215	3	72	40	29.3	95	369
Mexico	166×230	30	127×205	127×195	1	85	87	65.4	24	398
Italy	166×239	75	138×224	69×222	2	72	40	37.8	83	409
Haelsingfors ...	154×227	18	136×209	68×202	2	58	41	29.2	76	487
Estonia.....	135×198	22	105×164	90×155	1	42	52	27.7	41	622

and also a table giving the number of telephone instruments and number of volumes in the directory; unfortunately incomplete, but including those countries for which the necessary statistics were available. The data applies to the first part of 1923.

Country	Number of telephone instruments	Number of volumes in directory
Sweden	394,535	7
Norway	158,310	5

Country	Number of telephone instruments	Number of volumes in directory
Denmark	276,589	1
England	1,045,928	33
Holland	185,122	1
Belgium	96,516	1
Switzerland.....	167,440	3
Austria	133,400	9
France	524,592	4
Italy	125,100	1

Vid

IRELLI PNEUS u VOLLGUMMIREIFEN
WIEN I KARLSPLATZ N° 1
TELEPHON 51-12-17

632

Vidor A., Strumpf- u. Wirkwaren-
Fabrikate, I., Ertlg. 1. **68-0-98**
Wohnung, I., Wollzeile 19. **74-8-78**
Vidor Ernst, IX/1, Schulz-Strä-
nitzkyg. 11. St. 6 v. **53-70**
Vidor Eugen & Co., Trikotagen u.
Handschuhfabr., Werkstätte, Geschäft,
I., Tegetthofstr. 5 **70-3-22**
Büro, I., Rotenturmstr. 11. **67-0-65**
Vidor Ludwig, Kaufmann, VII.,

Vietze Heinrich, Vertrg. I., Fleisch-
markt 26 **79-1-63**
Vignati Julius, Bürger, Rauchfang-
kehrermeister, IV., Schloßmühlg. 8.
59-4-53
Vignati Jul., Großhändler, IV., Mayer-
hofg. 2 a. **52-2-15**
Viktoria, Hornwarenfabr., Ges. m.
b. H., Dion. u. Zentrale, IV., Wied.

„Vindobona“-Sensen, Zentralver-
triebsbüro u. alleing. Hauptniederl.
Bernhard Zelinka, II/1, Ausstellungs-
straße 19. **41-7-82**
**„Vindobona“-Wäsche-Werk-
stätte**, Herrenwäsche-Erzeugung, I.,
Trattnerhof 1. **66-6-48**
„Vinea“, Ges. m. b. H., Teig-
waren, XIX/1, Heiligenstädterstr. 103.
93-0-25

The Vienna Directory.

R 364

AUSTRIA.

Verzeichnis der Fernsprechteilnehmer in Wien is the title of the largest of the nine Austrian directories in which the telephone subscribers of this country are included.

The Vienna directory, as may readily be seen, is very closely related to the German directories mentioned further on, the directories for the Austrian provinces being arranged according to exchanges. In the Vienna directory the number comes last, divided up into groups. It is bound with pasteboard covers and cloth back, each page containing three columns and each subscriber being entitled to three lines of printed matter. Punctuation marks are used, abbreviations being rather unsystematic, probably owing to the subscriber's right to determine his own wording within a given space limit. An extra line is charged with 3000 Austr. crowns, one whole extra entry, however, being charged with not less than 9000 Austr. crowns, one normal entry requiring 293 sq. mm. A privately edited classified business directory in which each subscriber is entered free of charge with name, address and number, is included at the end of

this directory. Advertisements are included in both the regular and business directories, although they occur in much greater number in the latter one.

A special number index is issued parallel with the telephone directory, a column fragment of the same being herewith reproduced.

Olga, Tyn- Paul Ca-	5088 St. 4 Farkas Josef.	5128
	5088 St. 8 Glaser & Reichmann, Simplicissimus- Werke	5128 5130
1 Hermann. Med. Dr.	5089 St. 4 Kappelmacher Rudolf.	5131 5131
1. Dr. Sieg-	5089 St. 8 Diamant Norbert.	5133
	5090 St. 6 Kerndlinger Emma.	5133
ann C. W	5094 St. 6 Chaimowicz Karl.	
Ludwig.	5094 St. 4 Golarbeiter Marcel.	5133
Ludwig.	5095 St. 4 Zandt Marianne.	5133
ann Israel.	5095 St. 6 Lammerer Chr.	5135
	5096 St. 2 Richter Marie.	
1 Wilhelm.	5096 St. 4 Engel Moriz & Sidl.	5135
Viktor.	5096 St. 6 Mebus, Dr. Arthur.	5137
1 Sofie.	5096 St. 8 Freund, Dr. Felix	5137
Dr. Robert,	Artur.	5137
e Boden-	5097 St. 6 Juster Louis.	5137
	5097 St. 8 Jungmann Hugo.	
burg, Dr.	5099 St. 4 Weiss Ernst.	5139
	5099 St. 6 Reder, Med. Dr.	
ranz jun.,	Bertold.	
	5099 St. 8 Amtmann Abraham.	5139
Rudolf.	5101 St. 6 Grundhammer	5139

Vienna's Number Index.

R 365

BELGIUM.

Indicateur Officiel — Officiel Telefoonboek for 1924, in which general notes and directions are

Vorsteher C. A. & Paul, Schnür-
riemen-, Bänder-, Lützen u. Spitzen-
fabr., III., Neulingg. 29. **63-14**
Weismann Joachim, XVI., Feßl-
gasse 13. **25-0-28**

Schuhriemen und Lützen

Epstein Simon, VI., Kaserneng. 5.
St. 8 v. **304**
Falkenflek S., Großhändler, XX.,
Klosterneuburgerstr. 49. **40-707**

Schuhstrecker

Albeko, Hdls.-Ges. f. Artikel d.
Schuhind., Ges. m. b. H., XV. Kriem-
hildpl. 1. **32-0-98, 34-5-81**
Dambachwerke, Holzindustrie,
A. G. Windischgarsten Ob. Oe.,
Fabrikniederl., XIV., Hüttendorfer-
straße 53. **35-106**
Stadtbüro, III., Lisztstr. 10. **55009**
Gottreich Alfred, VII., Kaiserstr. 33.
24-0-00

Schuhwarenausfuhr

Böhmer Rudolf (Rubo), I., Zelinka-
gasse 13. **66-6-44**
Engel Alfred, VII., Mariahilferstr. 10.
31-4-68

M. FREUNDEL
Schutzmarke „Fermon“
VII., Kaiserstraße 106. Telephone 38-0-82

Vienna's Private Classified Directory.
Please note the attractive framing of the titles.

R 363

L. M. Ericsson

Liste n° 1 — BRUXELLES

Lijst n° 1 — BRUSSEL

542,06 298,00 187,99 127,04 405,25 280,38 490,37 679,03	} Automobiles	Suere, r.Croisades,37. Sunbeam, ag ^{co} Belgique, b ^o Régent, 11 Szawe, Vanden Driessche, r.Loinbard, 71 Talbot, r.Paix, 29. T. V. D., r.Châtelain, 41. Unie et Scemia, Delhaye, Dongrie & Co, r.Otlet, 42-44. Van de Poel, av Latérale, 51, Uccle. Van Gend & Co, r.Vanderstichelen, 22.	357,39 Baert, O., banquier, r.Cornet, 143. 624,46 Baervoe.s. V ^{vo} C., bois, scierie, q.Halage, 15 628,14 id. bois, scierie, q.Halage, 45 624,47 id. privé, r.Birmingham, 39. 536,99 Baes & C ^{ie} , pl.Masui, 10. 434,68 Baes, E., artiste peintre, r.Réforme, 4. 401,08 Baes, H. & C ^{ie} , r.Culture, 156. 311,15 Baes, R., électricité, r.Gérard, 65. 699,65 Baeten, Ch., ameubl ^{ts} , ch.Gand, 107.
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Belgium's Telephone directory.

R 343

printed in both French and Flemish, is responsible for the accompanying contribution.

The directory includes the net of the whole country, has two columns per page, and is stitched in pasteboard covers. The number comes first, subscribers being grouped according to exchanges, with an index of localities at the end of the directory. Only one line of print is allowed each subscriber free of charge, each extra line costing 15 francs. One standard entry requires 206 sq. mm., extreme abbreviations being sometimes used. The five-digit numbers are divided into one 3-digit and one 2-digit group by a comma. Punctuation marks are used and advertisements are inserted in the text. There is no special commercial index, but certain categories, such as bakeries, hotels, restaurants, chemists, and the like, are grouped together in the directory. (See *Automobiles* in above illustration.)

DENMARK.

The *Rigstelefonkatalog*, covering all subscribers in this country, is issued by the Danish telegraph administration, and contains both business directory and list of cable addresses. Kjøbenhavns Telefonaktieselskab issues a *Navnebog* with the company's subscribers in alphabetical order, and a *Fagbog*, or business directory. The *Rigstelefon*

directory has different sections with varying typographical make-up, but we will content ourselves with two fragments, the one for the capital city, the other for the provinces.

The Copenhagen directory has three columns, the provincial four columns to the page, as shown below. It is stitched and has elegantly decorated covers. The numbers of the Copenhagen sub-

Bjør

Bjørnelund C I Manufakturhdl. Jægersborg- alle 52	Ordrup 185
Bjørnemoose Cornelius Bygm. Gl.Kongev. 95	Vester 24 41
— I Murerm. Forhaabholmalle 43	Vester 30 42
Bjørner Sigurd Forst. f. Evangelieforsaml. Evangeliehuset Triangl.	Øbro 54 90
— Signe Fru Vald. Holmersg. 21	Strand 546 x
— Louise Frk. NyVesterg. 18	Byen 28 53 x
— 's M Parketfabr. Fabr. & Lager P.Andersensv. 21	Gothåb 44 53
— — — Bolig Egebæksv. 15	Strand 16 84
— J L Vald. Holmersg. 21	Strand 546 x
Bjørnhof E Spediter Absalonsg. 21 B	Vester 21 64 u
Bjørnholm Agnes Postkontorist Berghoras- gade 10	Amager 32 67 v
Bjørnkjær Mejeriet Akts. Amagerbrog. 93	Amager 22 43 y

Copenhagen.

R 345

scribers come first, but the provincial numbers last. Subscribers are grouped according to local areas, with an index of localities, there being separate sections for State and municipal telephones, as well as a complete toll tariff. One entry, consisting of name, occupation, address and, if desired, telephone hours is allowed each subscriber free of charge. Completing text is charged for at the rate of 3 Dan. crowns per line, underscoring

Helsingør

1177 Nielsen C E Togf. Hammerhus Ro- senkildelvej	963 Olsen Alfr: Lokomotivf. Solvej	207 Petersen Peter Slagterm. Kamperg. 3	715 Reiffenstein Fr. Bankbest. Stubbe- damsvej
777 — M Togf. Højmark Rosenkildelvej	813 — Olaf Malerm. Fiølg. 17	1044 — 's Peter Eftf. (Johan Hansen) Slagterm. Kamperg. 3	921 Reiler C B Bogholder Umanak Schleppergrellsvej
1165 — Engelbrecht Vaffelbager Brostr. 2	684 — O Chr. Mollejer Christians-Mølle	267 — Poul Slagter Suderg. 18	737 Rejse- og Afholdshjemmet (Best. Chr Jensen) Hestemallestr. 6
198 — J Vognmd. Strandg. 14: Herskabs- & Arbejds- kørsel besørget.	904 — C Overbanem. (D. S. B.) Villa W. E. M. S. Strandvej	816 — Sejer Smedem. Sdørg. 3	798 Remming Edv. P Togrevisor Pan Rosenstandsvej
829 — N P Vognmd. Christianshøj	241 — P L Skorstensfejerm. Lundeg. 16	1082 — J Car. Smedker Gl. Banegrødv. 6	*796 Rendal H. Sagf. 9-3 Bjergeg. 12
	282 — C Skotejshdl. (Forenede Skotejs- fabrikkers Uds.) Bramstr. 7	698 — E & J E Nissen Frkn. Syge- plejersker Nojsomhed	
	169 — Nicø Trikotageforr. Bjergeg. 16	333 — & Clausen Tapets. & Dekorát.	

Danish provinces.

R 344

L. M. Ericsson

costs 10 crowns a line, while additional data are entered at 2.50 crowns per line. A subscriber who does not wish to have his name in the directory must pay 5 crowns, presumably to cover extra enquiry service expenses. A standard entry requires 198 sq. mm., extreme abbreviations being used, but no punctuation marks except for abbreviations. When the same name occurs repeatedly, it is only printed once, after which it is substituted by a short dash, such subscribers being arranged alphabetically according to occupation, title, etc. Given names are resorted to only when occupations also are alike. This principle of registration seems to be unique for Denmark and Sweden; all other directories seem to arrange subscribers with like family names according to their given names. The type used is distinctive and saving, numbers are open and legible, different sections being printed on paper of different colours. The whole book makes a very pleasant impression and seems to be well premeditated. There are advertisements, but they occur principally in the business directory.

The *Telefon Fagbog* or commercial directory of Kjøbenhavns Telefonaktieselskab contains about 1700 titles. Each subscriber is entered once, including telephone number, name and address, free of charge, with special rates for additional wording. This directory seems to be an unusually popular advertising medium, and is presumably a good business venture. Types, width

Chabloner se Mærkepladers.

Champagne.

Bülow & Møller Storg. 6 Central ••465
I. Bollinger Champagne.
 Ballager Viggo St. Kannikstr. 11 Byen 80 02
 — Bolig Frøbergallé 23 Vester 2323v
Champagne Lanson
Père & Fils Reims.
 Netterstrøm & Sørensen Skt. Thomasallé 3. Central •25 86

Chauffører.

Andersen Martin M Oehlenschlägersg. 53 A. Vester 25 84 y
 Bode M Frdsundsv. 47 Taga 19 53 x
 Bousae F V Gunlogsg. 53 Amager 35 96 x
 Bergesen Robert Bergthorag. 20 Amager 30 79 y

Chokoladen Kigvæltta Grison.

Brasen G & Co. Kong. Nytt. 21 Byen 39 56



Centralbanegaardens Chokoladekiosk Akts.
 Centralbanegaarden Byen 73 87
 — Ankomstsiden Centralbanegaarden Byen 18 90 y
Chokolade-Huset (Paudrup) Nørrebro. 55 A Nora 23 55
 — Agnes Emme Bolig Nørrebro-
 gade 102 Nora 577
 Chokolade-Importen H C Ørstedsv. 22 B. Vester 58 49 y
 Christensen Niels Vimskeft. 47 Central 11,651
Repr. Galle & Jessen 9-4, Lord. 9-1.
 Christensen Toni:
 Gl. Kongev. 109 Vester 78 85
 Røde. 69 Palæ 30 60

Danish Classified Business Directory.

R 346

of columns, abbreviations, etc. are the same as in the regular directory.

This company also issues a special number index — *Nøgle til Telefonhaandbogen* — giving the number of the column in the directory in which a Copenhagen subscriber may be found. This little book has 192 pages with 520 numbers to a page, and costs 1.75 Dan. crowns.

ESTONIA.

Apparently, *Eesti Vabariigi telefonvõrgu abonentide nimekisi* (1922) includes all of this coun-

- 11-23. Raudsepp, H., krt., Oskari t. 15, 10.
- 9-52. Raudsepp, Jaan, IV politsei jaosk. ülem, krt., Graniidi t. 11, 9.
- 14-27. Raudsepp, Oskar, krt., Pikk t. 14.
- 8-72. Raudtee ülem, kab., Tehnikeri t. 16.
- 2-71. — — Reinok, V., krt., V. Tartu m. 13.

Estonia.

R 366

try's subscribers. This directory has but one column to the page, is bound in cloth and has

AMAGER 550

AMAGER 891

Telef. NR	Spalte	Telef. NR	Spalte	Telef. NR	Spalte	Telef. NR	Spalte	Telef. NR	Spalte	Telef. NR	Spalte	Telef. NR	Spalte
550 541		593 1247		635x 411		679y 1188		725y 1150		764v 877		808y 355	
551x 829		594 283		- y 1175		680x 887		726y 746		765 1295		- v 403	
- y 322		595x 785		636 1307		- y 629		- v 203		766y 1020		- - 405	
552 1271		- y 1142		637 1170		- - 962		727 1177		767 1142		809x 714	
553 1007		596x 1441		638x 597		681x 1432		728x 393		768x 1260		- y 826	
												846y 1474	
												847x 1348	
												848 1099	
												849x 584	
												850y 330	

R 347

Copenhagen's Number Index.

- nasg. 11.
121 67 Rönblad, A., Eriksg. 16.
Tö 42 911 Rönnbäck, M., hovrådinna, Arkadiag. 20.
067 64 Rönngren, Harry, sjökapt., Köpmansg. 3.
067 64 — Nicken, teaterdir., Köpmansgatan 3.

R 348

The Helsingfors Directory.

a clear plan of the telephone net. One entry requires about 622 sq. mm. The number comes first, separated into two groups by a dash, to simplify pronunciation, abbreviations and punctuation marks being used. Some advertisements occur in a special section, there being no business directory.

FINLAND.

The *Helsingfors Telefon-Katalog* or *Helsingin Puhelin-Luettelo* (1924), is issued by the Helsingfors Telefonförening and includes subscribers in this city and surrounding districts only.

The directory is bound in strong pasteboard covers with cloth back, the pages being two-columned. The number is placed first, pauses in the pronunciation being indicated by spacings.

- 105 50** Gröndahl, Väinö.
105 51 Penttilä, Hugo.
105 52 Barnskyddsnämnden.
105 53 Nasar, Hasan.
105 54 Lönnholm, Wentzel.
105 55 Kustannus O.Y. Otava.

R 349

The Helsingfors Number Index.

A few cautious abbreviations are used, also punctuation marks, and dashes to indicate repetitions of names with identical spelling.

A schematic map indicates the various exchange areas. This directory is the only one, among those examined by the writer, which is devoid of all advertising matter.

The Telefonförening also provides a separate number index, set up with two-columned pages.

- Roquette **38.01** Luquet (M.), entrepr. maçonn., r. de la Folie-Méricourt, 98 (1^{re}).
 Nord **28.94** Luquet et C^{ie}, peint. industr., r. de la Haie-Coq, 63, Aubervilliers.
 Wagram **66.35** — r. du Rocher, 68 (8^e).

R 350

The Paris Directory.

- 101 14** Saari, Alma, rouva, Malminkatu 30.
006 96 — H. O., kauppias, Fredrikinkatu 43.
043 70 — K., aktuario, Ullanlinnankatu 3.
117 45 — Lyyli, lääket. kand., Pursimiehenk. 5 A.

Naturally, there are other telephone directories for the provinces, but the author has not had recourse to the same.

FRANCE.

Annuaire Officiel des abonnés au réseaux téléphoniques issued by Sous-Secrétariat d'État des postes et des télégraphes is published in

13 Carter (M^{re}), artPassy 11 31

SOPHIE-GERMAIN

(Rue), 14^e Arr^e.

5 Paris (A), avoc. Gob. 47.27
 Poirier (E.).....Gob. 63.46

SORBIER

(Rue), 20^e Arr^e.

7 Bonnement (R.)...Roq. 81.13
 19 CoutoulyRoq. 34.89
 28 ter Bressy, archit.Roq. 52.72
 34 Mahler et Vinnat.Roq. 67.48
 Stoops, fonderie...Roq. 42.35
 34 bis Andrieu et HermetRoq. 83.29

SORBONNE

(Place de la), 5^e Arr^e.

1 Hôtel Select.....Gob. 29.01
 5 Garinot (C.).....Gob. 20.04
 Zaepffel, doct.....Gob. 36.88
 7 Galandrin (A.).....Gob. 52.04

SORBONNE

(Rue de la), 5^e Arr^e.

Faculté des SciencesGob. 63.64
 Sorbonne, cab. rec-

R 351

Street Index of Paris Directory.

- Wagram **82.25** Lutier (A.), doct.-médec., bd de Courcelles, 6 (17^e).
 Ségur **50.28** Lutier (G.), pharm., av. Bosquet. 49.
 Louvre **20.55** Lutra (C^{ie} génér. de lumière et traction), r. de Londres, 13 (9^e).

four large volumes, of which the largest contains the Paris zone.

This directory is bound in cloth, each page containing two columns. The name of the exchange and the number are placed first, the latter being divided by a period into two two-digit groups. The subscribers are grouped according to the exchanges, the city of Paris occupying the first half of the book. Each regular subscription is allotted one entry, consisting of name, occupation and address. The telephone administration has reserved the right to use abbreviations, but has done so with great caution. Observe that given name and initials are in parenthesis. A charge is made for denoting extension lines. A standard entry requires 315 sq. mm. and advertisements are included in large numbers. The outer margin contains varying

the German language, for the purpose of avoiding misunderstanding, must seem very odd indeed.

The Berlin directory has four columns to a page, practically all of the city as well as the suburban subscribers being entered in one succession and completed with reference notes at the end of the book indicating the exchange name for subscribers in certain localities. Potsdam and a few other small exchanges have their own sections, however. The covers are of exceptionally heavy pasteboard with cloth back. Name of exchange and number are placed last, three lines being allotted to each subscriber without charge. Each additional line costs 6 marks. One standard entry requires 360 sq. mm. The wording of the subscriber is usually accepted, but the telephone administration reserves the right to correct the spelling and to replace

477

Commerz- und Privat-Bank

HAN

Haneld, Oskar, Berliner Str. 77.
Pankow 8 05

Hanelt, Andreas, Restaurateur,
50 36, Wiener Str. 14.
Moritzplatz 118 80

Hanelt, Georg ✱, Beerdigungsinstitut, Annahme von Feuerbestatt., S 14, Alexandrinenstr. 88. Dönhoff 99 58

Hanelt, Hugo, Fahrräder u. Motorfahrzeuge, Hilbertstr. 1.

Hanff, Ludwig, Dr. med., Wilmersdorf, Umlandstr. 74. Umland 74 40

Hanff, Max, Fabr. v. Arbeitsanzüg., Engros — Export, C 2, Poststr. 20 a. Merkur (4 33)

Hanff, Max, mechanisches Kleiderwerk, NO 43, Georgenkirchstr. 64. Königstadt 65 36

Hanff, Otto, Bankgeschäft für Typ.- u. Grundbesitz, W 50, Regensburger

Hanicke, Oskar, Maschinenfabrik „Sigma“, Wilhelmsberg, Hohen Schönhausener Str. 46. Lichtenberg (3 28)

Hanicke, Arthur, Ingenieur, Tempelhol. Ordensmeisterstr. 56. Sudring 32 52

Hanicke, Paul, Schlossermeister, Wohnung, Niederschöneweide, Berliner Str. 63. Oberschöneweide 12 46

Hanisch, W., u. Cie., Maschinen- u. Ventilationsanlagen, N 58, Kastanienallee 84. Humboldt 16 28

Hanisch, Walter, Fondsmakler, 034, Romintener Str. 26. Alexander 17 35

Hanisch, Wilhelm, Fuhrgeschäft, Charlbg. 1, Kaiserin-Augusta-Allee 73. Wilhelm 12 37

Hanisch u. Co., Lebensmittel-Groß-

R 352

The Berlin Directory.

information concerning the service. The directory includes a business section — *Liste Professionnelle* — which contains advertisements only, however. A feature unique for the Paris directory is a four-columned street index in which the subscribers are arranged according to street and house number.

GERMANY.

Amtliches Fernsprechbuch für Berlin und Umgebend is the largest of the many district directories compiled by the German *Reichspost*. Great care has been used in preparing the general directions at the beginning of the directory, both from a systematic and typographical point of view. To an English speaking person, who has no troubles at all as concerns the pronunciation of numbers, the minute directions given in this respect for some languages and especially for

foreign words with German ones. In some instances the titles are excessively abbreviated, in others not at all. A postal address is often included besides name, occupation and street address. Telephone and office hours, as well as extension lines, are entered at the request of the subscriber. The subscriber must fetch his new directory himself or pay a fee to have it sent to his home, and a subscriber who does not return his old directory is charged one quarter of its sale price. Special care has been taken to make the advertisements harmonize discreetly with the text.

Separate business directories, *Branchen-Fernsprechbuch*, are now issued by a semi-official publisher and are bound in at the end of the provincial directories of the last edition, but are separate for the larger cities. These new business directories have been very conscientiously and methodically prepared.

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The smaller provincial directories are two-columned with 66 mm. wide columns, the Altona directory, for instance, requiring an area of 176 sq. mm. for each standard entry. Type and finish is similar to that of the Berlin directory, smaller provincial directories being flat-stitched.

ENGLAND.

England's telephone directory consists of 33 volumes of two different types (insofar as the author has been able to judge), the one, for London, with columns 95 mm. wide and the other, for the provinces with a corresponding width of 82 mm. Both are two-columned, distributed free of charge in pasteboard covers but costing 1 s. in attractive cloth binding. The directory is to be complimented for the clear and explicit directions in the beginning of the same and almost more so for the concise and catchy epigrams in a frame at the top of each page, where they effectively arrest the seeker's attention. They are so shrewdly placed and so well formulated that the reader inevitably is coaxed into reading them all. The author cannot resist the temptation of citing most of them:

- CONSULT DIRECTORY BEFORE CALLING.
- GIVE YOUR NAME OR NUMBER BEFORE CONVERSATION, DO NOT SAY »HALLO».
- GIVE NAME OF EXCHANGE FIRST.
- EMPHASIZE CONSONANTS WHEN GIVING NUMBERS.
- IF CUT ON INCOMING CALL REPLACE RECEIVER AND WAIT.
- READ PREFACE, ESPECIALLY II, III, IV.
- BE SURE THE NUMBER IS REPEATED CORRECTLY.
- IF NUMBER NOT IN DIRECTORY CALL »DIRECTORY ENQUIRY».
- ANSWER TELEPHONE PROMPTLY.

YOUR HELP IS ESSENTIAL TO GOOD SERVICE.

TRAIN STAFF IN USE OF TELEPHONE.

THE TELEPHONIST CANNOT MAKE YOUR CLIENT ANSWER PROMPTLY.

SUBSCRIBERS SHOULD NOT ENGAGE THE TELEPHONIST IN CONVERSATION.

THE TELEPHONIST ANSWERING CALLS YOU MAKE DOES NOT DEAL WITH THOSE YOU RECEIVE.

ANSWER WITH THE PROMPTITUDE YOU EXPECT.

SPEAK DISTINCTLY — NOT LOUDLY.

SHORT CONVERSATIONS REDUCE »ENGAGED CALLS».

ROLL THE »R» IN »THREE».

GIVE UP YOUR OLD DIRECTORY. A NEW ISSUE MAKES IT OBSOLETE.

GIVE THE COURTESY YOU EXPECT.

MAKE A NOTE OF CHANGED NUMBERS.

There is but *one* saying that seems to be lacking in these »rules of good behaviour» and that is what might almost be called the golden rule of telephonic intercourse, »The smiling voice wins». Of course, it is possible that telephone culture is so advanced in England as to make this rule unnecessary, in which case the English nation must be envied by telephone users the world over. Let us now glance over a fragment from the London directory.

Name of exchange and number are placed first, one entry only being allowed each subscriber, without regard to the number of exchange lines. One standard entry occupies a space of 252 sq. mm., additional text being charged for at the rate of 15 s. for a statement of one whole line, otherwise at the rate of 2 s. 6 d. per word. Street addresses are often exces-

240 **COO-COP**

GIVE THE COURTESY YOU EXPECT.

★ DENOTES PRIVATE BRANCH EXCHANGE.

Paddington . 6017 ★Gerrard . 5131 Purley 1488 Victoria 4356 Kensington . 6860 Mayfair 2253	Cooper-Mitchell Mrs. D. 4A Oxford & Cambridge mans N.W.1 COOPER-STEWART ENGINEERING Co. Ltd. 135 Long Acre W.C.2 Cooper-Wilkinson Mrs. Dorothy Sandilands Briar hill Cooper-Willis Mrs. E. I. 39 South Eaton pl S.W.1 Cooper-Willis Capt. G. 38 Draycott pl S.W.3 Co-operation of Temperance Male & Female Nurses 60 Weymouth st W.1
---	--

Victoria 1206 Museum 573 Ravensbourne 1454 ★Avenue 3018 City 8605 ★City 3180 Streatham 3998 Gerrard 6802	Cope & Co., Solicitors 61 On Anne's chas SW.1 Cope & Co., Tile Merchants, Fixers, 5 Bury st New Oxford st WC1 Cope D. 43 Southend rd Beckenham hill Cope D. 169 Commercial rd E.1 Cope D., Tobacconist 18 Tudor st E.C.4 Cope David, Turf Accountant 97 Fleet st E.C.4 Cope Miss E. 9 Sternhold av S.W.2 Cope & Fenwick, Church Publishers, 13 Old Burlington st W.1
---	---

sively abbreviated, occupations not so often and with more consideration. Punctuation marks are used only for abbreviations, advertisements being inserted with due consideration for the text proper.

The provincial directories are based on zones, all subscribers of the exchanges within a certain zone being alphabetically arranged. The directory is furnished with a thumb index for the sections covering the various zones. The English directories are issued twice a year, each direc-

It has three columns to the page, its general make-up, size, etc. being very similar to that of the official directory, a sample of the same being shown on this page.

ITALY.

Next to the Paris directory, *Elenco Ufficiale degli abbonati al Telefono del Regno d'Italia* (1920) is the most bulky telephone directory in Europe. Its green cardboard cover is decorated with an image of Mercury with a transmitter placed in front of his lips. This directory includes all subscribers in the country and is issued by a private publishing house with the authorisation of »Direzione del Telefoni dello Stato».

It is two-columned and arranged according to exchanges, with the telephone number first, divided into two groups by a short dash. One standard entry requires 409 sq. mm. Abbreviations, wherever they occur, are carefully used. Punctuation marks are used and advertisements are inserted in the text. There is no special business directory, but certain trades and occupations are grouped together in the alphabetical index. The subscribers thus grouped together may also be found under their own individual names in the same index.

MEXICO.

The *Directorio de la Empresa de Teléfonos Ericsson, S. A.* (1920) is bound in pliable cloth covers and provided with two thumb index grooves going in opposite directions, both of which divide the book into two halves.

FIRE EXTINGUISHER REFILLS

Clissold ... 1456 Money's Patents, Ltd., 111 Dalston La., E.8
Regent. ... 3762 Radium Fire Extinguisher, Ltd., Bond St. Ho., W.1

FIRE HOSE MANUFACTURERS

Avenue ... 7793 **ANGUS, GEO., & CO., Ltd.**, 7 Bury St., St. Mary Axe, E.C.3
Hop. 1970 Burkit, Frank, Vulcan Iron and Wire Works, Lant St., Borough, S.E.1
Avenue ... 9339 **RAVEN HOSE & BELTING CO., Ltd.**, 4 Sheppey Pl., Minories, E.1

FIRE LIGHTER MANUFACTURERS

Maryland . 1946 Gills, Ltd., High St. E.15
Tottenham 2161 Jiffy Prepared Firwood Co., 30 North Gve., N.W.15

FIRE PROTECTION ENGINEERS

Victoria .. 9423 Fire Protection & Engineering Co., Ltd., 75 Victoria St., S.W.1

R 354 The Buff Book.

tory beginning with the announcement »This directory cancels all previous issues», printed on the cover.

The London directory is well supplemented by a special business directory called »*Buff Book, Trade and Commercial Directory*» issued twice a year by a private publisher in co-operation with the Post Office, and distributed free of charge to all telephone subscribers in London.

Roma

1072

94-30 **GHISIO** Dionigi e Figli, Fabbrica nazionale di medicazione antisettica, Articoli gomma ed affini per farmacia ed ospedali, p. Colonna, 359-360.
29-61 **GHOBERT** Camillo, v. del Casaletto, 67
21-755 **GIACCHETTI** ing. Acciario, v. Ennio Quirino Visconti, 85.
2-54 **GIACCHETTI** ing. Acciario, impr. costr. edilizie, v. del Boschetto, 32.
8-72 **GIACCHETTI** Cesare, forniture per tipografie e litografie, v. S. Giovanni in Laterano, 133-B.

20-973* **Giani G. & C.**

Soc. Anon. Elenchi Ufficiali Abbonati al Telefono dello Stato. Agenzia di Roma per la Pubblicità, v. Cola di Rienzo, 243.

14-96* **Giani G. & C.**

Soc. Anon., Elenchi Ufficiali Abbonati al Telefono. Sede. Amministrazione, v. del Babuino, 89.

R 355

Italy.

Tacubaya	18-35	Hunter, J. W., Dom. 5 ^a Tabasco 154.
	4-13	Hunter, J. W., Dom. «Quinta Los Cedros,» Av. Independencia y Trabajo.
México	81	Hurrie, Carlos N., Sitio de Automóviles de Alquiler, Av. Juárez.
	36-55	Hurrie, Carlos N., Taller de Galvanoplastia, 1 ^a Revillagigedo y Av. Independencia.
México	4-82	Hurrie, Carlos, N., Dom. 4 ^a Violeta 96.
	1-08-87	Hurrie, Lauro, Dom. Cljón. del Pradito 16.
	89-50	Hurtado Escobar, José, Dom. 4 ^a Niza 73.

R 356

Mexico.

The directory is one-columned, with a generous margin. The numbers come first, divided into groups by dashes to facilitate pronunciation and arranged according to exchanges. One standard entry requires 398 sq. mm. Abbreviations are very carefully applied and, as a matter of fact, hardly necessary in a one-columned directory. We find here both punctuation marks and advertisements, certain subscribers being specially denoted by means of different type and framing. A one-columned trade directory is to be found at the end of the directory. Each subscriber with a business subscription is entitled to entry in five different places in either the subscribers' index or the business directory or both, according to the subscriber's wishes. Additional entries cost \$ 5.

HOLLAND.

Naamlijst voor de telefondienst uitgegeven door het Hoofd bestuur der Posterijen en Telegrafie apparently contains all of the country's subscribers in a somewhat bulky but rather convenient volume. The two editions a year account for the unusually thin covers. A page of this directory show a certain typographical likeness with the German directories, although there is much greater saving of space in the Dutch one.

De Naamlijst is three-columned and arranged according to exchanges with references from

name of locality to name of exchange. One entry per exchange line is granted, additional entries costing 1.50 florins each. A standard entry requires 282 sq. mm. Abbreviations are used, seemingly often of a radical

nature. The numbers are placed last and are not divided into groups. Punctuation marks are used, advertisements occurring but rarely. There is no commercial index in the directory neither is any mention made of a separate one. One-columned *Gids voor het locale Rijkstelefoonnet* well provided with advertisements are published, however. These local directories have the exchange name first, each letter group being concluded with a little framed admonition similar to the English ones.

I will later on terminate this little talk with a few strains of music from a Dutch directory, which give good evidence of how deeply music has entered into the daily life of the Dutch people.

NORWAY.

Rikstelefonen, Oslo og omegn is the name of the directory for the Norwegian capital, which is supplemented by four additional volumes covering the remainder of the country.

This directory is three-columned and flat stitched with pasteboard covers and cloth back. The telephone number comes last and is not subdivided. The directory contains first an alphabetical register of the Oslo subscribers, after which comes a section with edges of another colour wherein the subscribers are arranged in alphabetical order, subscribers of the same name being placed according to the names of their

Amsterdam.

Muller, H. Th. M. Notaris, Keizersgr. 229 41019
 Muller, J. Vleeschh., Ie C. Huijgensstr. 90 27711
 Muller, J. Kruijerij en goederenverv., Ie Helmersstr. 20 26691
 Muller Jr., J. H. Makel., Sarphatip. 100 25424

Musbach, J. F. Wijnh., Kalkm. 9 (9-5) 41665
 Musch Pzn., G. Sigaren, v. Woustr. 144 28554
 Musch, J. Prinsengr. 909 30719
 Musch Cz., Kl. Timmerm., aann. en gew. betonb., Deijmanstr. 2 52220
 — Woonh. Fred. Hendrikstr. 98111

Naaimachine- en Motorh. Rozengr. 69 34212
 Naaml. Venn. Aann. Mij. v.h. IJland & Borst Ie Oosterparkstr. 92 51377
 Naaml. Venn. Agentuur en Comm. h. Zeist Singel 273 (na 6 u. 25664) 31261
 Naaml. Venn. Alq. Bewaard. en Re-

R 357

The Amsterdam Directory.

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— Advokat Bredal's bolig. Rosenborg — Advokat Fougner's bolig. Uranien- borg terrasse 11 63331 — Advokat Schjelderups bolig. Vettakollen 68872 — Advokat Schjodts bolig. Parkvn. 41 b 44104 Bredal, Helga, f. Bugge. Enkefru. Bj. Farmannsgt. 11 43127 Bredal, Marie. Frk. Bolig. Rosenborg	Brekke, Gunnar. Disponent. Kontoret. Tollbodgt. 3 24135 — Kullavdelingen. Tollbodgt. 3. 24870 — Bolig. Oscarsgt. 78 b 44595 Brekke, Hans. Handelsgartner. Strøms- vn. 60 31856 Brekke, Helene. Bolig. Parkvn. 15 64905 Brekke, Jac. A. Bolig. Fredrikshavn	Bretteville, A. Direkter. Solligt. I. 43592 Bretteville, Chr. Landbruksingenior. Jacob Allsgt. 30 62028 Bretteville, Eugène. Bolig. Huitfeldts- gt. 49 12962 Bretteville, Halvor. Agent. Bolig. Nils Juelsgt. 1 45055 Brevick, A. M. Chiropractor. Inkognito- gt. 34 42980
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R 358

The Oslo Telephone Directory.

respective exchanges, these being alphabetically arranged for such subscribers. If there are several subscribers of the same name at the same exchange, the alphabetical order of their given names or initials determines their placing. Each subscriber is entered once and is entitled to two lines, additional lines costing 5 Norw. crowns ea. The entry shall include name, address and telephone number. Any left-over space in the two free lines may be disposed of by the subscriber for useful information, such as telephone hours, etc. One standard entry requires 337 sq. mm. Punctuation marks are used, abbreviations also, but very judiciously. Advertisements are inserted, being systematically and suitably arranged. There does not seem to be any commercial directory, but the directory contains complete instructions and telephone rates, as well as seemingly complete toll rates.

SWITZERLAND.

The title of the telephone directory issued by the Swiss telegraph and telephone administration — *Amtliches Verzeichnis der Telephon-Abonnenten, Annuaire officiel des abonnés au téléphone, Elenco ufficiale degli abbonati al telefono* — is printed in three languages, the directory consisting of three volumes in which the three language principle is used not only for titles and general directions, but also for the sub-

scribers' occupations, depending on whether they reside in German, French or Italian speaking parts of the country.

The directory is three-columned and flat-stitched, with thin carton covers and paper back. The names are classified according to exchanges with references from name of locality to exchange. When there is but one local exchange in a town, the number is placed first, but if a city has several individually named local exchanges, the telephone number comes last, being sometimes divided up into groups by a point. A subscriber is entitled to one entry, containing name, occupation and address. All additional items, such as business or telephone hours, are charged 5 francs each. A standard entry requires 344 sq. mm., abbreviations and punctuation marks being used with great care. There is no commercial grouping in the directory, neither is mention made of any separate business directory. Advertisements occur on the covers, but not in the text. Short admonitions are placed at the top of each page, but their diversity cannot compare with that of the English directory.

U. S. A.

It does not take a very lengthy inspection of the American *Telephone Directories* to convince oneself of the very excellent results achieved,

Gerber-Demme, E., Thunstrasse 7 Bollwerk 26.11 Gerber-Feller, Fr., Spenglermeister, Neuhäuserweg 9 Christoph 35.14 Gerber-Heiniger, Fritz, Garten- strasse 11 Christoph 43.28 Gerber-Hiltbrunner, F., i. Fa. Gerber & Kuhn, Zollikofenerstr. 24	Gutenbergstr. 19 Bollwerk 47.70 Gerstner, F., Photohaus, Marktg. 6 Christoph 24.38 Gertsch, Fritz, Pension, Brunng. 64 Christoph 34.75 Gesundheitsamt, eidg., Bollwerk 27 Direktor Christoph 32.91 Chemisches Laboratorium Bollwerk 32.91	Ghielmetti, J., Baumeister, Hoch- Tief- und Eisenbetonbau, Thun- strasse 83 Bollwerk 39.96 Ghielmetti, F., & Cie., Elektr. Appa- rate, Spitalackerstrasse 63 Christoph 19.64 Gianni, Henri, Bildhauer, Murten- strasse 64 Christoph 32.99
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R 359

Switzerland.

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naturally not without much painstaking and assiduous labour. The clear, legible open type used for letters as well as for figures make a most attractive impression even though printed on paper of comparatively cheap quality. There is a high degree of concentration, abbreviations being of a very extreme nature, yet offering no serious difficulties for even a foreigner to decipher. Punctuation marks are considered superfluous and have been conscientiously omitted. In other words, space has been so carefully utilized as to allow the inclusion, where necessary, of almost one million entries in a single volume which, in spite thereof, is not more difficult to handle than many European directories containing a far lesser number of entries. And

advertisers. Type and column width are chosen so as to permit the two-column setting to be made up into three-column setting, should the growth of the net make the directory over-bulky and difficult to handle. We now come to the medium sized American directory, the author having had access to the *Hartford District Telephone Directory*.

In respect to type, width of columns, placing of telephone number (last, with grouping of digits as an aid to pronunciation) etc. this directory is identical with the two-columned one; it is only in the number of columns that it differs. Both of these directories are flat stitched, with comparatively durable carton covers. They are issued twice a year.

Tussey H C coal 1738 Margaret av.....	6890	Valentine W B r 1127 4 av Jun.....	3195
Tussey H C r 2723 Broad av.....	2-4834	Vallade Bernadette r 1102 16 av.....	2-1866
Tussey Jay C & Co plbg & gas fig		Vallade Frank J r 1607 11.....	3688
2410 Union av.....	2-7406	Vallade J Clem r 1203 9.....	9967
Tussey Lillian M Miss r 840 27.....	2-5436	Valley View Sales Office real estate	
Tussey Raymond H r Wayne apts.....	2-1912	504 Pleasant Valley Blvd.....	9826
Tussey Walter r 218 5 av.....	8537	Valvano Adelaide Mrs r rear 217 7 av.....	2-7961
Twardon Mike r 2614 13 av.....	2-8832	Vance C D r 1808 11.....	2-7909

R 361

Altoona, Pa. U. S. A.

Note that residence is denoted by the letter r, also the attractive two-line setting at Tussey Jay C & Co and Valley View Sales Office.

yet, this concentration does not seem to have been gained at the expense of the convenience of the seeker, but at the expense of the individual wishes of many subscribers to be more worthily represented in this the most used reference book of a modern community. The writer has had the opportunity of investigating four different types of American directories, apparently gotten up with due consideration for the future growth of the net as well as for its present requirements. I will begin by mentioning the least accessible one, for *Altoona, Pa.*

It is set up with two-columned pages and arranged according to exchanges, with necessary references from names of localities to exchanges. The attractive manner in which entries requiring two lines are set up is worthy of notice and of being imitated. Generally, however, one entry requires but one line, the necessary area being not more than 176 sq.mm. There are advertisements, and also a small commercial index for

Among the largest type of American directories, we find some difference between those for Chicago and for New York, but this difference is so slight that it will be sufficient, in this connection, to describe the largest one, the *New York City Telephone Directory*, an immense four-columned book of 1730 pages.

As may be seen from the fragment on the next page, a record has been made as concerns concentration and abbreviations, and the seeker — especially if his eyesight is not of the best — may often feel the need of a magnifying glass. The stitching machine has not been able to cope with this volume, but machine binding on canvas with pasteboard covers has been resorted to. The machines necessary for the speedy binding of such million-volume editions are naturally worth a chapter of their own, but do not come within the scope of this article.

One little item of interest which I take great pleasure in mentioning, however, is the printed

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note on the Chicago directory giving the information that *the directory is the property of the company*. This little statement no doubt facilitates the collecting of old directories — when new ones are distributed — in no small degree, and makes possible the destruction of all old directories, which otherwise cause no end of trouble. Of all the directories investigated, the Chicago directory breaks the record for concentration, one standard entry requiring not more than 123 sq. mm. Both of these types are issued three times a year.

Donelley's Red Book Classified Telephone Directory should really have a chapter of its own; limited space, however, permits only a short mention of the same. This business directory is issued in New York by a private publisher in co-operation with and under the authorization

6 Liberty. *REC tor-4308
 sts 2 Pike ORC hard-0907
 Franklin av. JER ome-1613
 31 W 110. CAT hedri-8096
 13 W 125. MOR nsld-2462
 0-5th av *PEN slynia-2275
 Vyse av. INT rvaie-6732
 57 Dey. COR tland-5474
 (unts Pt av. INT rvaie-6660
 W 29. CHE lsea-0738
 141. MOT Havn-6043
 72-1st av. LEX lngtn-4088
 t Pk W. RIV rsid-0521
 E 119. HAR lom-6949

R 360

Sachs Julius Prof r The Belnord. SCH uyl-10400
 Sachs Julius Dr r 86 W 119. UNI rvaity-5046
 Sachs K r 632 Union av. MEL rose-4629-M
 Sachs L B Dr r 411 West End av. SCH uyl-9807
 Sachs Leo B 498-7th av. *LON gacre-4180
 Sachs Leo B Co Inc coats suits
 498-7th av. *LON gacre-4180
 Sachs Leo M diamonds 21 Mdn la. COR tland-5285
 Residence 380 Riverside dr. CAT hedri-7063
 Sachs Louis 38 W 21. CHE lsea-9790
 Residence 1044 Mad av. RHI nldr-10153
 Sachs Louis ladies tailors 102 E 86. LEN or-8688
 Sachs Louis lawyer 299 Bway. WOR th-3658
 Residence Bklyn 8005-19th av. BEN snbst-4794
 Sack Louis 200 W 110. HAR lom-6949

Sack Phil r 940 E 174.
 Sack Pincus r 5 E 107.
 Sack S B advtg 1476 Bway.
 Sack Samuel embdry 452 W
 Sack Samuel furs & skins 15f
 Sack Samuel laundry 1105-3d
 Sack Simon B r 1354 Morris
 Sack Trimming Co 10 E 14.
 Sack & Bernstein furs 159 W
 Sack & Fink clk & suits 20 '
 Sack's Music Store 1011 S
 Sackentoff F grocer 1598 Ams
 Sacker L & Son mfr dresses 1
 Sackett A Inc textiles 100 W
 Sackett Augustine Mrs r 1219.

New York City.

of the telephone company. It is financed by the advertisers and is distributed free of charge among the telephone subscribers. It is issued twice a year and contains 4000 titles of occupations and lines of business. The Red Book is combined with what is called *Buyers Service*, consisting of an information bureau where any person can obtain free information as to the nearest place of purchase for any certain article of merchandise. Type, size, abbreviations, width of columns, binding, etc., are all very similar to that of the telephone directory.

The same firm issues similar classified directories for the cities of Brooklyn, Chicago and Cincinnati, as well as for the states of Illinois and Connecticut. There is no need whatever to doubt that this is an excellent business venture, an efficient advertising medium, a good source of information for the seller as well as for the purchaser and, at the same, an invaluable aid to telephone service.

SWEDEN.

Rikstelefonkatalogen includes practically all the Swedish telephone subscribers and consists of six sections. The Stockholm section, which is the largest, is divided up into two volumes, the one with subscribers belonging to the Stockholm exchanges, and the other for the suburbs. The directory for Stockholm proper is published in two separate editions, one of them, for manual subscribers, giving exchange name and number, the other, for automatic subscribers, with only 6-digit numbers, but no exchange names. Naturally, this is but a temporary arrangement, due to disappear at a comparatively early date with the complete automatization of the city net, after which

Valet Royal 250 W 111th.CAT hedri-9788
 Washington Heights Valet
 4216 Bway. WAD swth-9379
 Zumbach Louis 829 Park av.RHI nldr-8762

Clothes Dryers

See also Laundry Machinery & Equipment
 Amer Clothes Dryer Co
 224 W 26th. CHI ckering-2240
 Chicago Dryers Co 224 W 26th. CHI ckering-2240
 Corbett Ceiling Clothes Dryer Co
 415 E 161st. JER ome-1724

HILL LAUNDRY EQUIPMENT
CO INC 67 6th LI City. HUN ters Pt-3960
 O K Clothes Dryer Co
 471 W 145th. EDG ecombe-2719
 Overhead Kitchen Clothes Dryers Co
 471 W 145th. EDG ecombe-2719
 Shannon Mfg Co 224 W 26th. CHI ckering-2240

Clothes Dryers, Roof

KUNKLER F J Wooden Platforms
 and Walks 338 E 124th. HAR lem-0951
SINGER M Roof Dryers Erected
 and Repaired. Roof Radio Frames
 Installed 2525 3d av.MOR nsld-8032

Clothes Lines, Mnfrs.

HOFFMAN-CORR MFG CO
 318 LafayetteCAN al-2001

Clothes Pins

For Information "Where-to-buy" Telephone
DONNELLEY'S RED BOOK
BUYERS SERVICE 28 W
 23dGRA mercy-7000

R 362 Donnelley's Red Book.

the manual edition will be a thing of the past. We reproduce here a fragment from each of these Stockholm directories.

The provincial directories each cover certain geographical districts, the boundaries of which are partly effaced by certain double-entry zones,

three lines, to be entered in either the subscribers' index or in the classified directory mentioned here below. A charge of 10 Swed. crowns is made for each additional line. A standard entry in the Stockholm directory requires 369 sq.mm., in other sections from 289 to 369 sq.mm. This

Br Broman, Fru

Broman, L., Fru, Surbrunnsg. 38.	Norr 283 14
Broman, Lotten, Fru, Karlbergsv. 85.	Vasa 175 43
Broman, Sofia, Fru, Kocksg. 21.	Söder 1746
Broman, Carolina, Fröken, Hagag. 20.	Vasa 1936
Broman Ida, Fröken, Västmannag. 48.	Vasa 4653

R 363

Stockholm Directory for Manual Subscribers.

Br Broman, Fru

Broman, L., Fru, Surbrunnsg. 38.	22 83 14
Broman, Lotten, Fru, Karlbergsv. 85.	31 75 43
Broman, Sofia, Fru, Kocksg. 21.	40 17 46
Broman, Carolina, Fröken, Hagag. 20.	30 19 36
Broman, Ida, Fröken, Västmannag. 48.	30 46 53

R 364

Stockholm Directory for Automatic Subscribers.

the subscribers within these zones being entered in the directories of both of the adjacent districts. In the Stockholm directories, subscribers with the same family name are alphabetically arranged according to their occupations, and after that according to their given names or initials. In the provincial directories, on the other hand, all subscribers with the same family name are placed consecutively and alphabetically arranged according to exchanges, and after that according to occupation.

All directories are three-columned and stitched with thin carton covers and cloth backs. The telephone number comes last and — in the case of five and six-digit numbers — is divided into groups by means of wider spacing. Each regular subscription entitles the subscriber to

variation is caused by the omission of street addresses except for Sweden's three largest cities. A classified commercial directory is included in the Stockholm, Gothenburg and Malmoe sections, but its use is not obligatory. Punctuation marks are used; abbreviations also, but with great care. Advertisements are plentiful, especially in the classified directory.

The investigation committee whose duty it is to submit a proposal for the revision of the directory, has now submitted a tentative proposal, some of the most important clauses being as follows: —

1. The right of the subscriber to formulate his own entry shall cease, such formulation being determined by the telegraph administration from the seeker's point of view only.

An Göteborg Andersson Bröderna

— 20 —

Andersson Bröderna se Bröderna Anderson		Andersson J A W Banv, Pallasg. 20.	125 59
Andersson & Börjesson Risåsg. 6.	8393	Andersson Olga Barnm. Brunnsg. 10	8201
Andersson & Co Alb. W Kont.	4047	Andersson H Befälh. Ankarg. 18	452 39
Andersson & Co C H Gust. Ad.g 27. Lunden.	505 59	Andersson Linnus Bilcentralen	5242
Andersson & Co H F Kont. Vallg. 8.	210 15	Andersson Wilh.	
Andersson & Dahlqvist Ab. Skeppsbron 1.	533	Bildhuggeristuekatörverkst. Nordhemsg. 39	413 68
— Pråmyarvet & Ringön Tingstadsv.	5010	Andersson Albert Bilför. bst. Stampg. 38.	502 59
Andersson & Lindberg Avenyen 2 A	3311	Andersson Gunnar Bilför. bst. Sten Stureg. 16	210 61

R 365

Proposed New Swedish Directory. Two-columned for smaller and three-columned for larger sections.

2. Classified directories shall be included in all of the sections. The entry of a subscriber in the alphabetical index and in the classified directory — if he is in business — is compulsory. A subscriber who does not wish to be entered in the directory can acquire this privilege by paying a special fee.
3. All subscribers belonging to larger exchanges shall be removed from the regular sections and listed separately according to exchanges in the beginning of the book. Street addresses can be included in these separate lists thanks to the omission of the exchange name. Subscribers of other exchanges retain their arrangement in common alphabetical succession without street address, but the rural address shall be included when it differs from the telephone address.
4. The column width shall be slightly increased so that, by adopting standard abbreviations and by eliminating punctuation marks except

in abbreviations, it shall, as a general rule, be possible to include one entry on one line. The columns shall be of such width as to allow smaller directories to be two-columned and yet permit a change to three-columned pages when made necessary by the expansion of the net. The illustration on page 105 gives a very good idea of the comparative sizes of the six sections before (to the left) and after (to the right) the adoption of the proposed changes. Flat stitching is proposed for all sections, as long as this method of binding shall be technically possible. For the sake of comparison, we have reproduced a fragment from this new revised directory.

The proposal in question has not yet been finally passed on by the board of directors of the telegraph administration.

Hugo Jonsson,
Controller of Telephones, Stockholm.

DE KENNIS

der geluidssignalen

is voor U van groote beteekenis



R 567 Strains of Telephone Music from Rotterdam.

CONTENTS: Torsten af Geijerstam. — A few Illustrations from the Works of The British L. M. Ericsson Mfg Co. — List of Ericsson Automatic Telephone Exchanges. — A Talk on Telephone Directories.

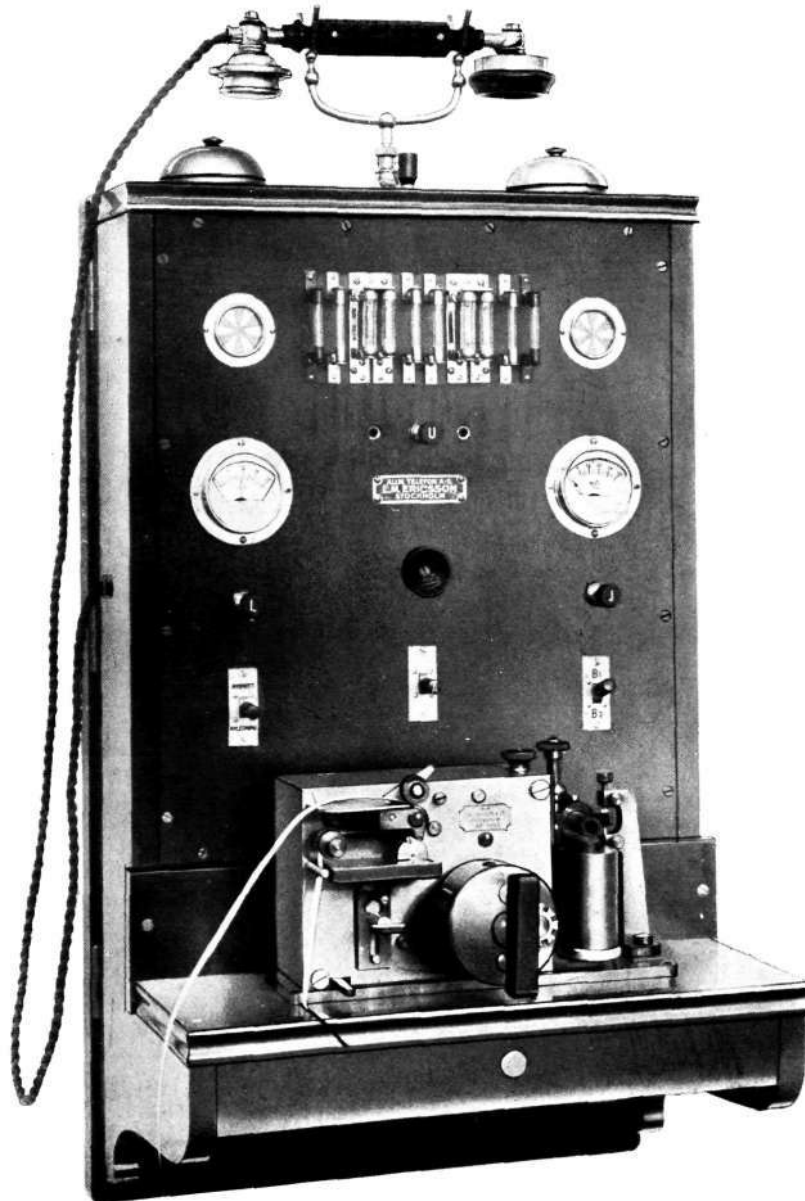
The L. M. Ericsson Review



VOL. 2

NOVEMBER-DECEMBER 1925

Nos. 11 & 12.



R 39E

ALARM BOARD FOR FIRE ALARM SYSTEM WITH MORSE
TELEGRAPHIC SIGNALLING.

ENGLISH EDITION

L. M. Ericsson

THE L. M. ERICSSON REVIEW

ENGLISH EDITION.

JOURNAL OF
ALLMÄNNA TELEFONAKTIEBOLAGET L. M. ERICSSON, STOCKHOLM.

HEMMING JOHANSSON, Director.

Issued monthly. ~ ~ ~ ~ ~ Yearly subscription rate: 7/-

All communications and subscriptions to be forwarded to the Editor.

*To all L. M. Ericsson employees
and friends throughout the world
my best wishes for
A Prosperous New Year.*

R. V. Minerault.

Junction Traffic between Automatic and Manual Exchanges.

The prime motive for replacing manual equipment with automatic is the elimination of all manual work in switching operations, but this purpose is not achieved until every exchange within the net has been thus equipped.

Since it usually is impossible to carry out such a rebuilding operation all at once, there must necessarily be a period of transition during which junction traffic between the automatic and the manual exchanges within the net is unavoidable. The problem of arranging such traffic in an efficient and economical manner is influenced by the special characteristics of both net and traffic in each separate case. Before deciding on any special system, therefore, due consideration must be given certain details, among which the following may be mentioned.

- a. The number of manual exchanges within the net with which junction traffic is to be established.
- b. The sizes of the various exchanges, i. e. the number of subscribers and the density of the traffic between the automatic and the manual exchanges. The experience which has gradually been gained as to traffic conditions within the net will be found useful in figuring the probable amount of traffic between the automatic and the manual exchanges. This knowledge is of value in calculating the cost of necessary equipment for the junction traffic, as the choice of a suitable system provides the possibility — even though limited — of varying these costs, i. e. of apportioning a greater or lesser part of the same on the automatic equipment, the manual exchanges or the junction lines.
- c. The distances from the automatic to the manual exchanges.
- d. The junction line facilities and the cost of new junction lines.
- e. The systems in use at the manual exchanges, i. e. common battery or local battery.
- f. The assumed length of life of the manual exchanges. This point is of importance when choosing a system insofar as it determines the more or less temporary character of the junction traffic. If a manual exchange is expected to remain in operation for any greater length of time, comparatively speaking, it is worth while installing more efficient and costly equipment, thus permitting a reduction in the personnel and consequently in the cost of operation. On the other hand, if the operation of the manual exchange is to be continued for only a very short time, simpler and less expensive arrangements are used, although the cost of operation, as a result, will be somewhat higher.

The Ericsson company has designed and built various systems for handling the junction traffic between automatic and manual exchanges, being guided in this work by the valuable experience acquired in its vast field of operation covering all parts of the world. These systems will be briefly described in the following.

I. TRAFFIC FROM AN AUTOMATIC TO A MANUAL EXCHANGE.

1. *System with manual B-board.*

This is probably the most simple method of arranging junction traffic from an automatic to a manual exchange, and is illustrated in principle in fig 1.

The junction lines go out from the multiple field in the group selector rack at the automatic

exchange and terminate at the manual exchange in special B-positions with single cord equipment and plugs *P*. One answering lamp *AL*, one calling lamp *CL*, one combined speaking and ringing key *K*, and the necessary relays are provided for each of these lines, this equipment being mounted in the B-board. The manual subscribers' lines are connected to the B-board multiple.

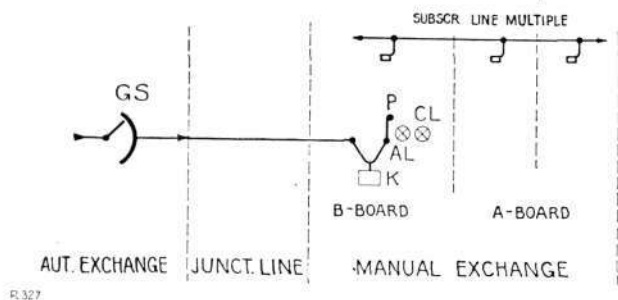


Fig. 1.

The switching operation for a connection from an automatic to a manual subscriber is briefly as follows:

The automatic subscriber dials a number — the digit 3, for instance — corresponding to the number of the manual exchange. The group selector is actuated and seeks a disengaged

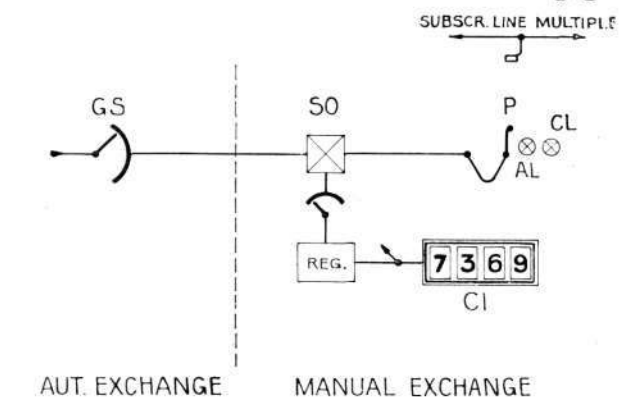


Fig. 2.

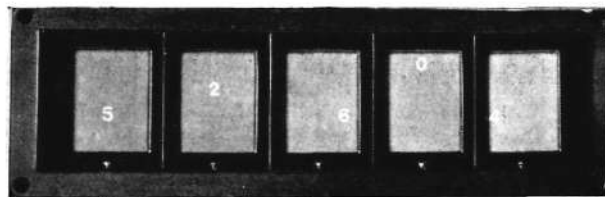
junction line. The answering lamp *AL* of this line glows and the operator presses the key *K* over into speaking position. The automatic subscriber requests the desired manual number and the B-operator — after first having tested the line — plugs up the cord with the plug *P* in the subscriber's multiple jack, whereupon the key *K* is pressed over in ringing position.

When the conversation is over and both subscribers have replaced their receivers, the automatic switching devices are restored to normal and the calling subscriber is free to make new calls. After the B-operator has pulled down the connection the junction line is indicated as disengaged.

The above system for handling junction traffic is the cheapest, when considering the cost of installation, on account of its simplicity and is therefore well suited for cases where the existence of the manual exchange will be of comparatively short duration. The fact that the automatic subscribers must first dial the exchange number and then request the desired telephone number from the B-operator is naturally a disadvantage. From the subscriber's point of view, therefore, there is a distinct difference between calls to manual subscribers and calls to automatic subscribers. The work of the B-operators is greater than with the next system to be described, a larger number of B-positions being required for this reason.

2. System with optical call indicators in the B-positions.

A development of the system already described is one in which the B-positions are provided



R 340

Fig. 3.

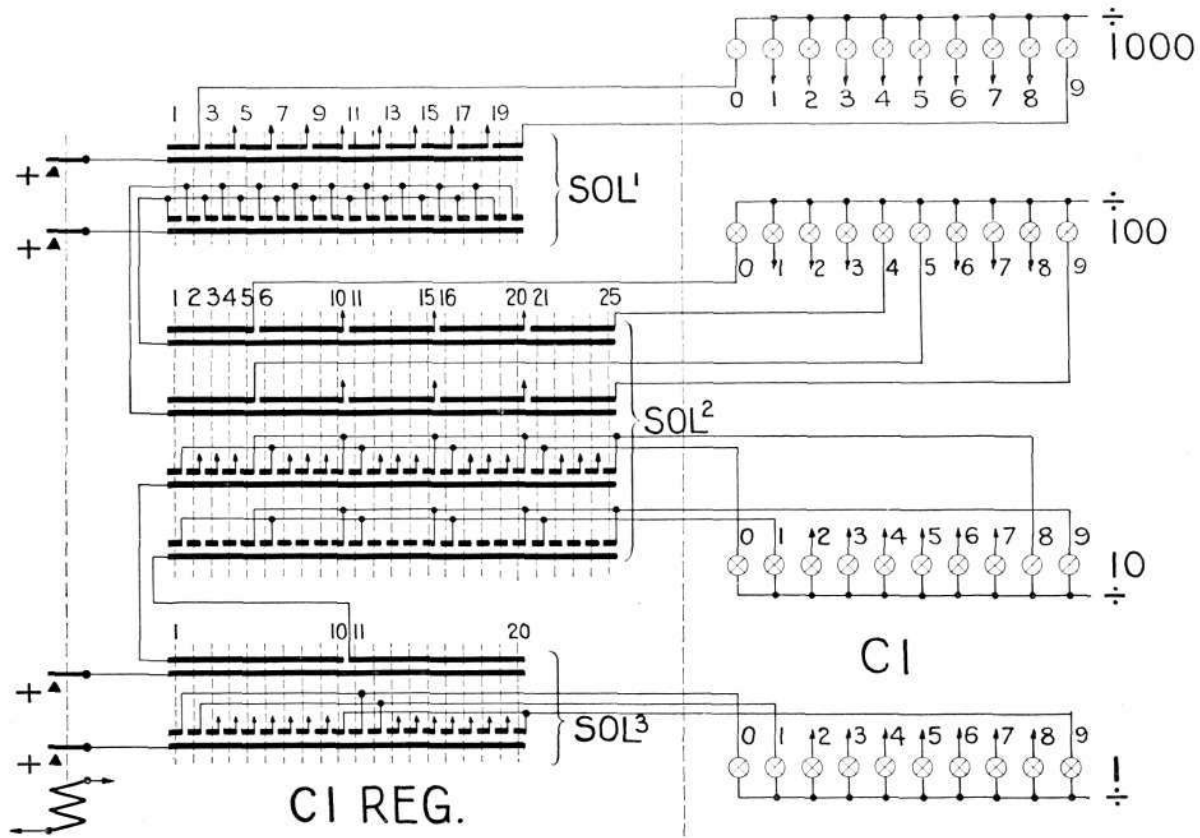
with optical calling devices or call indicators. The principle of this system is shown in fig. 2.

The incoming junction lines at the B-positions terminate in single cords with plugs *P* — as in the previous case — with one answering lamp *AL* and one clearing lamp *CL* for each circuit. On the other hand, there is no calling and ringing key. Each line is provided with a sequence switch *SO* and the necessary relays, each B-position having two or three call indicator registers *Reg* — the number depending on the traffic —

with register selectors *RS* for connecting up these registers with the junction lines. The registers as well as the register selectors are composed of sequence switches and relays.

Each position is provided with a call indicator *CI* on which the dialled numbers appear with luminous figures, these indicators being located on the keyboard or under the subscribers' multiple in the vertical panel. Fig. 3 shows such

been found and the register connected up to the same, the sequence switch of the register is immediately actuated. This sequence switch is set on the same principle as the group selectors and connectors during a switching operation at the automatic exchange, and is governed — by means of back impulse control — by the register at the automatic exchange which has received and registered the number dialled by the auto-



R329

Fig. 4.

a call indicator for five-digit numbers. The switching process is briefly as follows:

The automatic subscriber dials the number of the manual subscriber, the calling subscriber being connected to a B-position with idle call indicator register over the group selector *GS* on a disengaged junction line. The sequence switch *SO* of the junction line is set and the register selector *RS* of an idle register starts hunting for the calling line. This line having

automatic subscriber. Thus, a call indicator register composed of three sequence switches is provided for reproducing a four-digit number. The first sequence switch has twenty contact positions and corresponds to the rotary setting of the group selector. The second has twenty-five contact positions and its function replaces the rotary setting of the connector. The third, lastly, has twenty contact positions, its function corresponding to the radial setting of the connector. When

the entire call indicator register has been set, the three sequence switches stand in positions which exactly correspond to those positions which would have been occupied by the group selector and connector had the call been intended for an automatic subscriber.

A call indicator for four-digit numbers is provided with four sets of lamps, each set with ten lamps numbered from 0 to 9. These lamps are connected up with the sequence switches in the call indicator register as shown in fig. 4, i. e. by a return to the decimal system from the 500-basis on which the automatic system is built up. The principle for these connections, therefore, is the same as the one applied in the registers at an automatic exchange where a return to tens-groups from five-hundreds groups is made for the connections between the number registers and the registers which control the setting of the group selectors and connectors (the back impulse registers).

After the setting of the call indicator register the lamps on the call indicator will glow, giving the number dialled by the automatic subscriber in luminous figures, the answering lamp *AL* of the junction line being simultaneously made to glow. The operator inserts the plug *P* in the multiple jack with the number denoted by the call indicator, causing the *C. I.* register to be released and restored to normal and the luminous number on the call indicator to disappear.

Testing of the ringing signal on the called line is done automatically. If the line is disengaged, the ringing signal is heard by the calling subscriber, an occupied line being denoted by a busy signal.

Disconnecting takes place as usual after both subscribers have replaced their receivers. If the desired number is busy, or if no answer is received, disconnecting takes place when the calling subscriber gives a clearing signal.

As previously mentioned, each B-position is usually equipped with two or three call indicator

registers, making it possible for one position to receive two or three simultaneous calls. Of course, only one of these calls is connected up with the call indicator and only one lamp *AL* glows. The other calls must wait until the first one has been dispatched.

One advantage possessed by the system just described is that service — from the point of view of the automatic subscriber — is exactly the same, no matter if the call is made to another automatic subscriber or to a manual subscriber. The work of the B-operators is reduced to a minimum, enabling each operator to handle a greater number of calls per hour than with a system where the subscriber is asked for the desired number and where the operator must test the line and give a ringing signal, besides.

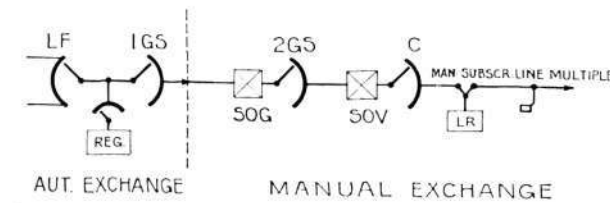
On the other hand, the comparatively high first cost for sequence switches, racks, control devices and power plant (in those instances where 12-volt current is not directly available) is a decided drawback, making this system advantageous only where the length of life of the manual exchanges is so long that the lower cost of operation will give a profit in spite of the high cost of installation.

The system with call indicators at the B-positions of the manual exchanges has been introduced by L. M. Ericsson in Stockholm, Shanghai and Mexico, among other places.

3. System with full automatic junction traffic.

A full automatic junction traffic system is obtained by connecting up the manual subscribers to connectors, installed at the manual exchange, together with the necessary group selectors, as shown in fig. 5.

To the left is shown the automatic exchange with its line finders and first group selectors. The required number of second group selectors *2 GS* and connectors — one rack being required for each 500 subscribers, as usual — are installed



at the manual exchange. The sequence switches SOG for the second group selectors are connected according to the same diagram as is used for the automatic exchange, while the connection of the sequence switches SOV for the connectors, on the other hand, differs from the normal method and depends on the telephone system of the manual exchange. Thus the principle for testing differs from normal. With the Ericsson c. b. system for manual exchanges, current is fed to the subscribers' instruments over the permanently connected line relays, while in the automatic system the same function takes place over relays in the sequence switches of the line finders and connectors, necessitating a deviation from normal in the connections for the sequence switches of the connectors.

The above system for junction traffic with full automatic switching has been introduced in Rotterdam. The central manual exchange — according to the Ericsson three-wire c. b. system and with a capacity of 15000 subscribers — has been equipped with connector and group selector racks for the traffic to these 15000 subscribers from the automatic exchanges Rotterdam West and Rotterdam Noord. The junction traffic from the Rotterdam automatic net to a manual c. b. exchange in the near by town of Schiedam has also been arranged in this manner. The Schiedam exchange, which is owned by the Dutch telegraph department, is built according to the Ericsson c. b. system with a capacity of 1200 lines. In this case, the group selectors for the incoming traffic are mounted at the outgoing exchange, i. e. at Rotterdam West, the connectors being installed at Schiedam.

The elimination of B-operators is the one great advantage of full automatic switching for junction traffic. The group selectors and connectors installed at the manual exchanges will come to use when these latter are rebuilt for

automatic switching, only the reconnecting of the sequence switches for the connectors being necessary.

II. TRAFFIC FROM A MANUAL TO AN AUTOMATIC EXCHANGE.

Various systems for handling junction traffic from a manual to an automatic exchange can also be applied, depending on the existing circumstances. B-positions are used with the first three of the four methods for handling such traffic described in the following. With respect to the switching operations, two different systems can come into consideration in connection with these three methods, viz.

a. Service with the aid of order wires between the A- and B-positions. Order wires, one of which terminates in each of the B-positions, are multiplied in the A-positions of the manual exchange so that each operator can reach any desired B-position. The outgoing junction lines

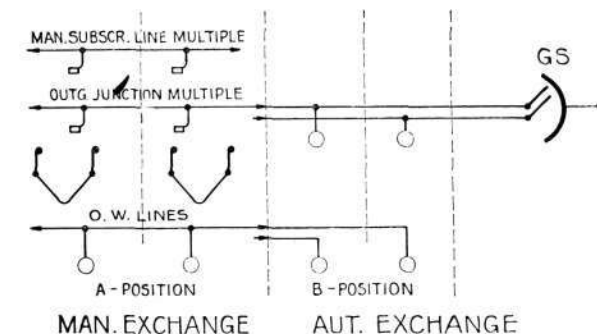


Fig. 6.

are multiplied in the A-positions of the manual exchange as shown in fig. 6. For instance, if three B-positions are necessary for handling the incoming traffic at the automatic exchange, the junction lines are divided into three groups, each B-operator disposing over one such group.

Service with the aid of order wires is given in the following manner.

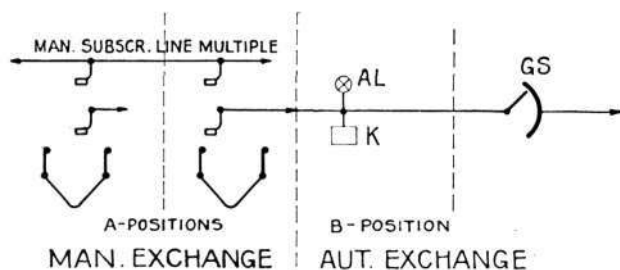
The calling subscriber, who is connected to the manual exchange, gives the desired automatic number directly to the A-operator. The A-operator seeks and calls a disengaged B-operator over an order wire, giving the name of the home exchange and the desired automatic number. The B-operator selects an idle junction line and gives its number to the A-operator, after which the connection is completed.

The advantage with order wires is that the calling subscriber need only speak with one operator. Since the junction lines form large

groups — each B-operator can handle about thirty lines — the total required number of junction lines is much smaller than for systems with individual jacks in each A-position.

A drawback with such a system is the increase in the work of the A-operators, and the seeking for idle order wires — when traffic is heavy — can consume a great amount of valuable time. This objectionable feature is counteracted by introducing order wire selectors, one for each A-position. When an A-operator depresses her order wire key, this selector is actuated and automatically selects an unoccupied B-operator.

b. Service without order wires. The outgoing junction lines are individual for each A-position



R. 332

Fig. 7.

or are multiplied over only a few positions — say two or three, at the most. The B-positions are equipped with one answering lamp *AL* and one speaking key *K* for each junction line according to the diagram in fig. 7. Calls are handled in the following manner.

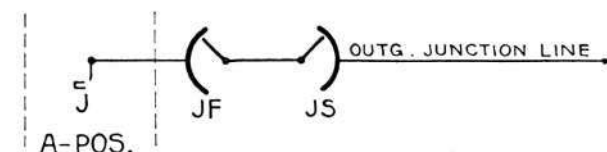
The calling manual subscriber gives the answering A-operator the name of the exchange over which the call is to be directed. The A-operator plugs up the calling cord in the jack of an unoccupied junction line to this exchange. The answering lamp *AL* glows and the B-operator answers by pressing the key *K* into speaking position. The calling subscriber gives the desired number and the B-operator completes the connection.

The advantage with this system is the simplicity of the work at the A-positions, while the fact that the calling subscriber must speak to two operators naturally is a disadvantage. Since

the junction lines are individual or multiplied over only a few positions, a much larger number is required than for a system with order wires. This number can be reduced, however, by introducing selectors, as shown in fig. 8.

The jacks in the A-positions are connected to a multiple field, common for a certain number of jack finders *JF*. Each such jack finder is connected to a selector *JS* whose function is to find an idle junction line. When a call is connected up to a jack *J* by an A-operator all the idle selectors *JF* to whose contact banks this jack is connected are set in motion. The first one to find the call is connected up and the corresponding selector *JS* is simultaneously set in motion for the purpose of finding an idle junction line.

The selectors are of the Ericsson cylinder type for 40 lines. By grouping them suitably the number of junction lines can be reduced so as



R. 333

Fig. 8.

not to exceed those required for a system with order wires.

We will now briefly describe the various methods for handling traffic from a manual to an automatic exchange.

1. *With manual switchboards at the automatic exchange.*

The automatic exchange is equipped with manual boards to whose multiple jacks the subscribers' lines of this exchange are connected, the connecting up of the cables to the multiple being best accomplished on the terminal strips of the line relay racks.

An incoming call at the automatic exchange is connected up directly to the multiple jack of the subscriber in question by the B-operator. Thus, the incoming traffic from the manual exchanges does not come in contact with the automatic switching equipment but is directed

straight out to the subscribers. This system for the handling of junction traffic is not frequently used but is resorted to in certain cases, however, where the temporary arrangements are expected to be of but short duration and where the B-positions and the multiple equipment can be subsequently used for other purposes.

2. *With semi-automatic B-positions at the automatic exchange.*

The most common method of handling junction traffic from a manual to an automatic exchange is, undoubtedly, with the aid of semi-

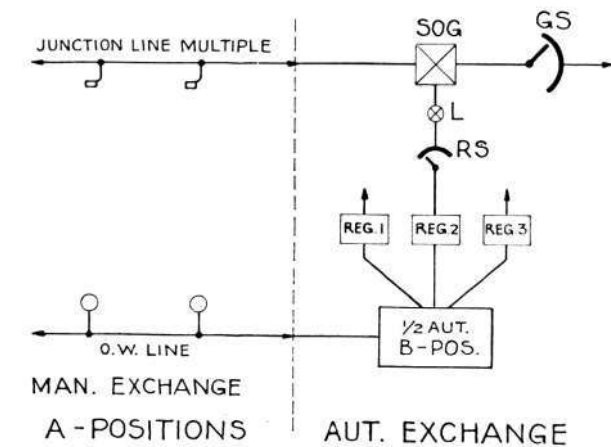


Fig. 9.

automatic B-positions at the automatic exchange, as shown in fig. 9.

The junction lines from the manual exchange terminate in group selectors *GS* with sequence switches *SOG* at the automatic exchange. The junction lines belonging to one B-position can be connected up to the three registers — *Reg. 1*, *Reg. 2* and *Reg. 3* — of this position over three selectors *RS*. The B-position is equipped with one supervision lamp *L* for each junction line, and one set of keys for setting up the numbers. A set of keys for four-digit numbers consists of four strips, each strip with ten keys numbered 0 to 9. The semi-automatic registers are built on the same principle as full automatic registers. The setting of the register units which register the number is not accomplished by

means of impulses, however, as with full automatic registers, but by means of a set of keys and according to the method illustrated in fig. 10, which shows a key strip for one digit and the corresponding register unit with its stepping magnet *Re*.

The operator sets up the desired number by depressing the corresponding keys, these keys being held in their depressed positions by means of a common locking magnet. The starting key *STK* is then depressed, closing a circuit through *Re* and causing this register unit to be stepped forward one step. *Re* de-energizes, causing the register unit to be advanced one more step to the position marked 0. Here *Re* is again energized over the spring contact of the key 0 — naturally on condition that this key has not been depressed — causing the register unit to

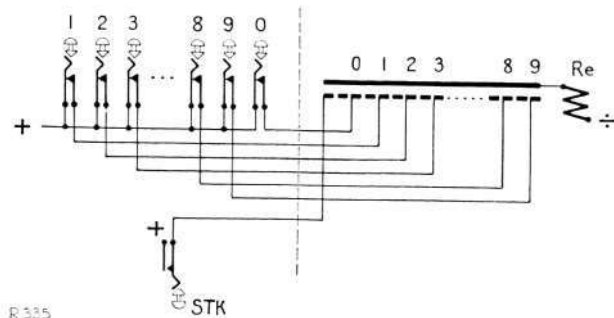


Fig. 10.

advance to position 1, and so forth, until it reaches a position where the circuit over *Re* is broken. For instance, if the key 8 is depressed, the register unit will stop in position 8.

Thus, all of the register units are stepped forward to positions corresponding to the desired number just as soon as the operator depresses the starting key, this setting requiring but the fraction of a second. The semi-automatic register works on the same principle as the full automatic register in regard to the setting of the group selectors and connectors.

As already stated, each B-position is equipped with three registers, permitting three calls to be simultaneously connected up to one position.

A system with order wires is illustrated in fig. 9. The switching operation is as follows:

At the same moment as an A-operator connects up with a B-position over an order wire, the register selectors *RS* belonging to idle registers are actuated. The function of these selectors is to select an idle junction line and connect it up to the position and the register, after which the lamp *L* glows. The B-operator gives the number of this junction line and sets up the number requested by the A-operator on her key set. Immediately following the pressing down of the starting key, this position is ready to handle a new call, in this case coming in over register No. 2. As soon as the operator is through with this call, another one can be received over register No. 3, etc. A register becomes disengaged simultaneously with the connecting up of the connector to the subscriber's line, the connectors being automatically restored to normal when disconnection takes place in the A-position. The B-operator need not take any part in the supervision of the call, her only duty being to set up the called number on her keyboard.

This system for handling junction calls from a manual to an automatic exchange by means of semi-automatic B-positions is used in Rotterdam, among other places. Service is given without the aid of an order wire, the subscribers themselves requesting the desired numbers from the B-operators. In this way the operators of the central manual exchange, who are kept busy handling the exceptionally heavy traffic, are not overloaded with extra duties, their work being performed in exactly the same manner either they are calling a subscriber or making connections with an automatic exchange. Each position in the multiple switchboards is equipped with two groups of jacks for outgoing junction lines to the automatic exchanges, i. e. one group for the »West» exchange and one for »Noord». The lines

to »West», which are 500 in number, terminate in line finder racks at the automatic exchange just like ordinary automatic subscribers' lines, while the junction lines to »Noord» terminate in group selectors.

3. *With special B-positions at the outgoing end, i. e. at the manual exchange.*

In dealing with small plants, where the placing of operators at the automatic exchange would be inconvenient, it is possible to place the B-positions at the outgoing end, i. e. at the manual exchange. This is the case at Johannesburg, where the B-positions for traffic to the two satellites Parkview and Rosebank are placed at the central manual exchange »Johannesburg Central» according to fig. 12, which shows such a B-position.

The switching is done with the aid of order wires *O. W.* The outgoing junction lines are multiplied over the A-positions and terminate at the automatic exchange in group selectors *GS* where they are connected up with full automatic registers *Reg* over selectors

RS. The B-position is equipped with a lamp *L* and a key *K* for each junction line for connecting up the line to the switching arrangements in this position. Furthermore, the B-position is furnished with a set of sending keys and a so-called impulse transmitter *IR*. This impulse transmitter has exactly the same function as a calling dial, i. e. to actuate a semi-automatic register *Reg* at the automatic exchange by sending out a series of impulses corresponding to the number that has been set up on the key set. Such an impulse transmitter is composed of relays and register units of the same type as those in a semi-automatic register set. However, the register units of this transmitting device are also furnished with impulse contacts over which impulses are



R 341

Fig. 11. Semi-automatic B-positions.

sent out when the register units return to their normal positions. A regular full automatic or semi-automatic register set has a common device for restoring all the register units to normal after the register has completed its function. An impulse transmitter — or impulse register, as it is also called — on the other hand, has individual restoring magnets for each unit.

The switching process is briefly as follows:

The desired subscriber's number is set up on the key set by the B-operator as soon as she has received it from the A-operator. The switch

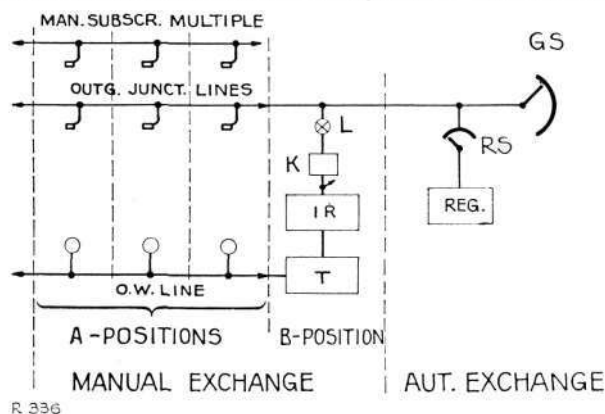


Fig. 12.

of an unoccupied junction line is pressed over. As soon as the operator gets a buzzing tone — indicating that a register at the automatic exchange has been connected up to the line — she depresses the starting key, causing the impulse register to be set to positions corresponding to the number which has been set up. This is immediately followed by the return to normal of the first register unit, causing impulses to be transmitted to the register at the automatic exchange. For instance, if the first digit is five, the same number of impulses will be sent out. As soon as the first register unit has returned to normal, the second one is actuated in the same way, meanwhile transmitting a number of impulses corresponding to the second digit, and so forth. When the entire impulse register has been restored to normal, this is indicated by the glowing of a lamp, informing the B-operator that the switching is completed. Switch *K* is then restored to its normal posi-

tion, and the operator is ready to receive a new call.

The two B-positions at the Johannesburg exchange have but one impulse register each, this being considered sufficient to handle the small amount of traffic to the automatic exchanges. However, there is nothing to hinder the installation of additional impulse registers where called for by existing traffic conditions. This permits the time of the B-operators to be utilized to better advantage, as the waiting time for impulse transmitting is eliminated.

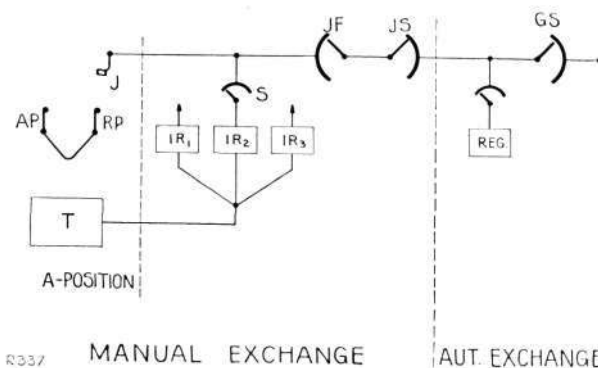


Fig. 13.

4. System without B-positions.

B-positions can be entirely dispensed with by equipping the A-positions with key sets and impulse transmitters, such a system being illustrated in fig. 13. The A-position has individual jacks *J* connected to the multiple by means of jack finders *JF*, these, in turn, being connected to junction line selectors *JS*, which select an idle junction line at the making of a call. This arrangement is identical with the one previously described in connection with fig. 8. Each A-position has a key set *T* which can be connected up to one of the impulse registers *IR* 1, *IR* 2 or *IR* 3. Each impulse register has a selector *S* for making a connection with the line.

The switching operation is briefly as follows:

When the operator has received a number from a subscriber, she inserts the ringing plug *RP* in an unoccupied jack *J*. This actuates the finder *JF* and the selector *JS*, causing an idle junction line to be connected up. A register at the

automatic exchange is connected up over its selector *RS* and a disengaged impulse register is brought in circuit over a selector *S*. All these operations are accomplished in about one second and the operator receives a tone indicating that a register at the automatic exchange has been connected up. She now sets up the desired number on her key set and depresses the starting key, causing the impulse register to start functioning and to transmit the number to the register at the automatic exchange in the form of impulses. This last register, in turn, controls the setting of the group selector and connector, as usual. Just as soon as the A-operator has depressed her starting key, her key

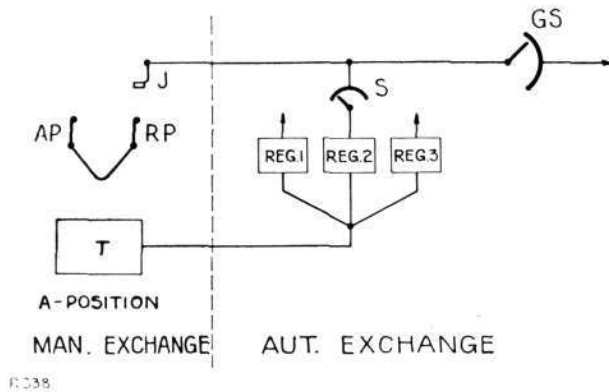


Fig. 14.

set is ready for a new call, which is then handled by one of the unoccupied impulse registers.

If the manual and automatic exchanges are situated very close to each other, for instance in the same building, it is possible to arrange this system without impulse registers by connecting the key sets directly to semi-automatic registers, as shown in fig. 14. For traffic to an automatic exchange the A-position functions — from a schematic point of view — according to the same principle as a semi-automatic B-position according to fig. 9.

The advantage gained by adopting this system is the elimination of the B-operators. This reduces the cost of operation as well as the percentage of faulty connections.

TOLL TRAFFIC.

Although regulations and requirements for toll traffic vary considerably in different countries, it is yet possible to arrange junction traffic from the toll exchange to a local automatic exchange according to one of the previously described systems. It is often required that a toll operator be able to cut in on a local call and disconnect the same, if necessary. With the Ericsson system, this is achieved by short-circuiting the holding circuit for the local connection, thus forcing the selector (selector or connector) to return to normal.

In Stockholm, the incoming toll traffic to the automatic exchanges is carried over manual junction boards, the switching being accomplished with the aid of order wires. The toll boards are furnished with arrangements for disconnecting local calls.

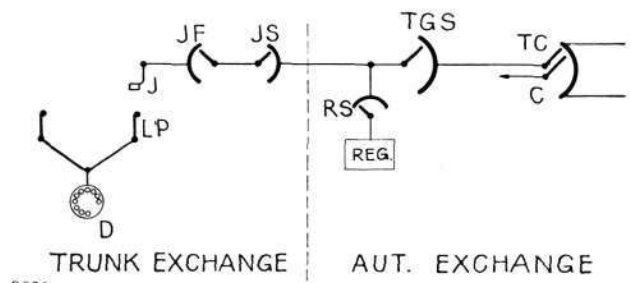


Fig. 15.

In Rotterdam a full automatic switching system for junction traffic has been applied, as shown in fig. 15.

The toll positions have individual jacks *J*, connected to the junction lines by means of selectors *JF* and *JS* according to the principle described in connection with fig. 8. The junction lines terminate in toll group selectors *TGS* at the automatic exchange. There are a number of toll connectors for each five hundred subscribers, mounted in the same rack as the regular connectors.

Each toll position is furnished with a calling dial for dialling the subscribers' numbers. The switching operation is as follows:

The toll operator inserts the plug *LP* in an

unoccupied jack *J*, causing the selectors *JF* and *JS* to be actuated, thus connecting up an idle junction line. An idle register *Reg* is connected up, the operator receiving a tone signal indicating that the circuit is closed. The desired subscriber's number is now dialled, causing the setting of the toll group selectors and toll connectors. The toll connector is wired so that it connects up with the subscriber's line no matter if this latter is idle or occupied by a local call. If the desired number is disengaged, the clearing lamp of the local cord in the toll board glows and the connection can be completed without further trouble. If the number is engaged by a local call — this being denoted by the clearing lamp not glowing — the toll operator

can cut in on this call and inform the speaking subscribers that it must be disconnected in favour of a toll call. The toll operator accomplishes this by pressing over the key of the cord into ringing position. This causes the sequence switch of the toll connector to be advanced to the next position, shorting the holding circuit for the local connector. This connector is restored to normal and the local connection is broken.

If the automatic subscriber is engaged with a toll call, the operator receives a busy signal.

The advantage with full automatic junction traffic is the elimination of B-positions, the entire switching operation and supervision being taken care of by the toll operator.

G. G.

The Ericsson Fire-Alarm System.

II. WITH MORSE TELEGRAPHIC SIGNALLING.

A description of Ericsson's fire-alarm system with generator signalling has already been given in this journal; we will now continue with a description of Ericsson's system with Morse telegraphic signalling.

With this system, all the alarm boxes are connected in series on the same circuit, this latter being divided into two or more loops. The ends of these loops terminate in the central alarm board, the system being under constant electrical control while at rest, permitting any faults which occur on the line to be automatically signalled on the alarm board.

The alarm board is equipped with one or more telegraph instruments, which are connected up directly to the alarm box circuit as soon as an alarm is sent in, thus registering the alarm signal without the help of any intermediate relays. The telegraph instruments are brought in circuit by the closing of one contact only. One telegraph instrument is sufficient if the number of alarm boxes does not ex-

ceed twenty-five. If there are more than this number of alarm boxes, two or more telegraph instruments should be used, as otherwise it is impossible to receive simultaneous signals.

When an alarm is given from an alarm box, the signalling mechanism is set in motion and the code number of this box is automatically transmitted to the alarm board, where the signal is registered. When the signalling has ceased the control circuit is automatically restored.

Line trouble, such as a break, or a leak, or both at the same time, is automatically indicated at the fire station. The alarm board is furnished with the necessary instruments for investigating what kind of trouble has occurred and for determining

the alarm box loop in which the fault is located. A fault in but one single place on the line does not prevent the sending in of alarm signals from any of the alarm boxes. The alarm board is furnished with telephone equipment for communication between the station and the alarm boxes. This board can



K 16

Fig. 1. Alarm Box with Telephone Device. When the button is depressed — after having broken the glass window — the mechanism is released and the signal is sent to the station in the form of the code number of the box in question.



K 17

K 18

Fig. 2. Alarm Box with Telephone Device. When the handle is pulled out — after having broken the glass window — the mechanism is released and the signal is sent to the station in the form of the code number of the box in question.

also be furnished with arrangements for connecting up conversations to the residences of the officers of the fire department or to other places outside the station. Telephone conversations do not in any way interfere with the sending of alarm signals.

This system also permits the direct connecting up of polarized bells in the alarm box loops for alarming the firemen, in which case a signalling generator is provided, together with the necessary switches for connecting up the alarm box loops to the generator.

THE ALARM BOXES.

The alarm boxes are constructed both with and without telephone equipment. Figures 1 and 2 show types with such equipment and fig. 3 a type without.

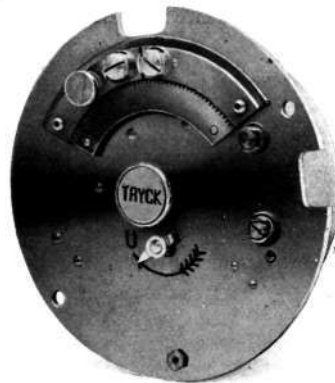
The alarm boxes have a red lacquered cast iron casing with a glass window in the door. An alarm is sent in by breaking the glass and either pushing a button (see figs. 1 & 3) or pulling a handle (see fig. 2).

The alarm boxes with a handle for pulling as shown in fig. 2 has a decided advantage in that the signal works are wound up each time the handle is pulled out, thus enabling the giving of any number of alarm signals without having to open the door of the box. A mechanism with push button release, on the other hand, must be wound up with a key after each alarm signal.

Alarm boxes without telephone (fig. 3) are equipped with an indicator which shows if the mechanism is wound up or not.

On larger alarm boxes, such as in fig. 1, the push button is given a slight turn during the release of the works so that the

inscription is askew after the giving of an alarm signal. Also, there is a device which prevents the door from being closed — after it has been opened for replacing the broken window or for testing — unless the signal mechanism is wound up.



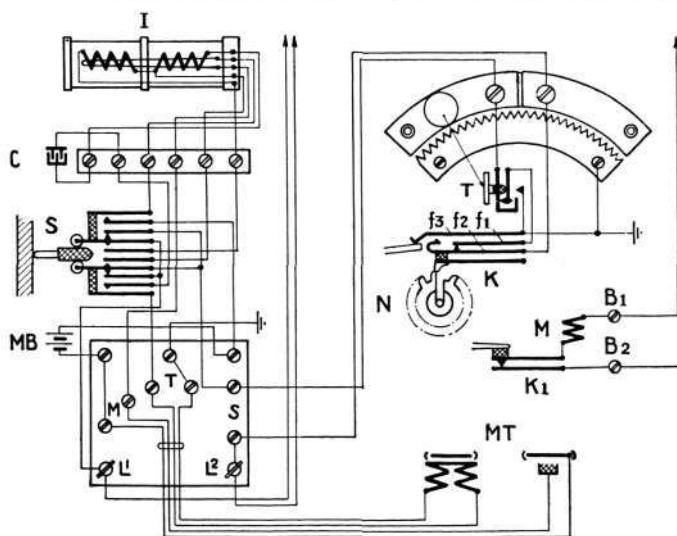
K 20
Fig. 4. Signal Mechanism with Push Button Release.
The indicator under the button shows whether the works are set or not.

Fig. 5 gives a schematic diagram for an alarm box with telephone device. The switch *S* is actuated by the closing of the door and is here shown in its depressed position, i. e. the door is supposed to be closed. In this position the telephone device is disconnected from the line, being connected up only when the door is opened.

The telephone circuits are arranged in such a



K 19
Fig. 3. Alarm box without Telephone.



R 381
Fig. 5. Wiring Diagram for Alarm Box with Telephone Device.

manner that conversations can take place with a break as well as with a leak on the line.

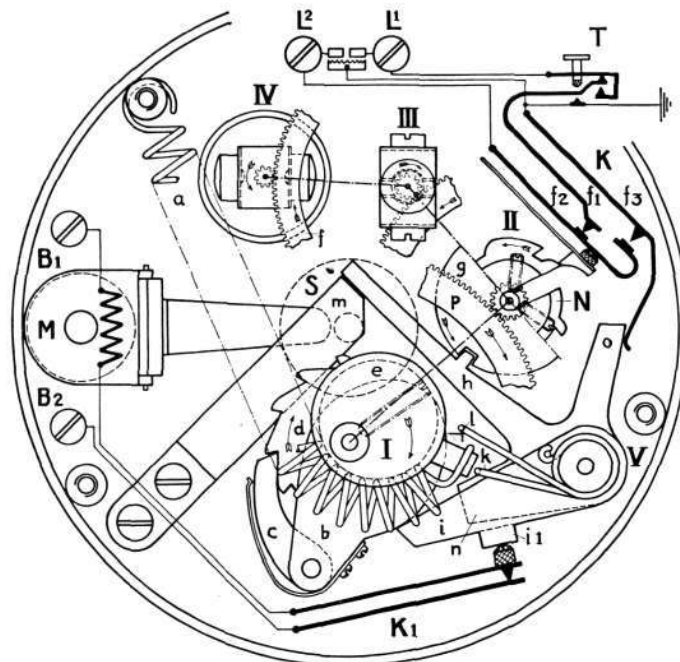
The signal mechanisms used in different types of alarm boxes are mainly of the same construction. Fig. 4 shows the mechanism used in smaller alarm boxes, such as in fig. 3, a detailed description of the same being given in the following.

Fig. 6 schematically illustrates the mechanism of an alarm box seen from behind with protective cover and rear bearing plate removed. The works are here shown wound up.

The rotary movement of shaft *II* is transmitted to the shaft *IV* of the speed regulator by means of two sets of gears. The gear wheel *f* idles on shaft *III*, the rotary movement of this latter being transmitted to the gear wheel by means of a friction drive which acts as a shock absorber when the works stop moving at the end of an alarm signal.

The locking and releasing devices are constructed in the following manner:

A locking disc *g* with a slot for engaging the dog on the locking arm *h* is mounted on shaft



R 382 Fig. 6. Skeleton Drawing showing Mechanism of Signal Works for Alarm Box.

The necessary power is furnished by a spiral spring *a*, which is wound around an eccentric *e* by turning the winding shaft *I*. The eccentric and spiral spring are dimensioned so that the torsion moment shall be constant during the release of the works.

In addition to the eccentric *e*, a cam disc *b* with pawl *c* — which engages the toothed wheel *d* — is mounted on the shaft *I*. This toothed wheel is joined to the gear wheel *p* which transmits the rotary movement to the shaft *II* with the number wheel *N*. The toothed wheel *d* and the gear wheel *p* idle on the shaft *I*.

II. The locking arm *h* and the distribution arm *i* idle on shaft *V*. The spring *l* presses the arm *i* against the periphery of the cam disc *b* which latter is shaped so as to force the arm to rotate counter-clockwise during the winding up of the works. This sets the spring *k* which is placed between the arms *i* and *h*. While the works are at rest, the blocking spring *m* prevents the rotation of the arm *h*.

The mechanism is released by pressing the button *S*, deflecting the spring *m* and releasing the locking arm *h*, which is forced counter-clockwise by the spring *k*. The release of the

locking disc g by the arm h releases the signalling mechanism. The movement of the locking arm h is limited by the shoulder i_1 on the arm i .

The number wheel N rotates while the mechanism is functioning. This wheel is furnished with a series of shoulders which correspond to the code number of the alarm box, depending on their number and position along the periphery of the wheel.

When the number wheel rotates, these shoulders actuate three contact springs. Two of these springs — f_1 and f_2 — are connected up with the two line terminals L_1 and L_2 , the third — f_3 — being grounded through the casing of the alarm box.

In the rest position, i. e. before and after an alarm signal, the position of the number wheel is such that the last shoulder — corresponding to the last symbol of the telegraphic code number — holds the contacts of the line springs f_1 and f_2 closed. In its rest position, the earth contact spring f_3 is held separated from the line contact springs by means of the arm o which is of one piece with the locking arm h .

When the works are released, the earth contact spring is brought in contact with the line springs before the number wheel starts rotating. This causes a preliminary impulse to earth to pass through the telegraph instrument at the station, setting it in motion before the transmission of the number impulses begins.

During the sending of an alarm signal all three spring contacts are consecutively broken and closed, thus giving rise to a succession of impulses which are received and registered at the alarm board.

The number wheel N makes four revolutions during each alarm signal, the code number of the alarm box thus being repeated four times.

The arm i slides along the periphery of the cam disc b while the works are in motion. The first part of this periphery, which corresponds to an ample three revolutions of the number wheel, is formed of a circular arc concentric with the shaft I . The force exerted by

the tension of the spring l is transferred — during the first three revolutions of the number wheel — to the cam disc b by means of the arm i . During the fourth revolution of the number wheel the curve formed by the periphery of the cam disc is brought closer in towards the center of rotation, i and i_1 causing the spring l to force the arm h against the locking disc g .

At the end of the fourth revolution the dog h falls into the slot in the disc g as soon as these come opposite each other. The earth contact spring f_3 is simultaneously actuated by the arm o and is separated from the line springs. When the signal button S is released, the arm h is locked in rest position by the blocking spring m . After the works have again been wound up and the spring k set anew, the mechanism cannot be released without pressing the button S .

A contact arrangement T is placed between the line spring f_1 and the terminal L_1 , for signalling by hand, usually to call the station for telephoning or testing purposes. The key for this arrangement is not accessible until the door of the alarm box has been opened. Signals are given by repeatedly depressing this key, thus alternately breaking and grounding this line circuit.

The signal works can also be released at a distance, in which case the mechanism is provided with a release magnet M . When this magnet is energized, it lifts the blocking spring m , releasing the mechanism in exactly the same way as when the button S is depressed.

The signal works are usually provided with a control contact K_1 connected in series with the winding of the magnet M . This contact is closed when the works are wound up but breaks and remains broken after the giving of a signal.

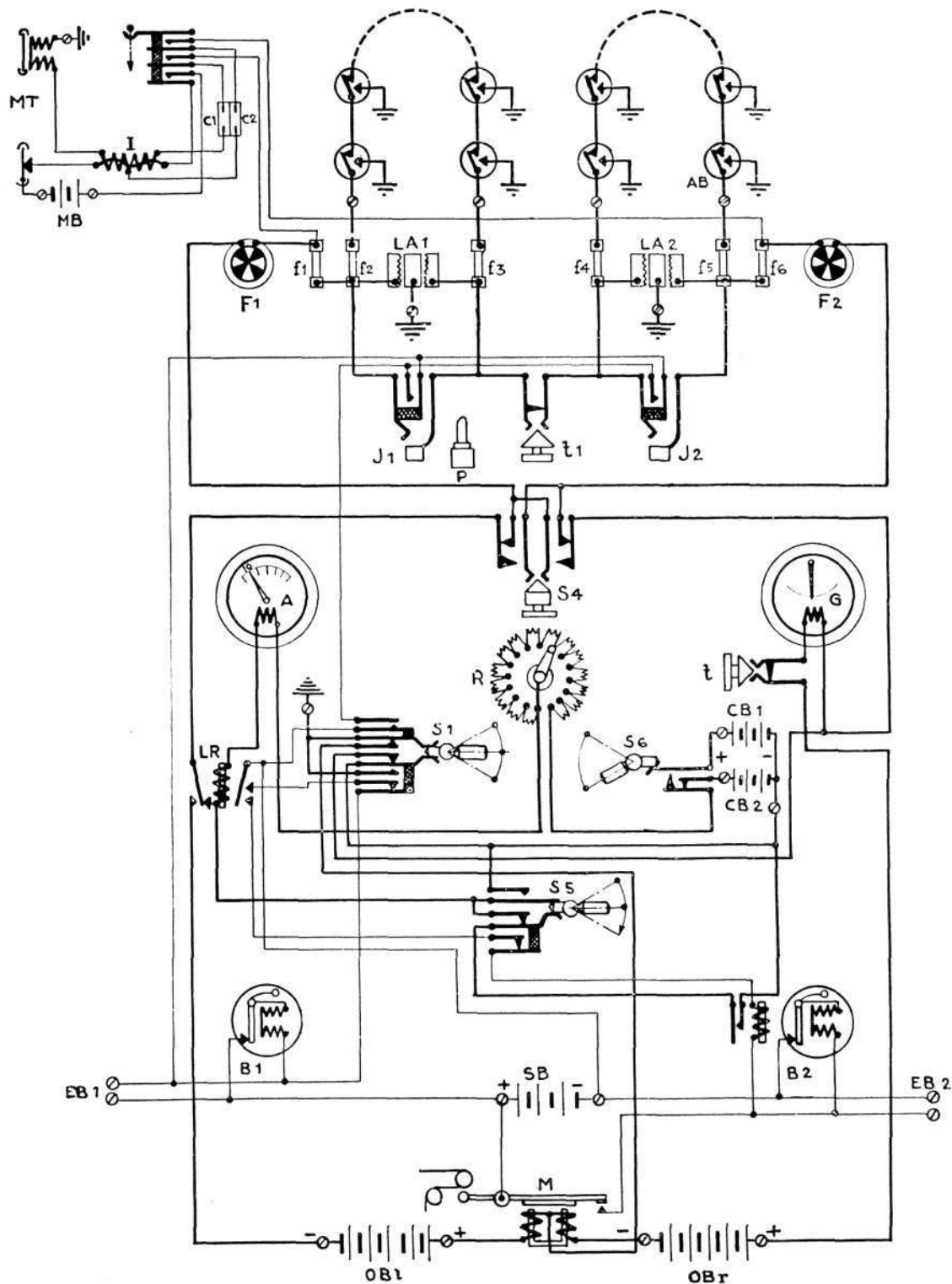
This arrangement gives an effective control whereby one may ascertain at a distance whether or not the works are wound up as well as whether the alarm signal has actually been sent out after a distance release of the works.

THE MORSE SYSTEM FOR SMALL PLANTS. EQUIPMENT OF THE ALARM BOARD.

- M Telegraph instrument* with arrangement which automatically releases the works as soon as the armature is attracted and locks the same when they stop recording the signal.
- LR Line relay* (control circuit relay). When the system is at rest, a control current passes over the line and through the windings of this relay. At the giving of a signal and when the control circuit is broken (on the line), the relay de-energizes and the changed position of only one contact breaks the control circuit and simultaneously connects up the line *directly* to the telegraph instrument.
- R Regulating resistance* for regulating the strength of the control current.
- A Milliampère meter* for the control current, which should be held at about 10 milliamperes. Abnormal changes in the strength of the current denote the presence of a fault on the circuit (usually a leak or short circuit).
- F₁, F₂ Star indicators*, left and right. These are connected to the extreme ends of the line branches and indicate whether or not a current is passing over the line or a part of the same.
- G Milliampère meter* for the operating current. This meter indicates the presence of a current from the right hand operating battery when a signal is being received or when there is a leak on the line. Such a leak, so slight as not to interfere with the correct reception of a signal, is indicated by the meter *G*.
- B₁ Trouble bell*. This bell rings when the control circuit is broken, for instance at the sending in of an alarm or when there occurs a break or a leak on the line, when an alarm box loop is accidentally short circuited at the alarm board.
- B₂ Signal bell* with device for automatically closing the control circuit after the recep-

tion of an alarm signal. The bell rings when the armature of the telegraph instrument is attracted. After the signalling has ceased, the circuit closing device is actuated, closing a local circuit over the winding of the relay *LR* after one or two seconds. *LR* energizes, breaking the operating circuit over the telegraph instrument and again closing the control circuit.

- S₅ Restoring switch*. This switch is used for restoring the control circuit by hand (the lever is pressed down) and also, when necessary, to disconnect the automatic restoring device of the signal bell (the lever is pressed upwards).
- S₁ Faulty-line switch*. This switch is used when trouble of some sort occurs on the line. With a break only, or a break together with a leak on the line, the switch is thrown upwards to the »Break» position, while for a leak only it is brought down to the »Leak» position.
- S₄ Line switch*. This switch permits the cross-connecting of the incoming and outgoing line ends (see diagram *D*, break to the left and leak to the right).
- S₆ Battery switch* for switching over from one control battery to the other.
- t Earth testing key*, used when testing the earth connections of the alarm boxes.
- t₁ Testing key*, to determine in which alarm box loop an existing leak is situated.
- J₁, J₂ Short-circuiting jacks*, and
P Short-circuiting plug, for determining in which loop an existing break is located and for short circuiting a broken loop circuit, when necessary, thus providing electrical control for the other, undamaged, loop.
- f₁, f₆ Fuses*, 0.15 amp.
f₂ to f₅ Fuses, 2 to 3 amp.
- LA₁, LA₂ Vacuum lightning protectors* for two alarm box loops.
- MT Microtelephone*.
- I Induction coil*, 1 ohm × (70 + 70) ohms.
C₁, C₂ Condensers, 2 mf.
The necessary *terminal screws* for connec-



K 21

Fig. 7. Circuit Diagram for System with One Telegraph Instrument.

Diagram No. 100522

ting up line wires, batteries and extra control and signal bells are placed within the alarm board.

BATTERIES.

Dry cells are generally used on account of the small amount of current required by this system. The following batteries are required for the operation of the alarm board.

CB₁, CB₂ Control current batteries, each one consisting of from 6 to 10 cells.

OBl, OBr Operating current batteries, left and right, each one consisting of from 10 to 15 cells.

SB Signal battery, 8 to 10 cells.

MB Transmitter battery, 2 cells.

The batteries should be regularly tested so as to make sure that they are in good condition. Abnormal changes in voltage or strength of current indicate that something is wrong.

The following requirements are of value when testing the condition of the batteries:

For the operating current batteries: The telegraph instrument shall give clear signals with both unbroken and broken line as well as when the key *t* is depressed for testing the earth connection of the alarm boxes.

For the control current batteries: the strength of the control current must not fall below ten milliamperes when the regulating resistance is entirely cut out of the circuit, and the automatic restoring device shall function properly.

For the signal battery: the signal bells shall give a clear, loud signal when an alarm is given from the alarm boxes, and the automatic restoring device shall function properly.

DESCRIPTION OF DIAGRAMS.

A. Faultless line.

System in normal position.

Normally, with a faultless line and when the system is at rest, the armature of the line relay *LR* is attracted and the control current, emanating from one of the control batteries (*CB₂*,

for instance) passes over the following circuit (control circuit).

1. + *CB₂*, *S₆*, *R*, *A*, winding and contact of *LR*, *S₄*, *F₁*, *f₁*, *f₂*, left loop, *f₃*, *t₁*, *f₄*, right loop, *f₅*, *f₆*, *F₂*, *S₄*, *S₁* to negative of *CB₂*.

The milliamperè meter shows the strength of the control current, which is kept at about 10 milliamperes by means of the regulating resistance *R*. The indicators show the presence of an electrical current (white signal).

At the *sending in of an alarm* from an alarm box the control circuit (1) is broken at the first separation of the line contact springs in the mechanism. The line relay de-energizes and the left branch of the line is connected up to the telegraph instrument *M* over a relay contact. A circuit through the trouble bell *B₁* is closed over another relay contact:

2. Positive of *SB*, *B₁*, *S₁*, contact in *LR* to negative of *SB*.

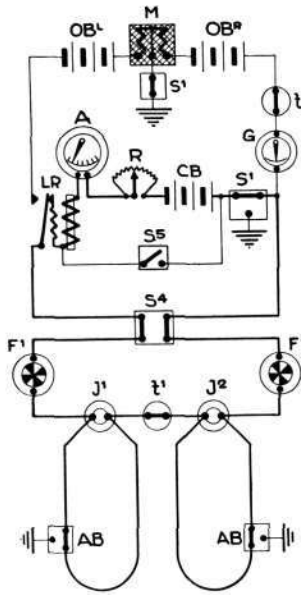
B₁ rings continuously until the relay energizes at the termination of the alarm signal.

During the release of the signal works, its three spring contacts are alternately closed and opened in accordance with the code number of the alarm box, each closing of the contacts causing the following operating circuits to be closed:

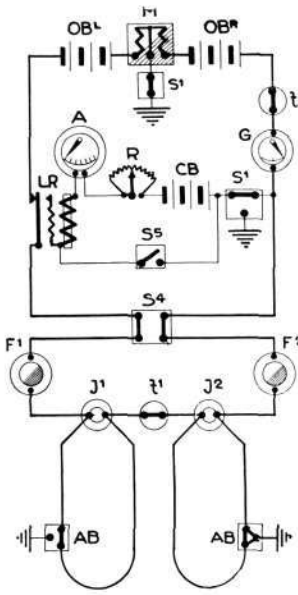
3. Earth at the station, *S₁*, right winding of *M*, negative *OBr*, positive *OBr*, *t*, *G*, *S₄*, *F₂*, *f₆*, *f₅*, right branch of line, spring contacts in alarm box, earth at the alarm box.
4. Earth at the alarm box, spring contacts, left branch of line, *f₂*, *f₁*, *F₁*, *S₄*, contact in *LR*, negative *OBl*, positive *OBl*, left winding of *M*, *S₁* to earth at station.

The telegraph instrument *M*, which is set in function at the first impulse of the operating current, records the code signal on the tape. The signal is simultaneously repeated by the flash signal indicators and by the bell *B₂*, this last receiving current at each impulse over a contact in the telegraph instrument:

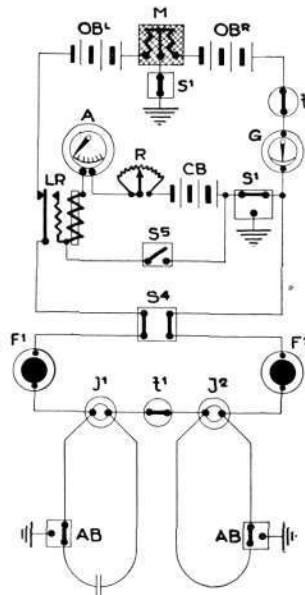
5. Positive of *SB*, contact in *M*, *B₂*, negative of *SB*.



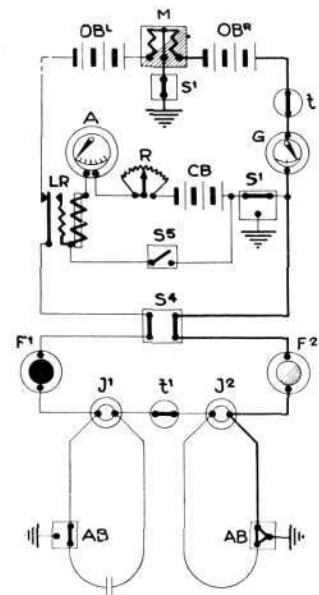
R 368 Fig. 8.



R 369 Fig. 9.



R 370 Fig. 10.



R 371 Fig. 11.

Line Intact and System in Normal Position.

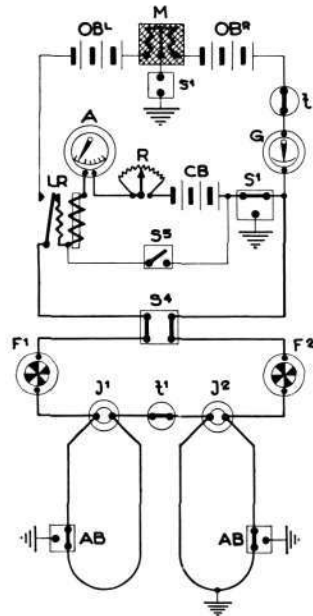
In rest position: Control current passes through the entire line. F_1 and F_2 show white, A indicates 10 milliamp.

During alarm: Signal registered by M , F_1 and F_2 flash in time with M , G indicates presence of current.

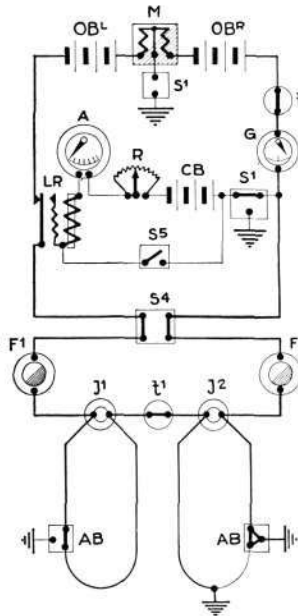
Broken Line.

In rest position: No control current passes through the system. (By short circuiting the faulty loop electrical control of the other, intact loop can be obtained). F_1 and F_2 show black, A indicates 0.

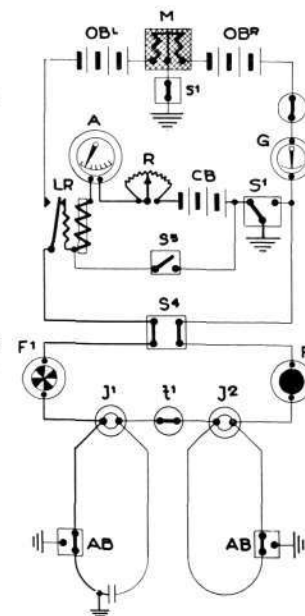
During alarm: M registers the signal, one indicator flashes in time with M and the other shows black.



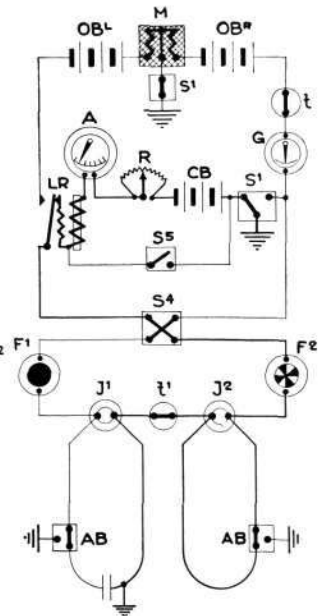
R 372 Fig. 12.



R 380 Fig. 13.



R 374 Fig. 14.



R 375 Fig. 15.

Leak on the Line.

In rest position: M 's earth connection is broken at S_1 , the control current passes through the entire line, F_1 and F_2 show white, A indicates 10 milliamp.

During alarm: M registers the signal, F_1 and F_2 flash in time with M , G indicates presence of current.

Break and Leak on the Line.

Break to right, leak to left. *In rest position:* By making earth connection at S_1 , electrical control of a part of the line is obtained. A indicates 10 milliamp., one indicator shows white, the other black.

Break to left, leak to right. *In rest position:* By making earth connection at S_1 and cross-connecting at S_4 , the same circuit is obtained as with break to right and leak to left.

During alarm: M registers the signal.

At the end of the signal the line circuit remains closed in the alarm box but is not connected to earth. The telegraph instrument receives current over a metallic circuit (see circuits 3 & 4) and records a long uninterrupted line. B_2 rings continuously.

A circuit through B_2 as well as over the restoring magnet at B_2 is closed over a contact in M :

6. Positive of SB , contact in M , magnet coil, S_5 , contact in LR to negative of SB .

The restoring magnet attracts its armature, the restoring contact — over which LR is energized — being closed after a certain pre-determined time:

7. Positive of CB_2 , S_6 , R , A , LR , S_5 , contact in B_2 to negative of CB_2 .

The line relay energizes, breaking the operating circuit (3, 4) and again closing the control circuit (1). Thus *the control circuit is automatically restored.*

M stops functioning. B_1 and B_2 receive no current. F_1 and F_2 show white. A indicates 10 milliampères.

Note 1. The control circuit can be closed by hand by pressing down the lever of the restoring switch S_5 , whereby the following circuit is closed:

8. Positive of CB_2 , S_6 , R , A , LR , S_5 (upper contact), to negative of CB_2 .

Note 2. If necessary, the automatic restoring device can be disconnected by pressing up the lever of S_5 to the upper position, thus breaking circuit 6 of the restoring magnet in the lower contact of S_5 .

B. Broken line.

When the system is in normal position and a break occurs somewhere on the line, the control circuit (1) is broken and the line relay LR de-energizes, causing the trouble bell B_1 to ring (circuit 2). *Both indicators F_1 and F_2 show black.*

To restore the system to *rest position with break* the lever of the trouble switch S_1 is raised

to the »Break» position, breaking circuit (2) and silencing B_1 .

In rest position with break the system is without electrical control. A indicates 0, *the indicators F_1 and F_2 showing black.* The left-hand portion of the line is connected to the telegraph instrument over a relay contact.

When the system has been set to »Break» and an alarm signal is given from an alarm box, either circuit (3) or circuit (4) is closed for each contact made between the contact springs in the mechanism, and the telegraph instrument makes a written record of the signal. One of the star indicators flashes and the code signal bell B_2 rings in time with the electric impulses.

No restoring is required after an alarm signal.

At the station, the plug P is inserted in the jacks J_1 and J_2 to ascertain in which loop the break is located. If a signal for an unbroken line (indicators show white, etc.) is received on the insertion of the plug in one of the jacks, this indicates that the break is located in the loop belonging to this jack.

If a break *without leak* occurs on the line and the trouble cannot be immediately remedied the broken loop is shorted in the manner just mentioned and the trouble switch is restored to normal, thus providing electrical control for the unbroken loop. Should a break occur in this loop also, it will be automatically signalled at the station.

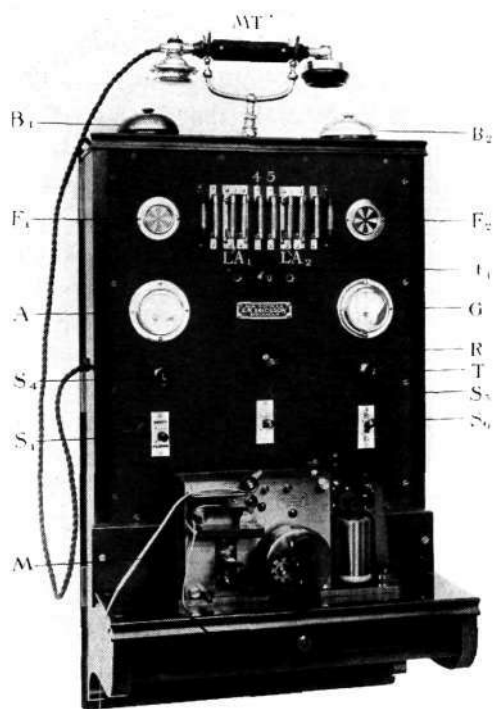
The control circuit is not broken when an alarm is sent in over a short-circuited loop, the signal passing over the earth contact in the alarm box. The impulses are transmitted over the following circuit (compare with circuit 4):

9. Earth at station, S_1 , right winding of M , negative of OB_r , positive of OB_r , t ,

$$G, \left\{ \begin{array}{l} S_4, F_2, f_6, f_5, \dots \dots \dots \text{line,} \\ S_1, CB_2, S_6, R, A, \text{winding and} \\ \text{contact of } LR, S_4, F_1, f_1, f_2 \end{array} \right\} \begin{array}{l} \text{earth at} \\ \text{alarm box.} \end{array}$$

This causes the signal bell to ring (circuit 5) and the milliampèremeter G shows the presence of a current.

No resetting is required after an alarm, since the control circuit has not been broken.



K 22 Fig. 16. Alarm Board for System with one Telegraph Receiver, intended for from 5 to 25 Alarm Boxes.

A signal from an non-shortened loop is received in the usual way.

Note. If breaks occur in both loops, one of them must be shorted at the station to permit the reception of alarm signals from alarm boxes situated between the breaks.

C. Continuous or interrupted leak on the line.

When the system is in normal position and a leak occurs on the line, the telegraph instrument *M* will write a continuous line, or, if the leak consists of momentary contacts, a sequence of several short lines (circuit 9, with earth contact on the line). *B*₂ rings and *G* shows the presence of current. The control circuit is not broken, both indicators, as a rule, showing white.

The system is restored to *rest position with leak* (also with interrupted leak) by bringing the lever *S*₁ down to the position marked »Leak». This breaks the earth connection at the station and connects up one of the middle

contact springs of each short-circuiting jack to *SB*, thus preventing any unwarranted short-circuiting of the loops at the station. As a result, the introduction of the plug *P* in one of the jacks *J*₁ or *J*₂ causes the following circuit to be formed through *B*₁:

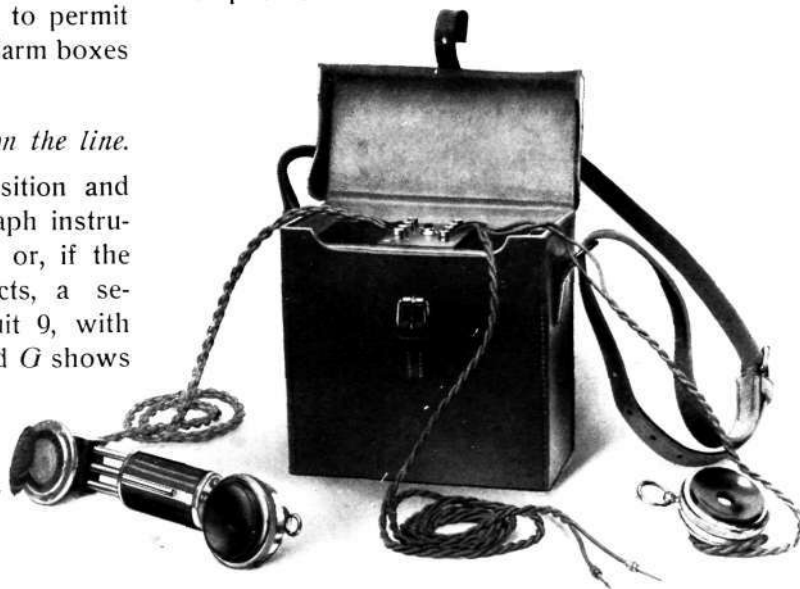
10. Positive of *SB*, *B*₁, contact in *J*₁ or *J*₂, *S*₁, negative of *SB*.

In rest position the control current passes through as usual. *F*₁ and *F*₂ show white, *A* indicates 10 milliamperes.

An alarm signal is received at the station as usual, the only difference being that instead of two circuits (3 and 4) only one common metallic circuit is formed (without earth at the station).

The location of the fault can be determined by depressing the test key *t*₁ — the trouble switch *S*₁ being in normal position — and observing the indicators. If the right indicator is actuated (shows white), the trouble is located in the right loop, and vice versa.

When the trouble has been remedied, no signal is received at the station. The line is tested by restoring *S*₁ to normal. If no leak signal is received, this is a sign that the leak has been removed, and *S*₁ is allowed to remain in its normal position.



K 23 Fig. 17. Portable Testing Set, for testing alarm boxes without telephone device and for trouble finding.

D. *Simultaneous break and leak.*

When the system is in normal position and both a break and leak occur simultaneously on the line, the control circuit (1) is broken, the line relay de-energizes and B_1 starts ringing (circuit 2), a circuit over M being closed through the earth connection on the line (compare circuits 3 or 4). M writes a single continuous line while B_2 rings. *One indicator shows white and the other black.*

With both a leak and a break, the system is restored to rest position by bringing the handle of the trouble switch S_1 up to the position marked »Break». This switches over the negative connection of the control batteries from the right line branch to earth and disconnects the trouble bell. *With a leak to the right and a break to the left along the line, the line switch S_1 , in addition, must be depressed.*

After setting these switches, the control current is restored — either automatically or by hand — through that portion of the line which lies between the station and the leak, the following circuits being formed:

With break to the right and leak to the left (F_1 shows white):

11. Earth at station S_1 , negative of CB_2 , positive of CB_2 , S_6 , R , A , winding and contact of LR , S_4 , F_1 , f_1 , f_2 , line, to earth on line.

With break to the left and leak to the right (F_2 shows white, S reset):

12. Earth at station S_1 , negative of CB_2 , positive of CB_2 , S_6 , R , A , LR , S_4 , F_2 , f_6 , f_5 , line, to earth on line.

That branch of the line which lies between the station and the break is connected up with the right operating battery OB_r at the alarm board and is without electrical control.

In the rest position one of the indicators shows white, the other black. A indicates 10 milliampères (adjusted by R).

When an alarm is sent in from the *leak side*, the control circuit is broken and the line is switched over to the left operating battery OB_l . The signal reaches the station over the earth contact in the

alarm box (compare circuit 4). B_2 and the white indicator repeat the signal. When the alarm signal has ceased the control circuit is restored either automatically or by hand.

When an alarm is sent in from the *break side*, the control circuit is not broken. The signal reaches the station over the earth contact in the alarm box (compare circuit 3). B_1 and the black indicator repeat the signal. No restoring is necessary after the signal.

When the line is again free from trouble, *both indicators show white*. M writes a long unbroken line and B_2 rings without interruption. The switch S_1 and, eventually, S_4 , are restored to normal, after which the system is restored to normal rest position either automatically or by hand.

Note. When both break and leak occur on the line, *never short-circuit a loop on the leak side.*

E. *Short-circuit on the line.*

A short-circuit on the line is not indicated at the station unless the control current be increased. This fault is discovered when testing the alarm boxes or when sending in an alarm, by the fact that the control circuit is not broken when a signal is sent in from an alarm box on the short-circuited portion of the line (compare circuit 9).

Alarm signals from that portion of the line which is not short-circuited come in as usual (circuits 3 and 4).

When the short-circuit has been remedied, this fact can be ascertained only by testing the alarm boxes.

F. *Break in the earth connection of the alarm box.*

A break in the earth connection of the alarm box is not indicated at the station.

A signal from an alarm box with a faulty earth connection reaches the station as usual if that portion of the line on which the box is located is under electrical control.

Signals from an alarm box with broken earth connection and situated on a part of the line

that *is not under electrical control, do not reach the station.*

With a break in *one* loop, signals from an alarm box with broken earth connection in the faultless loop reach the station on condition that the broken loop has been *short-circuited* at the alarm board.

A break in the earth connection can be ascertained in the following way when testing an alarm box. While the works are in motion, the earth testing key *t* is depressed, after which the telegraph instrument continues to record the signal if the earth connection of this box is intact (circuit 4). If, on the other hand, the earth connection is broken, the telegraph instrument will stop.

G. *Several simultaneous alarm signals.*

When signals are simultaneously given from *two or more alarm boxes*, they can not all be automatically recorded by the telegraph instrument without being all mixed up. One of the

signals can be received, however, by depressing the earth testing key *t* (circuit 4).

As has already been mentioned, this system is intended for smaller installations for from five to twenty-five alarm boxes. With a system of this size the chances that several signals will be given simultaneously are so remote, that this risk need not be taken into consideration. A difference of not more than four or five seconds is amply sufficient for obtaining distinct signals from two alarm boxes.

H. *Telephoning from an alarm box.*

The calling signal from an alarm box is given by slowly depressing the calling button *T*. This button is usually depressed *three* times.

The calling signal is received and recorded at the station in the same manner as alarm signals.

After the reception of the calling signal the system is restored to rest position, after which the conversation may proceed.

A. P. — B. K.

L. M. Ericsson

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ALLMÄNNA TELEFONAKTIEBOLAGET L. M. ERICSSON
STOCKHOLM

THE ERICSSON LOW FREQUENCY RADIO TRANSFORMER



Transformer, complete with case.



Transformer, with case removed.

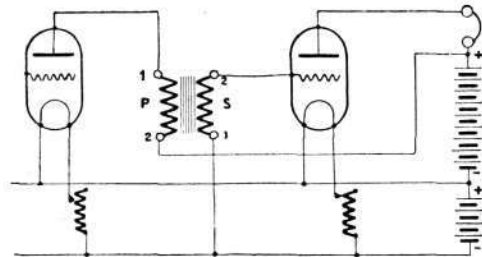
This transformer is of exactly the same construction as our well-known, reliable type with core of nonmagnetic annealed iron wire, bent over so as to completely enclose the wire coils. This method has proven very efficient for the purpose of protecting the transformer from the detrimental influences of neighbouring circuits.

The transformer is enclosed in a beautifully lacquered metal case with ebonite top on which are mounted four terminal screws P_1 , P_2 and S_1 , S_2 , corresponding to the inner and outer ends of the primary and secondary windings.

The transformer is connected up according to the accompanying diagram.

These transformers are furnished with the following ratios of transformation:

Type RM 2100.	Ratio 1:5.
* RM 2101.	* 1:4.
* RM 2102.	* 1:5.



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