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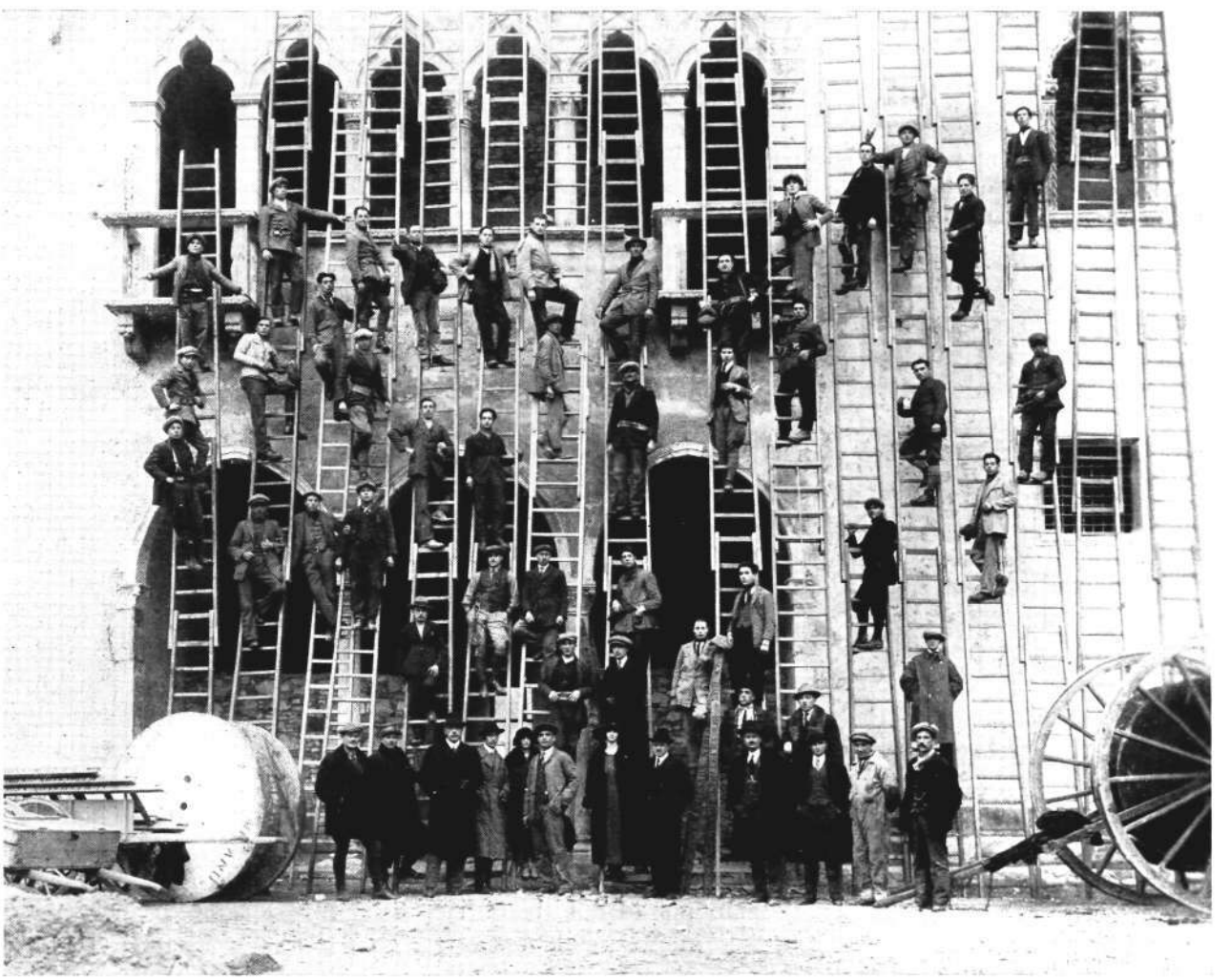

VERONA ERECTION FORCE WITH LADDER EQUIPMENT.

ENGLISH EDITION

L. M. Ericsson

THE L. M. ERICSSON REVIEW

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JOURNAL OF

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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.

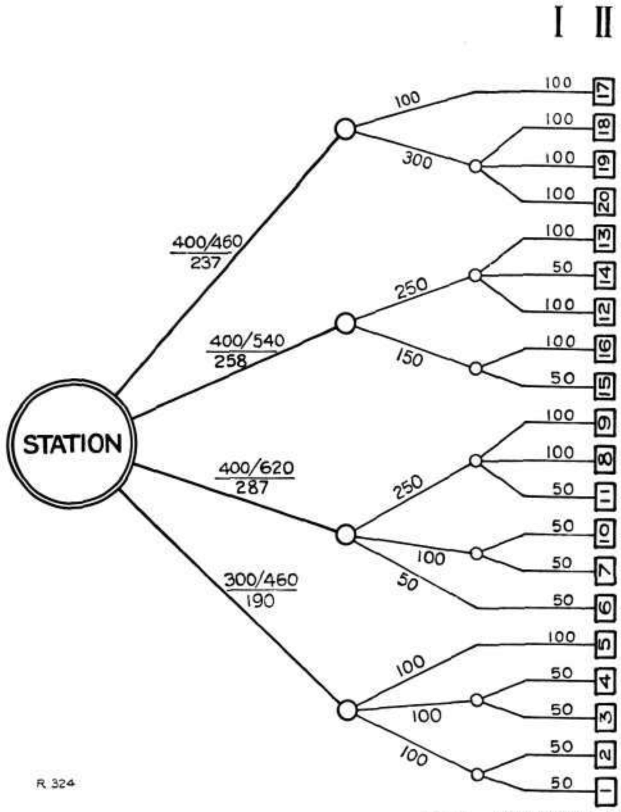
The exchange building is located in the centre of the city, just behind the old Roman amphitheatre.

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



II	III	IV	V	VI
17	300	80	80	43
18	100	110	110	57
19	300	170	170	69
20	100	100	90	58
13	100	130	120	62
14	100	70	60	32
12	300	140	130	68
16	100	110	100	61
15	100	90	90	35
9	100	130	110	64
8	300	180	170	72
11	100	80	70	37
10	100	80	60	39
7	100	80	80	40
6	100	70	60	35
5	300	130	120	55
4	100	60	50	28
3	100	70	50	36
2	100	100	100	35
1	100	100	80	36

Fig. 1. Distribution Diagram for Verona.

Description of designations:

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.

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.

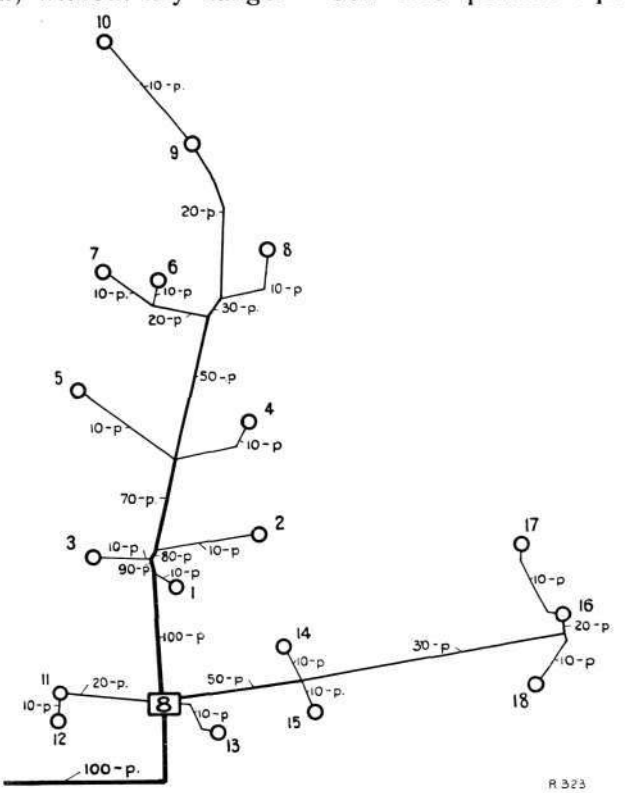


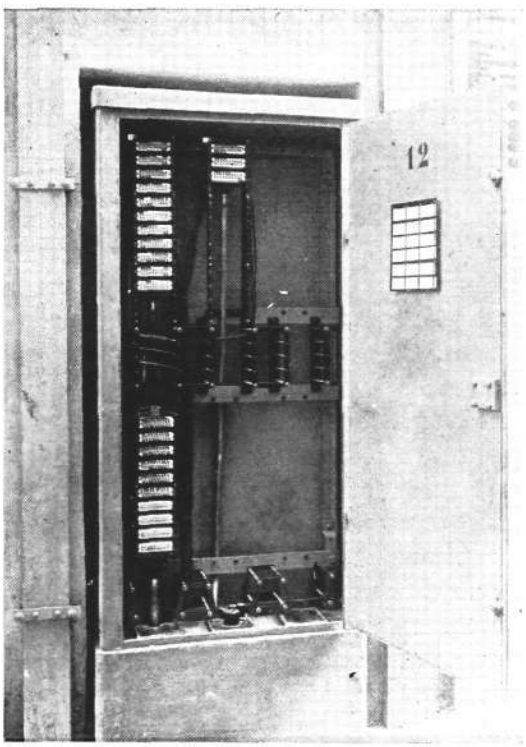
Fig. 2. Cable Distribution within a Cabinet Area.

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 i front of the old Castel Veccio.

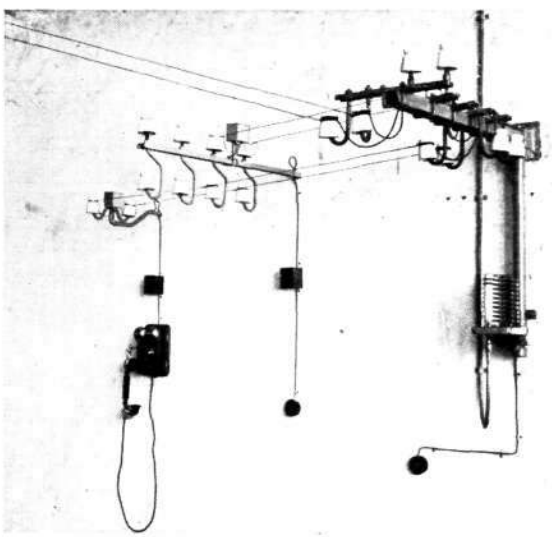
All outside cable has been furnished by Pirelli, the largest being for 400 pairs, as previously mentioned. The conductors are of copper and have a diameter of .6 mm., being wrapped with double layers of paper insulation. The lead

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 $^1/_8$ 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 $^0/_{00}$.

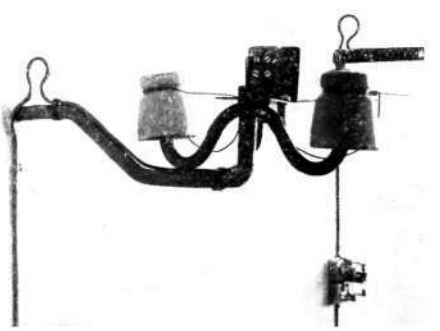
The racks are made to accomodate forty line finders corresponding to an increase from 1250 *Sm* to 1550 *Sm*, or of about 25 %.

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 1 11, 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 1 11. At the exchange, all of 145 87's multiple jacks are then fitted with reference pegs inscribed with the number 1 11, white galalite pegs being commonly used for this purpose. *All* calls *to* number 145 87 will then be connected to number 1 11 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 1 11 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 1 11. The subscriber must then disconnect and put in a new call for No. 1 11.

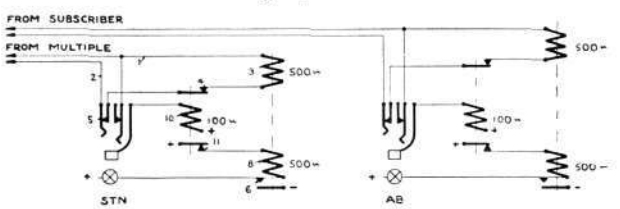
Reference service through the special service bureau.

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 1 11, Vf or Nb. At a small exchange, reference service can very well be arranged with pegs; it becomes troublesome, hovever, 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.

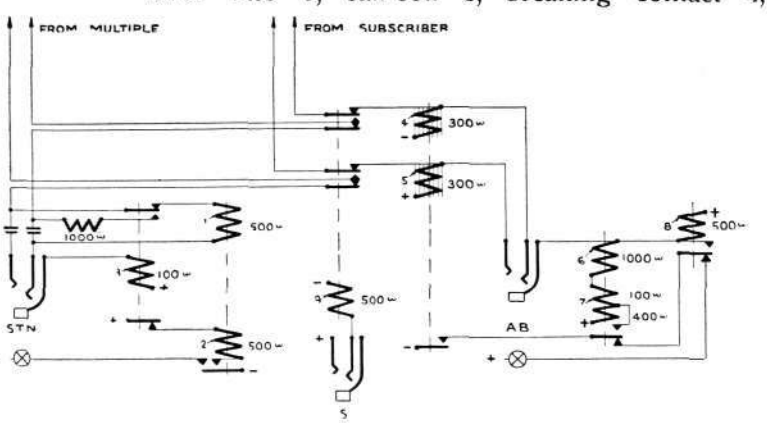
The special service bureau and its scope.

The bureau in question is open both day and night. It is located in 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 subsriber 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 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. 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 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

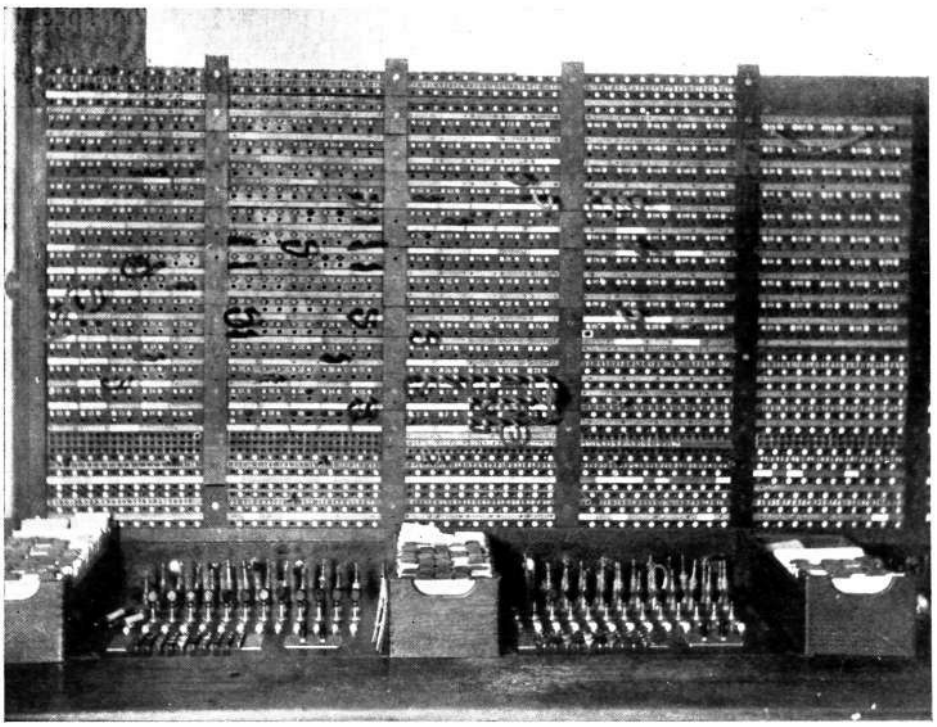


Fig. 3. Part of Special Service Switchboard.

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

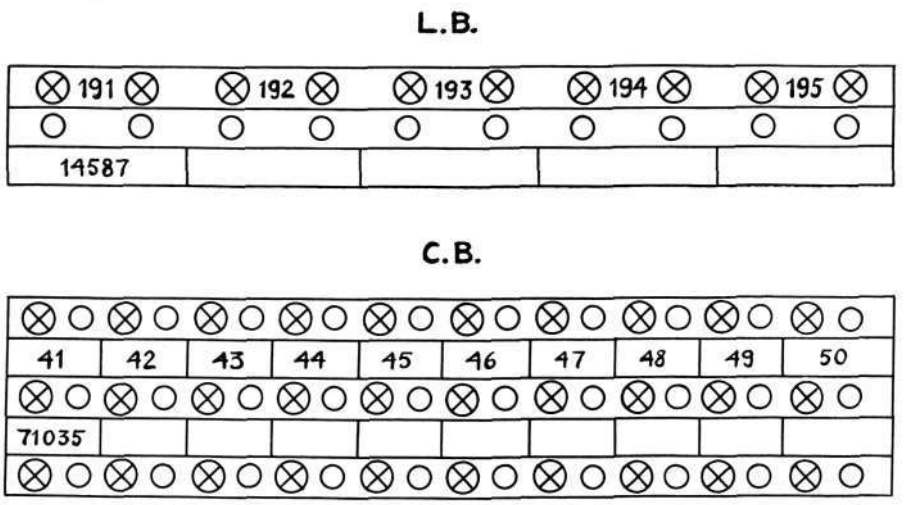


Fig. 4 (Scale 1 : 2). Grouping of Lamps and Jacks on Switchboard.

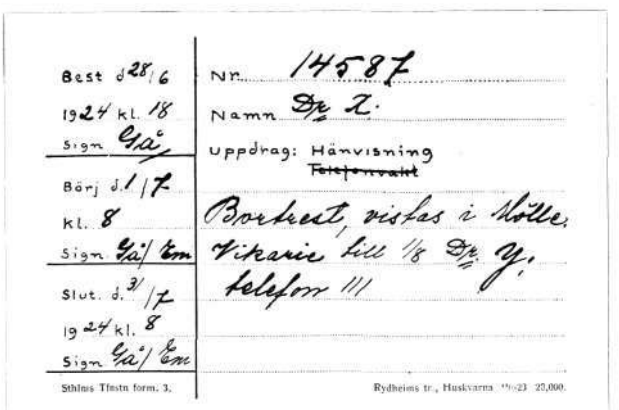
The special service switchboard.

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.

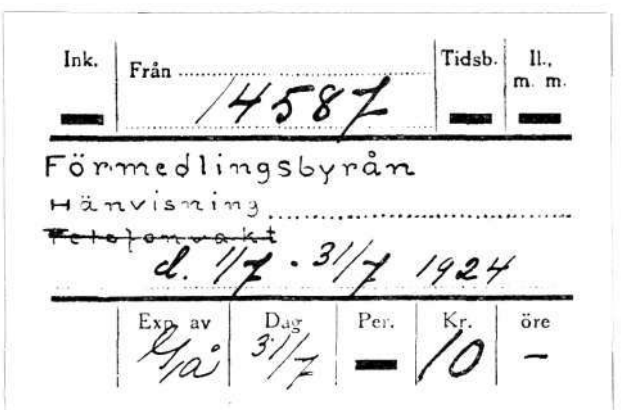
Each position is equipped with twelve pairs of cords, twelve combined speaking and ringing keys, twelve supervisory clearing lamps and twelve listening buttons which, aside from their ordinary function, serve to break the supervisory lamp circuits. In addition, there are two dividing keys (one for speaking 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



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



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.

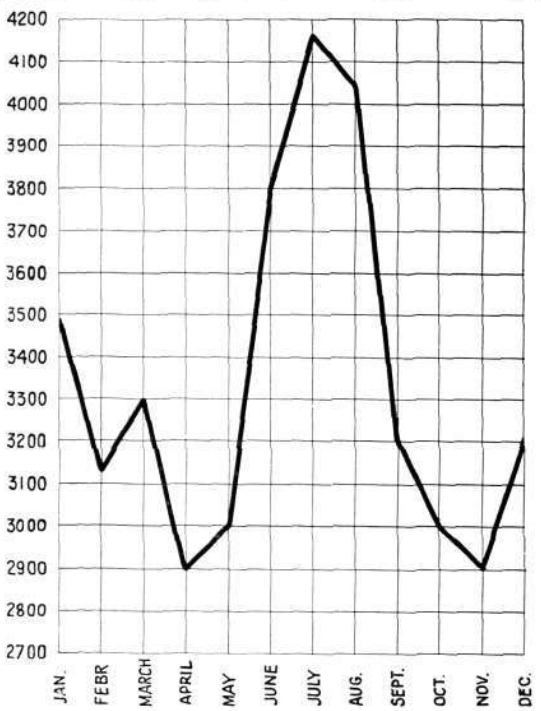
1. Reference service. The bureau refers calling subscribers to another number, or gives information as to the called subscriber's absence, when his return is expected, his temporary address, etc. The bureau does not make any note of the calling subscriber's number or business. Rates: a) for one whole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

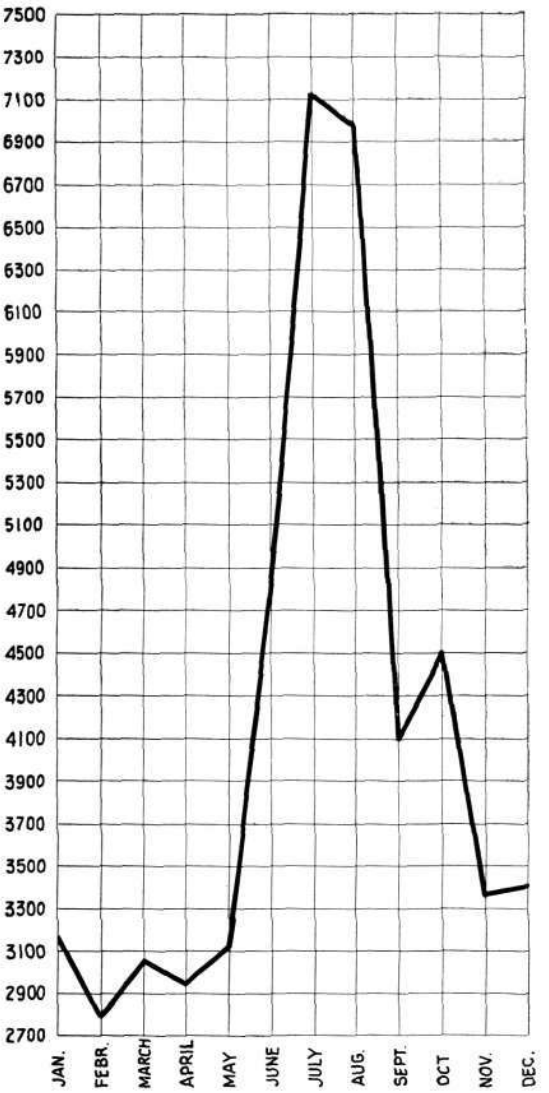
6. Supervision. Subscribers with exceptionally heavy traffic can be connected up to a special position where the operator answers and takes an order for a new call as soon as the clearing signal of the previous call has been given. Rates: 0.95 Swed. crowns per hour.

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



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



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

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 i 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 existance 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.

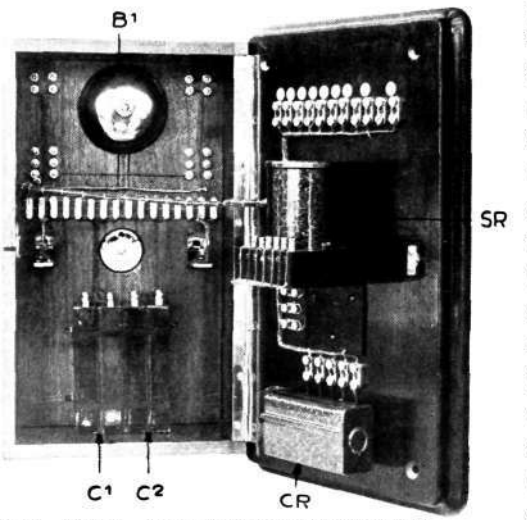
A small and inexpensive plant suitable for a small rural community naturally need not meet all the enumerated requirements. For instance, the smaller a community, the smaller is the risk of several alarms being simultaneously given. One quality which the system at all costs must possess, however, is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

R 298



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.

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.

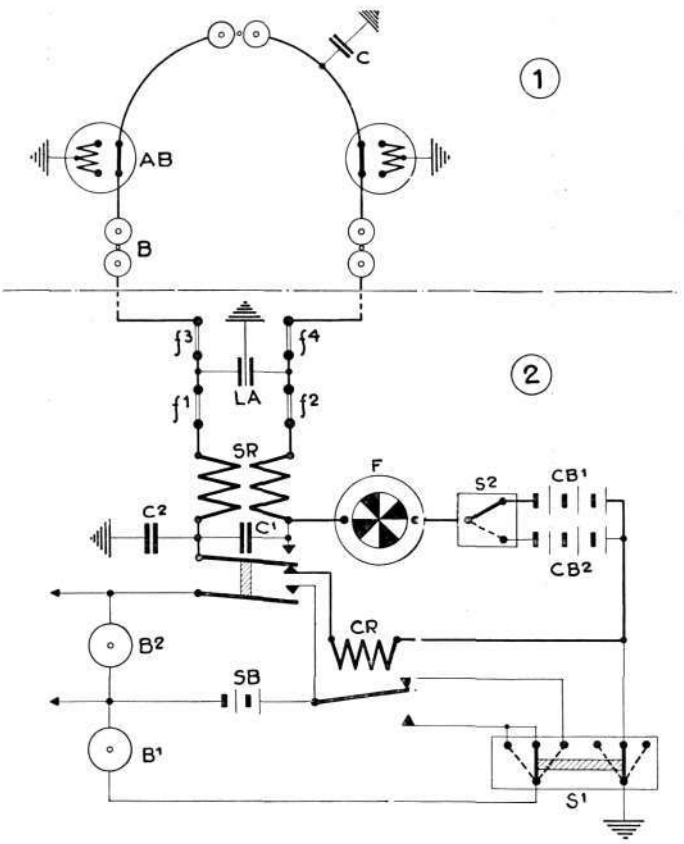
The turning of the generator handle causes the generator winding to be automatically con-

nected 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 $^3/_4$ of the alarm bells.



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

A. *Description of circuit over faultless line.*

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

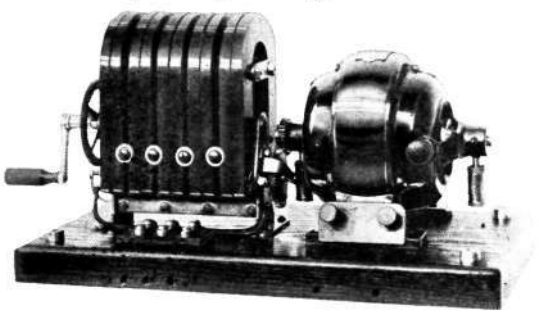
Description of Diagram for Alarm Board with one Alarm Box Loop.

Designations.	
	1. Alarm box loop.
AB	Alarm box, with or without arrangement for code-signals (see fig. 4).
B	Bell (se 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 — 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.



R 330 Fig. 3. Power Driven Generator with Arrangement for Hand Drive, for Alarming the Firemen.

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 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.

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

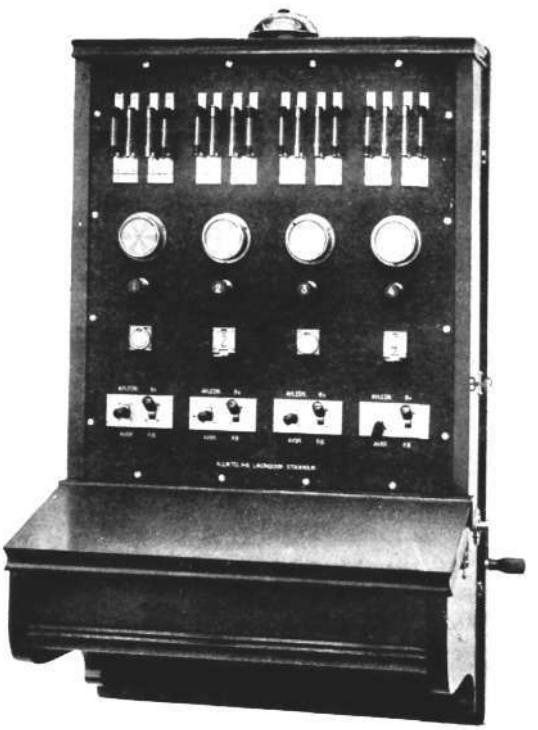
C. *Description of circuit with leak on the line.*

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



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

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, depending 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 leak. If, thereafter, the trouble alarm bell keeps on ringing and the indicater 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.

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Fig. 6. Firemen's Alarm Bells.

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

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

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

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

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

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

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 horisontal 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

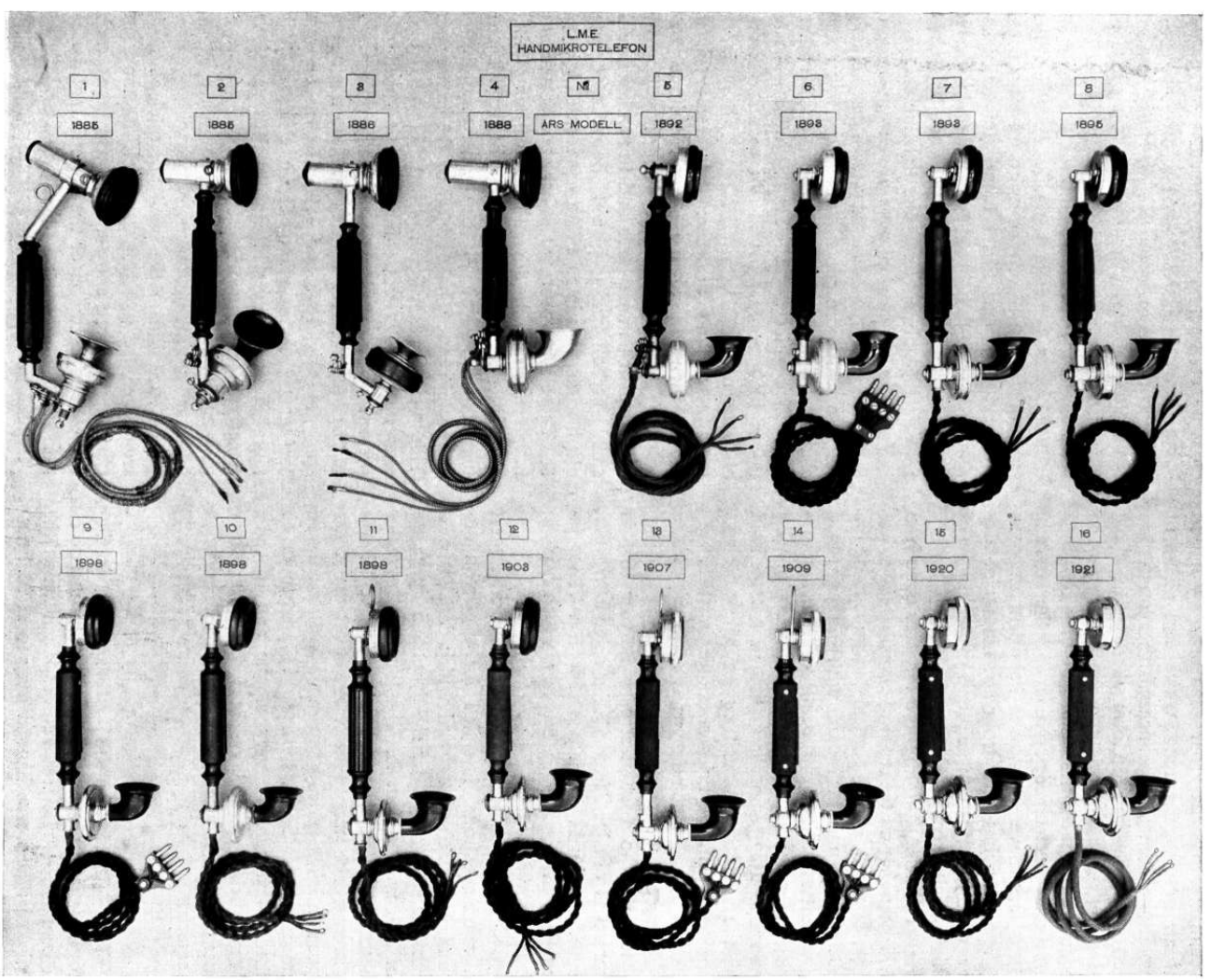


Fig. 3. Evolution of the L. M. Ericsson Hand Micro-telephone, 1885 to 1925.

No.	Year	Description
		magnet receiver, stem bent in an obtuse angle. Suspension eyelet and exposed terminal screws for cord connection.
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.
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.
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.
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.
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.
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 of varnished silk gauze with the word: »Patent». Ring magnet receiver, partially protected cord terminals.
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.
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.
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.
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.
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.

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 mouthpiece, etc.

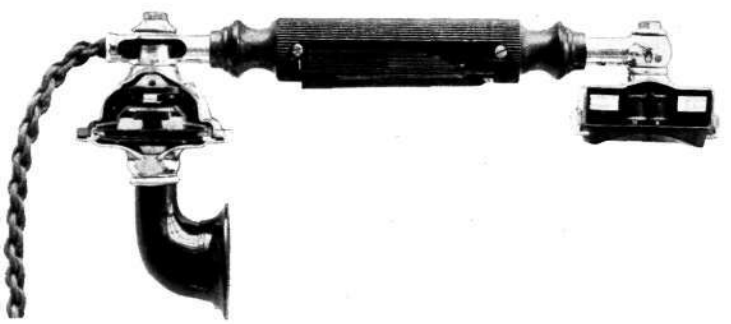
A number of other types have also been constructed for special purposes, such as for military use, for mines and for divers.

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
		1908	44,952
1891	193	1909	43,842
1892	1,037	1910	68,322
1893	3,017	1911	69,251
1894	6,175	1912	76,277
1895	9,279	1913	86,880
1896	21,661	1914	64,224
1897	27,977	1915	83,485
1898	52,180	1916	117,574
1899	51,442	1917	127,293
1900	54,749	1918	79,069
1901	45,632	1919	69,904
1902	67,872	1920	67,965
1903	69,355	1921	72,682
1904	77,460	1922	26,883
1905	83,489	1923	37,257
1906	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.

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