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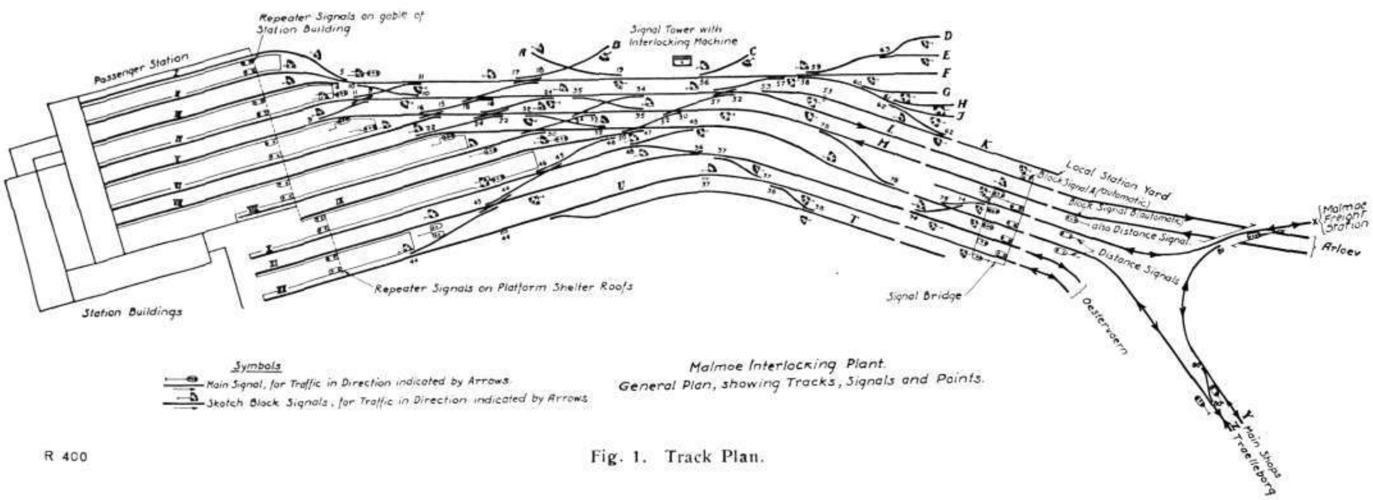


R 400

Fig. 1. Track Plan.

The New Interlocking Plant in Malmoe.

We hereby have the pleasure of presenting an article by Lieutenant I. Larsson, signal engineer for the State Railways of Sweden, describing the new electric interlocking plant at the Malmoe state railway terminal. The project for this plant has been prepared by Mr. T. Hård, engineer and member of the Board of The Royal Railway Administration of Sweden, the work of installation having been executed by Signalbolaget of Stockholm with electrical equipment from L. M. Ericsson in Stockholm and Westinghouse in London, and signal lanterns from the Avos company in Örebro.

The Malmoe terminal of the State Railways of Sweden has, during the past decade, been subjected to a number of radical changes and improvements, culminating in the installation of a new interlocking and signal control plant.

The previously existing interlocking plant, consisting of three mechanical interlocking machines — could, it is true, be temporarily adapted to the new track system, but as it no longer filled the demands of modern railway practice, the installation of an entirely new plant was decided upon by the railway administration. Following the custom which has become general during latter years, the choice was in favour of an electrical system, in which have been embodied a great many of the most recent developments and improvements achieved within the field of railway signal engineering. A number of designs and methods used in England and America, in particular, have been applied to this plant after having been modified to suit our requirements.

The Malmoe passenger station is a terminal station at which the traffic — during certain periods, at least — is very lively. The following lines enter this station: Stockholm—Malmoe, Gothenburg—Malmoe, Trelleborg—Malmoe (the so-called continental line) and the privately owned lines Malmoe—Simrishamn and Malmoe—Genarp. The two last mentioned use a common, hitherto single-track line between Malmoe and Oestervaern, a second track having now been completed, however. The lines from Stockholm and Gothenburg meet at Arloev, thus making the double-track line between Malmoe and Arloev common for them both. Judged from a Swedish point of view, the traffic on all of these lines is very lively, and there are times when express trains from Stockholm, Oslo, Copenhagen and the continent arrive at Malmoe simultaneously with a number of local trains, creating traffic conditions which put the interlocking and signal control plant to a very severe test.

R 401 Fig. 2. Signal Bridge, looking away from Track Yard.

The entire track system of the Malmoe passenger terminal as well as some of the tracks to the Malmoe freight station are controlled by a single interlocking machine, the interlocking zone, in consequence, being unusually extended, as may be seen from the track plan in fig. 1. All of the points, skotch blocks and signals shown on this plan are manoeuvered from the interlocking machine, none of the points or skotch blocks being set locally.

The plant has been executed with provisions for arranging a large number of track combinations for the purpose of providing the greatest possible freedom in the choice of platforms, this matter being of great importance on account of changes in the time table and the possibility of new train combinations.

The track combinations are as follows:

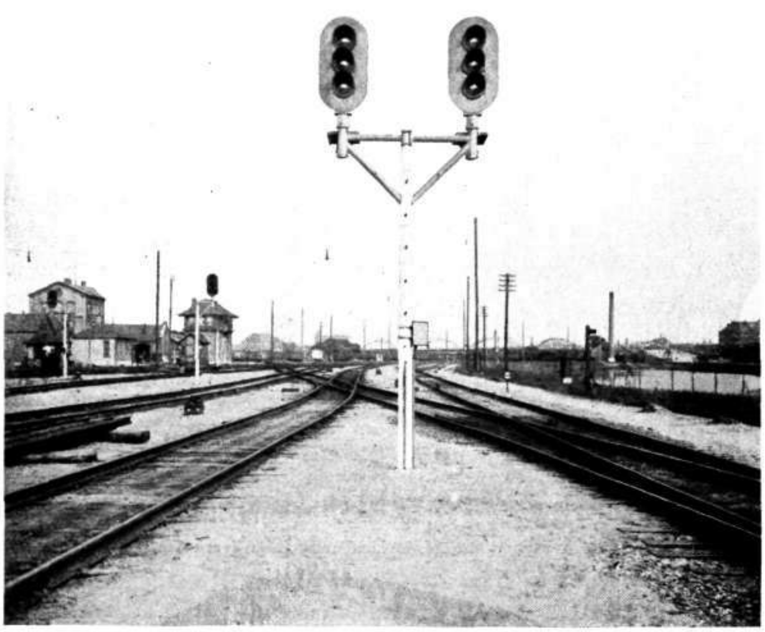
Incoming.

From Arloev to all the tracks Nos. I to XII,
» Malmoe freight station to all the tracks Nos. I to XII,
» Trelleborg to all the tracks Nos. I to XII,
» » to Malmoe freight station,
» the main shops to Malmoe freight station,
» Oestervaern over the North track to tracks Nos. X, XI or XII,
» Oestervaern over the South track to tracks Nos. X, XI or XII.

Outgoing.

To Arloev from all
» the tracks Nos. I to X,
» Malmoe freight station from all the tracks Nos. I to XII (the trains being directed over the passenger track yard proper by means of shunting signals without main signals).
» Trelleborg from all the tracks Nos. I to X,
» » » Malmoe freight station,
» the main shops from Malmoe freight station,
» Oestervaern from the tracks Nos. XI and XII.

The track combinations in their entirety form track circuits with track current. The track system is divided up into a suitable number of insulated sections, alternating current — which energizes a relay — being fed to each section. When a car enters a section the current is carried off through the wheel axles and the relay de-energizes. Various signals are influenced by these track relays, making it impossible to signal »clear» for a track when a car is standing on any section forming a part of the track in question. Automatic control of the fact that the track is actually clear is thus obtained before a »clear» signal can be given.



R 402 Fig. 3. Double and Single Starting Signals.

All signals are so-called »day signals», i. e. signals are given both day and night by means of certain light combinations. The signals are of two different kinds, i. e. main signals and skotch block or shunting signals. The former are colour signals, the different combinations being formed by means of varycoloured lenses, while the latter are placement signals, the different combinations being formed by altering the mutual positions of two or more lights.

Such light signals have come into use more and more during latter years, especially in America and England. They have some decided advantages over semaphores, revolving signals and the like, in that they have no moving parts that are affected by sleet, ice or other unfavourable weather conditions. Furthermore, they are more easily discernible in foggy weather, and their clearness does not depend on the colour of the background, as with semaphores. The use of specially constructed lenses makes it possible to discern these signals at a sufficient distance during the brightest sunlight without having to resort to exceptionally strong lamps.

The main incoming signals are mounted on a special signal bridge, shown in fig. 2. They have been hung from this bridge, partly so as to bring them as close as possible to the level of the locomotive engineer's eyes, partly on account of a street viaduct which spans the tracks at a distance of about 250 metres from the signal bridge and under which the signals must be visible at the greatest possible distance.

The incoming signals do not show whether or not the entire track is clear, but occur in the form of *one green light* for incoming trains to tracks VIII to XII (the shorter track group) and *two green lights* for incoming trains to tracks I to VII (the longer group). Thus, it is not possible for the engineer to ascertain — by means of the incoming signals — whether or not the entire track is clear, but the information given is sufficient to enable him to choose a suitable speed and — with regard to the insulated tracks, which prevent the giving of a »clear» signal for an occupied track — this has been deemed a sufficient safeguard.

R 403 Fig. 4. Repeating Signals on Gable of Train Shed.

The main starting signals are arranged partly as inner signals — placed at the ends of the platforms — and partly as outer signals on the previously mentioned signal bridge. Thus, an outgoing train must necessarily pass double signals. The inner signals are mounted on concrete poles, most of them at the ends of brackets which bring them closer to their respective tracks than the supporting poles themselves. This arrangement makes the signals more easily discernible, especially as it is not always possible — on account of insufficient space between adjoining tracks — to place the signals to the left of their respective tracks. The inner starting signals — when set to »clear» — do not denote which track is cleared except in those cases when outgoing tracks can be laid in two different directions: *one* green light to Arloev and *two* green lights to Trelleborg.

The work of the station master is simplified by the use of repeater signals — which repeat the various starting signals — placed further in on the platform or on the gables of the platform roofs.

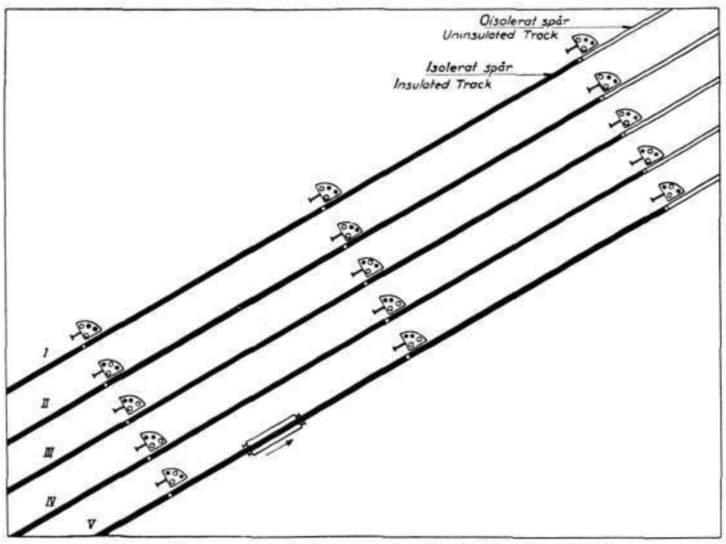
The passing of the outgoing train sets all the starting signals to »Stop».

The shunting which takes place at this station is often very lively, since the fact that it is a terminal station makes such operations necessary for every train. The existing branch lines, especially the Malmoe—Lund line, have a very lively traffic, judged from a Swedish point of view. The more important express trains usually have through traffic, and in Malmoe they are taken apart and made over for various destinations. In order to create as safe conditions as possible

R 404 Fig. 5. Skotch Block Signals. The nearest one indicates »Caution» and the one in the left background »Stop».

for these shunting operations, the shunting tracks have been provided with the same control and locking devices as the incoming and outgoing tracks. To accomplish this end, a large number of special skotch block signals are required, since all operations permitted by this system are controlled by the interlocking machine.

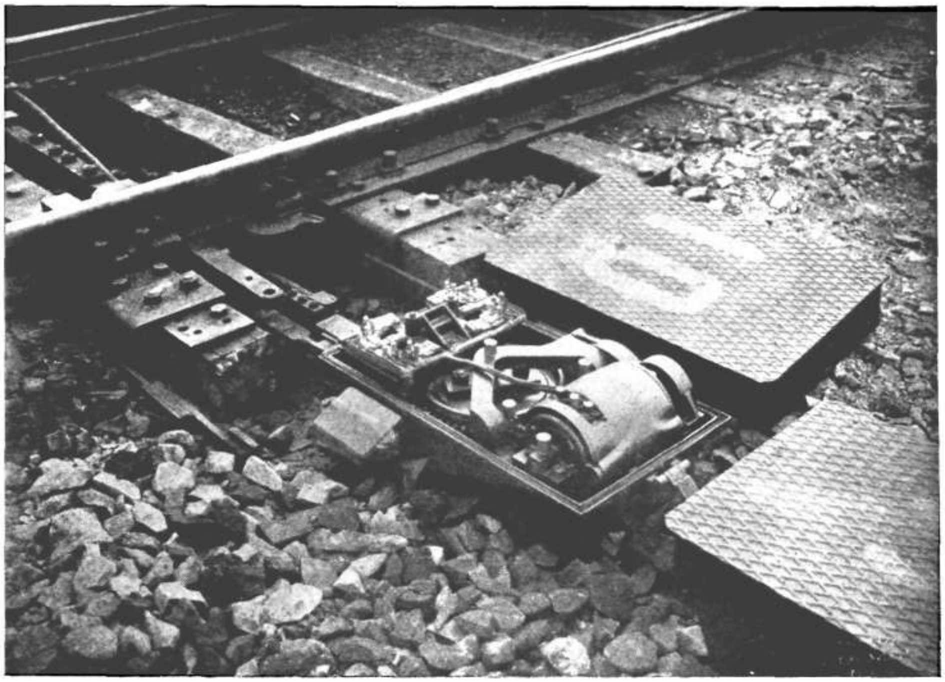
These signals have been given the form of dwarf signals, which require very little space, the various signal combinations being obtained by the different placing of two white lights in relation to each other. The signals are three in number, viz. »Stop», »Caution» and »Clear».



R 405 Fig. 6. Co-operation between skotch Block Signals and their relation to Occupied Track.

Alternative I. All three signals show »Stop».
» II. Left signal shows »Caution», because middle signal shows »Stop».
» III. Left signal shows »Clear», because middle signal shows »Caution». (Right signal shows »Stop»).
» IV. Left and middle signals show »Clear», because right signal shows »Caution».
» V. Car has entered left insulated track section after having passed a »Clear» signal to the left, which is then automatically set to »Caution».

For »Stop» the connecting line between the two lights is horizontal, for »Caution» it forms an angle of 45°, and for »Clear» it is vertical. When a signal is set to »Clear», all the points beyond it and up to the next signal on the shunting track, are locked. As soon as a car has passed the first signal, the points remain locked even if the signal is set to »Stop», and are released only in the measure that the car passes the respective points; thus the points are released as soon as this possibly can be done without risk, so as to provide the greatest freedom of movement for the interlocking machine.



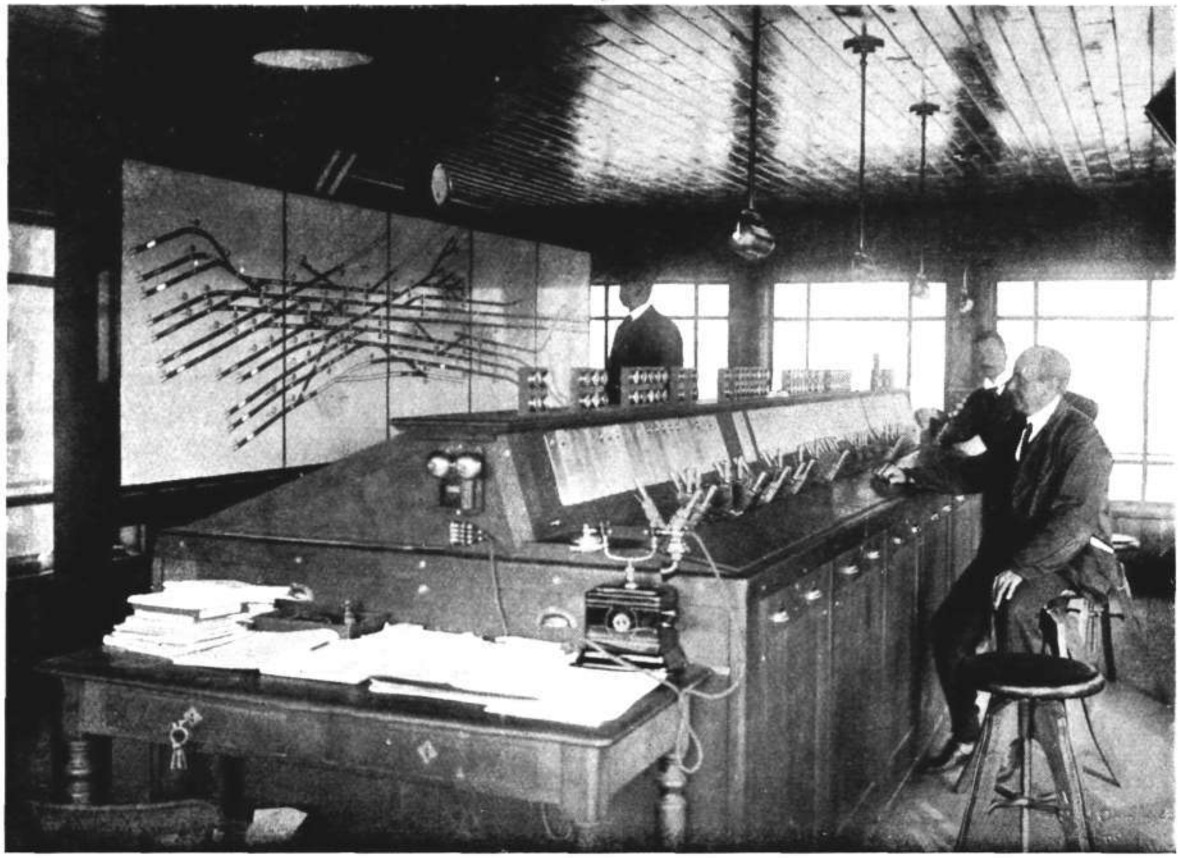
R 406 Fig. 7. Point Driving Mechanism.

R 407 Fig. 8. Cable Distribution Box.

R 408 Fig. 9. Signal Tower.

The skotch block signals do not show in which direction the cleared track leads, neither have point signals been arranged for this purpose; but, since a signal cannot be set to »Clear» unless at least one track is actually clear, and since, furthermore, shunting tracks which interfere with each other, cannot be simultaneously cleared, all movements are safeguarded, even if it should happen that a cleared track leads in a different direction than the switch operator has intended. The absence of point signals makes for increased simplicity and clearness, and experience has shown that the possibility of observing at a distance how the points are set is of minor importance, since all movements are controlled from the interlocking machine by means of signals.

A succession of skotch block signals co-operate mutually according to a definite system, so that one signal serves as advance signal for the following one. A signal cannot be set to »Clear» unless the preceding track section is clear and the following signal indicates »Clear» or »Caution», this co-operation being automatic. The interlocking machine maneuvres for »Stop» or »Clear» only, the actual signal given depending upon the setting of the following signal and the condition of the tracks. This association is clearly shown in fig. 6. Besides being used for shunting operations, skotch block signals also regulate the movements of the trains. The skotch block signals for a cleared track, therefore, are set to »Clear» in advance of or in conjunction with the setting of the main signal to »Clear»; thus, a cleared track is always indicated to a certain degree by means of the adjoining skotch block signals which show »Clear».



R 409 Fig. 10. Interlocking Machine and Illuminated Track Plan.

The point driving mechanisms are of Ericsson's latest design and are constructed for 130 volts d. c. An opened driving mechanism with motor, friction clutch and contact arrangement for the motor current and control current is shown in fig. 7.

All electric current is led through armoured underground cables. Fig. 8 shows an opened distribution box, also designed by Ericsson's. The type illustrated is for distribution from one main cable to eight smaller cables.

The signal tower, shown in fig. 9, has been erected in three stories.

The first story contains the power plant, storage batteries and a repair shop; in the second story are mounted the relays, and in the top story the interlocking machine and other apparatus are placed.

The interlocking machine (see fig. 10) is of English manufacture, delivered by The Westinghouse Brake and Saxby Signal Co. The point levers maneuvre one, two or — in a couple of instances — three driving mechanisms each. Two is the most usual number, as the track system contains several pairs of points, both points of which can and should be maneuvred simultaneously. The two driving mechanisms are connected in parallel, so that the time required for maneuvering them both is not longer than for one.

The signal levers are normally in vertical position and can be set either inwards or outwards thereby actuating different signals. The same lever can actuate both main and skotch block signals, the actuating of several different signals with the same lever being made possible by leading the signal circuits over point lever contacts or relay contacts.

The various levers are associated with each other by means of a cross locking gear, located behind the vertical front of the machine. This gear contains all the necessary control locks, and that they are very numerous can readily be understood if one reflects over the fact, that the interlocking machine, with its 74 levers, must have locking combinations for 70 starting and incoming tracks and 175 shunting tracks.

The necessary control and locking operations are obtained partly by means of contacts actuated by the levers and locking magnets which influence the levers, partly by means of a large number of relays, mounted in the second story of the signal tower.

The interlocking machine is in no wise connected up with other apparatus for the releasing of points. A cleared track remains locked until the train has passed and released the points itself, the points being generally released one after the other as the train leaves them.

This plant requires a large number of different types of relays for both d. c. and a. c., mounted under protective glass covers. The illustration on the title page shows a relay for d. c., of Ericsson's manufacture.

A satisfactory view over the very extensive zone which is controlled by the interlocking machine, cannot be obtained even in broad daylight, and at night conditions are still more unsatisfactory. For this reason, an illuminated track plan (see fig. 10) has been designed and constructed by L. M. Ericsson, and has been placed above and back of the interlocking machine. The main as well as the dwarf signals are indicated on this plan and it is divided up into track sections which represent the corresponding sections of insulated track out in the track system.

The different signal combinations are repeated on the track plan by means of differently coloured lights, obtained by the lighting of coloured lamps placed back of the small windows which represent the signals. The presence of a car on a track section is indicated by the lighting of a lamp behind a window placed in the track line; when the track becomes unoccupied, the lamp is extinguished. In this way it is possible to follow all the movements out on the track system as well as the maneuvering of points and signals without having to make inspections on the spot.

This plant was put in operation in August 1925.

The Ericsson Fire-Alarm System.

II. WITH MORSE TELEGRAPHIC SIGNALLING.

(Continued.)

As has already been stated in the previous article, alarm boards with but one telegraph receiver are recommended for plants with not more than twenty-five alarm boxes. If there are more than this number, or if conditions are such that the number of alarm boxes can be expected to exceed twenty-five within a not too distant future, an alarm board with at least two telegraph instruments should be used.

In the following we shall describe an alarm board (see fig. 14) with provisions for electrical control of the system and equipped with two telegraph instruments, specially suited for plants with a maximum of from 60 to 70 alarm boxes. This alarm board is normally intended for three alarm box loops, but this number can easily be increased to four or five, should local conditions so require.

K 28

Fig. 14. Alarm Board with two Telegraph Instruments.

The loops are all connected up in series at the alarm board, a common control current passing through the whole system when it is in rest position. Incoming signals are recorded by both telegraph instruments.

In larger plants, the alarm boxes are divided up among several control circuits with from three to five loops in each, the same schematic principle being applied and the alarm board containing the same number of instrument panels as there are control circuits. According to the diagram (fig. 15) two telegraph instruments are required for each control circuit; in larger plants this number can be reduced without impairing the reliability of the system, this result being obtained by connecting up some of the instruments in parallel with several control circuits.

ALARM BOARD WITH TWO TELEGRAPH INSTRUMENTS.

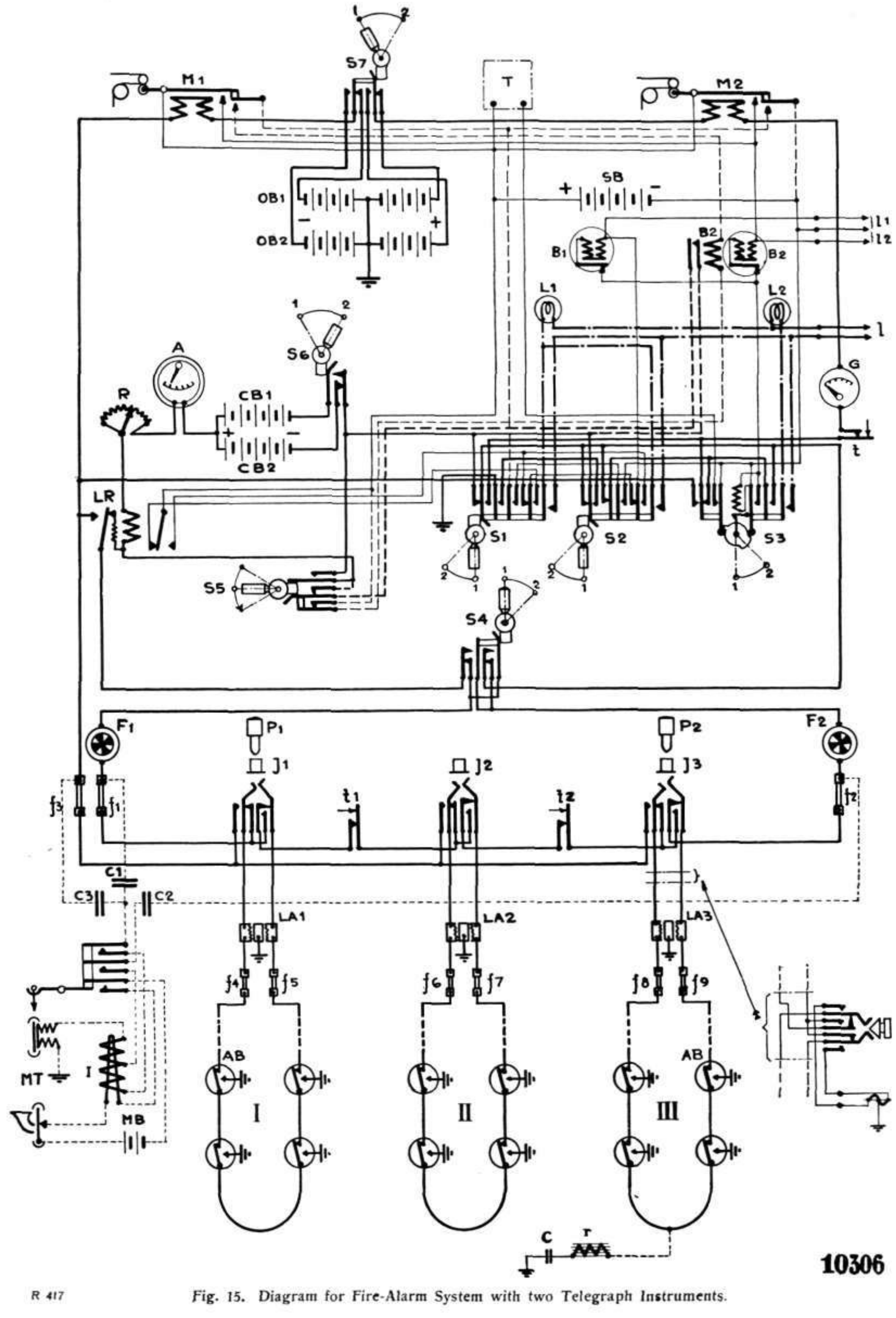
EQUIPMENT OF THE ALARM BOARD.

(See diagram n:o 10306, fig. 15, and reference diagrams figs. 1 to 13.)

M_1, M_2 *Telegraph instruments,* left and right, with arrangement which automatically releases the works as soon as the armature is attracted and locks the same when the recording of the signal ceases. With extra contacts for the automatic restoring device (see B_2).

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. When, at the sending in of a signal, the control circuit is broken (on the line), the relay releases its armature and herewith breaks the control circuit and simultaneously the telegraph instruments will be connected up *directly* to the line.

A *Miliampere meter* for the control current. Abnormal changes in the strength of the current denote the presence of a fault on the circuit (usually a leak or short circuit).



10306

R 417

Fig. 15. Diagram for Fire-Alarm System with two Telegraph Instruments.

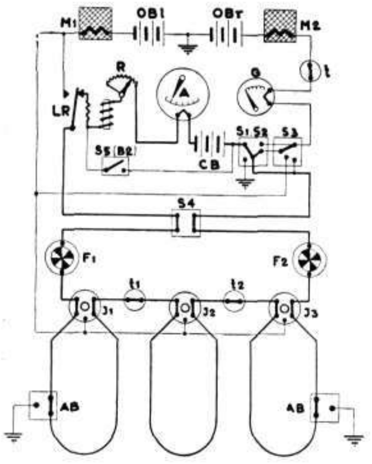
L. M. Ericsson

CODE SIGNALLING FIRE ALARM SYSTEM.

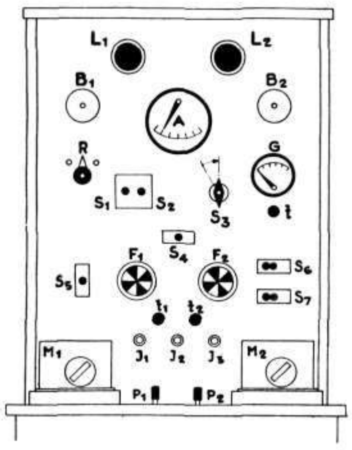
A. NORMAL POSITION.

REST POSITION.
Switches in normal position. Line under control current.

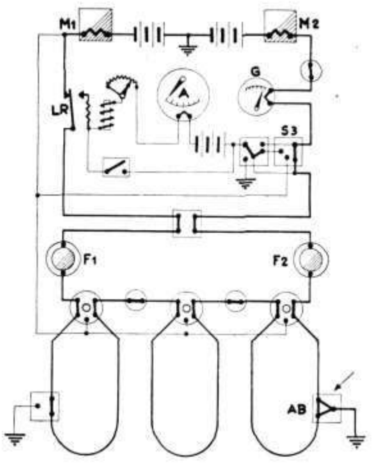
ALARM.
L_2 glows, B_1 rings, B_2 repeats the signal.



R 383 Fig. 1.



R 891 Fig. 2.

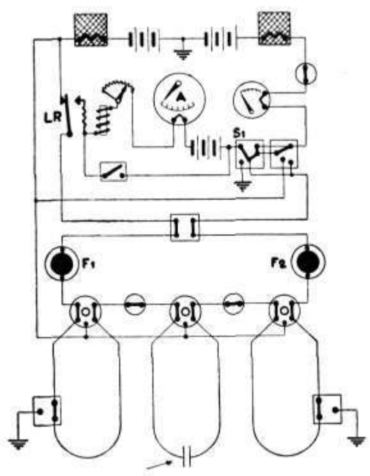


R 384 Fig. 3.

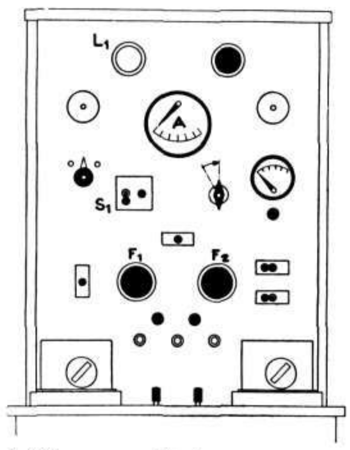
B. BREAK: L_2 glows, B_1 rings, F_1 & F_2 black.

REST POSITION.
S_1 pressed down. No control current.

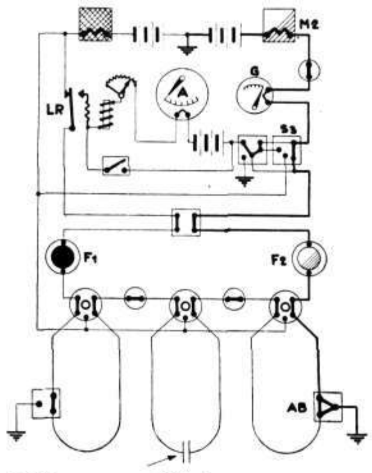
ALARM.
L_2 glows, B_2 repeats the signal.



R 385 Fig. 4.



R 392 Fig. 5.

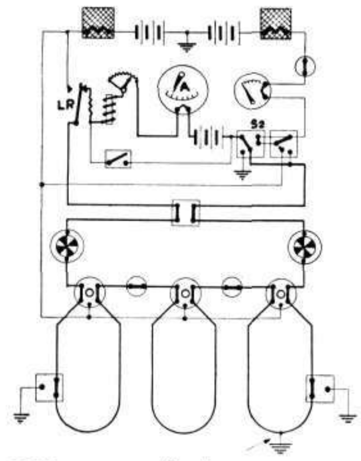


R 386 Fig. 6.

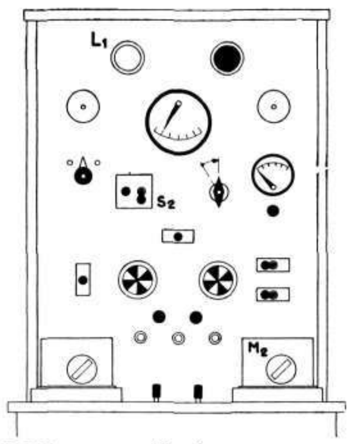
C. LEAK: L_2 glows, B_1 rings, F_1 & F_2 white, M_2 writes.

REST POSITION.
S_2 pressed down. Line under control current.

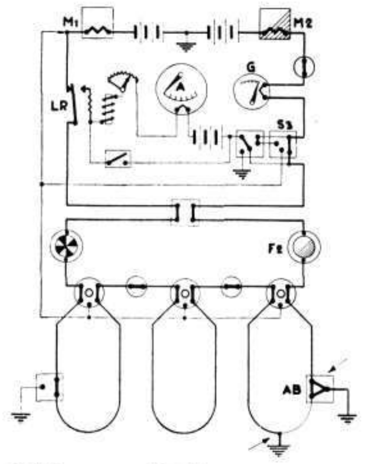
ALARM.
L_2 glows, B_1 & B_2 ring.



R 387 Fig. 7.



R 393 Fig. 8.



R 388 Fig. 9.

DEFINITIONS:

Telegr. instr. does not write.

Telegr. instr. registers signal.

Telegr. instr. writes continuous line.

Indicator shows absence of current.

Indicator flashes.

Indicator shows presence of current.

Extinguished lamp.

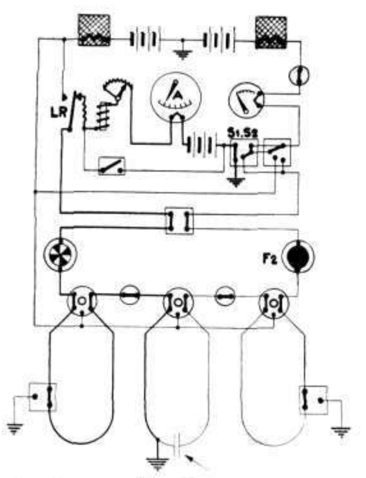
Glowing lamp.

• *Short circuited loop.*

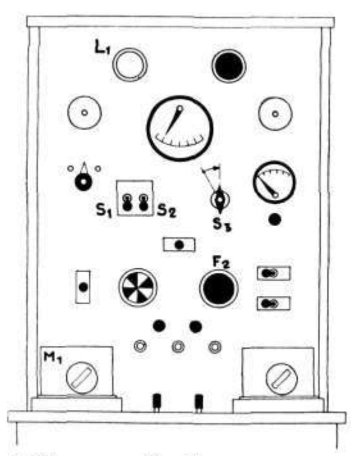
M_1, M_2: *Telegraph instruments.*
A: *Amperemeter for control current.*
G: *Amperemeter for operating current.*
F_1, F_2: *Star indicators.*
LR: *Line relay.*
R: *Regulating resistance.*
L_1: *Trouble indicator lamp, red.*
L_2: *Signal lamp, white.*
B_1: *Trouble bell.*
B_2: *Signal bell, with restoring device.*
S_1: *Break switch.*
S_2: *Leak switch.*
S_3: *Trouble switch.*
S_4: *Line reversing switch.*
S_5: *Restoring switch.*
t: *Earth testing key.*
t_1, t_2: *Testing keys.*
J_1, J_2, J_3: *Short circuiting jacks.*
P_1, P_2: *Short circuiting plugs.*
CB: *Control current battery.*
OBl, OBr: *Operating current battery, left and right halves.*
AB: *Alarm box.*

D. BREAK TO RIGHT AND LEAK TO LEFT.

L_2 glows, B_1 & B_2 ring. F_1 white, F_2 black, M_1 writes.
REST POSITION. S_1 & S_2 pressed down.



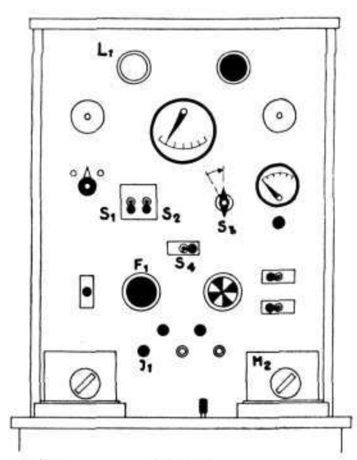
R 389 Fig. 10.



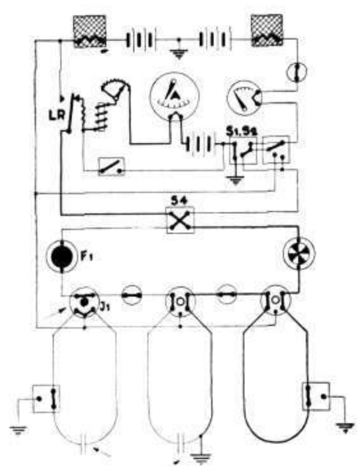
R 394 Fig. 11.

E. BREAK TO LEFT AND LEAK TO RIGHT.

L_2 glows, B_1 & B_2 ring. F_1 black, F_2 white, M_2 writes.
REST POSITION. S_1 & S_2 pressed down. S_3 to right.



R 395 Fig. 12.



R 390 Fig. 13.

D (E) ALARM: 1. From leak side: L_2 glows. B_1 rings. M_1 registers signal. B_2 and F_1 (F_2) repeat the signal.
2. From break side: L_2 glows. M_2 registers signal. B_2 and F_2 (F_1) repeat the signal.

After the signal has ceased, the control current is restored either by hand (S_5 is pressed down) or automatically (B_2). The trouble switch S_3 must always be restored (by hand) and L_2 extinguished, when the system is in rest position.

NOTE: Loop with break but without leak is generally short-circuited on the alarm board (fig. 13).

R *Regulating resistance* for regulating the strength of the control current, which should be held at about 10 milliamperes.

F_1, F_2 *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 *Milliampere meter* for the operating current. This meter indicates the presence of a current from the right part of the 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*.

B_1 *Trouble bell.* This bell rings when the control current is broken, for instance at the sending in of an alarm or when there occurs a break on the line.

B_2 *Signal bell* with device for automatically restoring the control current after the reception of an alarm signal. The bell rings when the magnets of one or both telegraph instruments energize. After the signalling has ceased, the restoring device is actuated, closing a local circuit over the winding of relay *LR* after one or two seconds. *LR* energizes, breaking the operating circuit over the telegraph instruments and again closing the control circuit, the control current being thus restored.

S_1 *Break switch,* used when a break occurs in the control circuit, for the purpose of bringing the system in *break position* until the fault can be remedied (see figs. 4 to 6.)

S_2 *Leak switch,* used in conjunction with either a continuous or an intermittent leak on the line (see figs. 7 to 9).

When a break and leak occur simultaneously, both switches S_1 and S_2 are set (see figs. 10 to 13).

L_1 *Trouble indicator lamp* which glows as long as one or both of the switches (S_1 and S_2) are set, indicating that the line is faulty.

S_3 *Trouble switch* which is automatically set at the reception of a signal or when a fault occurs, thus momentarily breaking the earth connection at the station. At the same time, the time stamp *T* (if there be one) and the telegraph instruments are actuated and L_2 glows.

L_2 *Signal lamp,* which glows while a signal is being received at the station and does not cease glowing until the switch S_3 is restored to normal (manually) after the signal has ceased.

S_4 *Line reversing switch,* by means of which the outgoing and incoming line ends are reversed (used when break to the left and leak to the right occur simultaneously on the line) (see figs. 12 & 13).

S_5 *Restoring switch,* for manually restoring the control current (the lever is pressed down) and, when necessary, for disconnecting the automatic restoring device in the signal bell B_2 (the lever is set upwards).

S_6 *Control battery switch.*

S_7 *Operating battery switch.*

t *Earth testing key,* which is used when testing the earth connections of the alarm boxes.

t_1, t_2 *Testing keys,* to determine in which alarm box loop an existing leak is situated.

P_1, P_2 *Short circuiting plugs.*

J_1, J_2, J_3 *Short circuiting jacks.* The insertion of af plug into one of the jacks causes both branches of the affected loop to be connected up directly to the left telegraph instrument M_1, and the line circuit to be shorted in the jack (see J_1, fig. 13). These jacks are used for determining in which loop an existing break is located and for short circuiting a broken loop circuit, when necessary, for the purpose of providing electrical control for the other, undamaged loops.

f_1, f_2, f_3 *Fuses,* 0,15 amp.

f_4 *to* f_9 *Fuses,* 2 to 3 amp.

LA_1, LA_2, LA_3 *Vacuum lightning arresters.*

MT Hand microtelephone

I Induction coil

C_1, C_2, C_3 *Condensers*

T Time stamp, which prints the time of arrival of an alarm trouble, or telephone call signal on the tape of the right telegraph instrument.

The necessary *terminal screws* for connecting up line wires, batteries and extra trouble and signal bells are placed within the alarm board.

BATTERIES.

The following batteries are required for the alarm system.

CB_1, CB_2 *Control current batteries,* 10 to 20 volts.

OB_1, OB_2 *Operating current batteries,* 20 to 30 volts.

SB Signal battery, 10 to 15 volts.

MB Transmitter battery, 3 volts for *MT*.

Electric light current is used for the trouble indicator lamp L_1 and the signal lamp L_2.

Dry cells are generally used. Eventually, only one operating battery is required, in which case the corresponding terminals of OB_1 and OB_2 are connected up, so as not to allow the operating battery to be disconnected when switch S_1 is in the wrong position. The control batteries, on the other hand, should be two in number, to be alternately connected up every other day.

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 importance with regard to the batteries.

For the control current batteries: the strength of the control current must not fall below 10 milliamperes when the regulating resistance R is entirely cut out of the circuit, and the automatic restoring device shall function properly.

For the operating current batteries: the telegraph instruments shall give clear signals with both intact and broken line as when the key t is depressed for testing the earth connection of the alarm boxes.

For the signal battery: the bells shall give a clear, loud signal when an alarm is sent in from the alarm boxes, and the automatic restoring device shall function properly.

ALARMING OF FIREMEN.

The system permits the connecting up of polarized bells with low resistance directly in the alarm box loops for the purpose of alarming firemen whose quarters are not located within the station building.

If such is the case, an alarm magneto is included in the station equipment and the alarm board is provided with the necessary switches for switching over the loops to the magneto (see diagram 10306).

Switches for the alarm bells within the station building can also be mounted on the alarm board.

A so-called safety connection — to permit ringing the bells when the line is broken — is made by earthing the middle point of the magneto armature winding and by connecting up a retardation coil in series with a condenser out on the line, between line and earth. The point for making this connection out on the line is chosen so that the alarm bells connected to this loop will be divided into two equal groups. By making this arrangement, one half of the alarm bells in the loop will ring when a magneto alarm is sent out over a broken loop.

DESCRIPTION OF DIAGRAMS.

A. Faultless line. System in normal position.

Normally, when there is no fault on the line, the switches S_1, S_2 and S_4 shall be in their normal positions, i. e. with the lever standing straight out. The trouble indicator lamp L_1 does not glow (see fig. 2).

With the system in *rest position* the line relay *LR* is energized and current passes from one of the control batteries (*CB* on the diagram) over the following circuit *(control current circuit).*

1. CB_2+, A, R, winding and contact of LR, S_4, F_1, f_1, J_1, f_4, loop *I*, f_5, J_1, t_1, J_2, f_6, loop *II*, f_7, J_2, t_2, J_3, f_8, loop *III*, f_9, J_3, f_2, F_2, S_4, S_1, S_2, S_6 and $-CB_2$.

The milliamperemeter A indicates the strength of the current, which must be held at about 10 milliamperes by means of the regulating resistance R. The indicators F_1 and F_2 show white, indicating the presence of a current.

The lever of the trouble switch S_3 stands in vertical position, the signal lamp L_2 being extinguished (see fig. 1).

At the giving of an alarm signal, the line is momentarily connected to earth in the signal works of the alarm box, causing the right telegraph instrument to receive an electric impulse from the right part of the operating battery (OB_1 on the diagram):

2. Earth at the station, middle point of OB_1, $+OB_1$, S_7, M_2, G, t, S_3,

S_2 { S_4, F_2, f_2, J_3, f_9, right branch of line ....
S_2, S_1, S_6, $-CB_2+$, A, R, winding and contact .... }

of LR, S_4, F_1, f_1, J_1, f_4, left branch of line to earth in the alarm box.

The magnet of M_2 energizes, closing a circuit over the signal bell B_2 and the releasing magnet of the trouble switch S_3.

3. $SB+$, contact of M_2, B_2, magnet of S_3, $-SB$.

The trouble switch is thereby released and set to its second position, causing the signal lamp L_2 to glow.

While the trouble switch is in motion

a) a circuit through the magnet of the optional time recorder T is closed,
b) the connection between the operating battery and the line (circuit 2 through M_2) is broken, for the purpose of eliminating the detrimental influence of an occasional leakage current (circuit 2) on the line relay, since this relay must de-energize at the first breaking of the control circuit in the mechanism of the alarm box, and
c) a local circuit through both telegraph instruments is closed:

4. OB_1+, S_7, M_2, G, t, S_3, M_1, S_7, $-OB_1$.

The magnets of telegraph instruments energize, causing their clock-works to start functioning, thereby permitting the correct reception of the first code signs.

During the continued functioning of the signal works the control circuit 1 is broken at the first break between the line contacts in the works. The line relay LR de-energizes, causing the left line branch to be connected to the telegraph instrument M_1 over a relay contact.

A circuit through the trouble bell B_1 is closed over another relay contact:

5. $SB+$, contact in LR, S_1, S_2, B_1, magnet of S_3, $-SB$.

B_1 rings continuosly during the entire signal. After the signal, when the control current is restored, B_1 ceases to ring.

While the signal works are functioning, the three contact springs close and separate — in accord with the code number of the alarm box — each closing of the contacts causing the following *two operating circuits* to be closed (see fig. 3):

6. Earth at the station, middle point of OB_1, OB_1+, S_7, M_2, G, t, S_3, S_4, F_2, f_2, J_3, f_9, right branch of line, contact springs in alarm box, earth in alarm box,
   and:

7. Earth in alarm box, contact springs, left branch of line, f_4, J_1, f_1, F_1, S_4, contact of LR, M_1, S_7, $-OB_1$, earth at station.

Both M_1 and M_2 record the signal on their tapes, the signal being repeated by the indicators F_1 and F_2 and the signal bell B_2 (compare circuit 3).

When the signal ceases, the line remains intact in the alarm box, but is not connected to earth. This arrangement provides the telegraph instruments with current over an all-metallic circuit (compare circuits 6 & 7) and they write long unbroken lines. B_2 rings uninterruptedly.

A circuit over the restoring magnet in B_2 is closed over extra contacts on M_1 and M_2:

8. $SB+$, S_5, restoring magnet of B_2, contacts in M_1 and M_2, $-SB$.

The armature of the restoring magnet is attracted, and after a lapse of time of from 1 to 2 seconds, a local circuit through the winding of LR is closed:

9. CB_2+, A, R, winding of LR, S_5, contact in B_2, S_6, $-CB_2$.

LR energizes, breaking the operating circuits 6 and 7 and again closing the control circuit 1. The control current is thus automatically restored.

M_1 and M_2 stop functioning, B_1 and B_2 cease to ring, while F_1 and F_2 show the presence of current (white). A indicates 10 milliamperes. The trouble switch S_8 is restored to normal *by hand* (lever in vertical position), causing the signal lamp L_2 to cease glowing.

Note 1. The control current can also be restored *by hand* by pressing down the lever of S_5, the following circuit being closed:

10. CB_2+, A, R, winding of LR, S_5, S_6, $-CB_2$.

Note 2. When so required, the automatic restoring can be cut out by bringing the lever of S_5 to its upper position. This breaks circuit 8 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 deenergizes, causing the trouble bell B_1 to ring and setting the trouble switch S_3. The signal lamp L_2 is brought to glow over a contact in the trouble switch. *Both indicators F_1 and F_2 show black.*

The system is brougt to *rest position with break* by pressing down the lever of the break switch S_1 to the »Break» position, breaking circuit 5 and causing B_1 to cease ringing. The trouble lamp L_1 is brought to glow over a contact in S_1. The trouble switch is restored by hand, L_2 ceases to glow (see fig. 5).

In rest position with break the system is without electrical control. A indicates zero, F_1 *and* F_2 show black. The left branch of the line is connected to M_1 over the contact in LR (see fig. 4).

When an alarm is turned in from an alarm box with the system in rest position with break, one of the operating circuits 6 or 7 is closed at each contact made between the earth and the line contact springs in the alarm box, and one of the telegraph instruments records the signal. One of the indicators flashes and B_2 rings in time with the signal impulses. At the first impulse S_3 is set (circuit 3) and L_2 glows (see fig. 6).

When the signal has ceased, the automatic signal device S_3 is restored by hand and L_2 ceases to glow.

Trouble investigating at the station.

At the station, one of the short circuiting plugs P is in turn inserted in the short circuiting jacks J to ascertain in which loop the break is located. If a signal for an unbroken line (both indicators show white) 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 an investigation of the fault on the line is not to be made immediately, the broken loop is kept short circuited, and the break switch S_1 is restored to normal (point A). This short circuiting connects the broken loop to the left telegraph instrument M_1 and restores the control current over the other loops. Alarm and leak signals from the shorted loop are received by the left telegraph instrument M_1 only. The signal impulses are carried over the following circuit:

11. Earth in the alarm box, contact springs, line, J, f_3, M_1, S_7, $-OB_1$, earth at station.

Alarm and trouble signals from the other intact loops, on the other hand, are received as usual (point A).

If a subsequent break occurs on one of the other, previously intact loops, signals are automatically received at the station according to point B, the same procedure as above being resorted to with the sole exception, however, that if *all* the loops become broken, one of them shall *not be short circuited*, the system being retained in *break position*, according to point B.

Trouble investigating on the line.

When seeking the location of a break in a loop, the short circuiting plug is removed from the jack of the loop, and the system is brought to *break position* (point B).

Note. If breaks have occured in several loops, all the broken loops except the one being investigated are kept short circuited on the alarm board.

To locate the trouble in question, the line repair man selects an arbitrary alarm box on the loop under investigation, gives a call signal (see point J, Telephoning) and obtains information as to which one of the telegraph instruments or indicators records the calling signal.

For instance, if the signal is received by the left instrument and the left indicator, this proves that the break is located to the *right* (see diagram) of the alarm box chosen by the repair man. He must then proceed with his investigation in the direction in which the trouble is located — to the right in the present case — and repeat the test from the next alarm box, and so forth until the call signal is received by the other telegraph instrument and indicator. Thus the location of the trouble is restricted; it is to be found between the two alarm boxes, whose signals are received by different telegraph instruments and indicators. Lastly, the line between these two alarm boxes is inspected and the trouble remedied.

After the fault has been remedied and the line is again intact, this fact is automatically signalled at the station. M_1 and M_2 write a long unbroken line. G indicates the presence of a current, *both indicators show white* (compare circuits 6 & 7), S_3 is reset and B_2 rings (circuit 3). L_2 glows. The restoring magnet in B_2 receives current (circuit 8) and the control current is automatically restored (circuit 9), causing M_1 and M_2 to cease writing, while B_2 ceases to ring. A circuit through the trouble bell B_1 is simultaneously closed, over a contact in LR:

12. $SB+$, contact in LR, S_1, S_2, B_1, magnet of S_3, $-SB$.

B_1 continues to ring until break switch S_1 is restored to normal, after which the system is restored to rest position (according to point A) by the bringing of S_3 to its normal position and the extinguishing of L_2.

C. *Continuous or intermittent leak on the line.*

When the system is in normal position and a leak occurs on the line, the telegraph instrument M_2 will write an unbroken line, or, if the leak consists of momentary contacts, a sequence of dashes (circuit 2, with earth connection on the line). G indicates the presence of a current, B_2 rings, S_3 is set (circuit 3) and L_2 glows. The control current is not broken (increases). *Both indicators generally show white.*

The system is restored to *rest position with leak* (also in case of intermittent leak) by bringing the lever of the leak switch S_2 down to the »Leak» position and by restoring S_3 to normal. This breaks the circuit through M_2, which ceases to function, and B_2 stops ringing. The trouble lamp L_1 receives current over a contact in S_2 and glows. F_1 and F_2 show white and A indicates 10 milliamp. (see figs. 7 & 8).

The sending in of alarm signal causes LR to de-energize at the first break between the contact springs of the signal works, closing circuit 5 and connecting up M_1 to the left line branch. S_3 is set simultaneously, and B_1 starts ringing. L_2 glows and M_2 is connected up to the right line branch over a contact in S_3 (see fig. 9). The signal is registered by one of the telegraph instruments, while the other writes an unbroken line (circuits 6 & 7).

When the signalling has ceased, the control current is automatically restored, M_2 continues to write a long, uninterrupted line and B_2 rings until S_3 is restored to normal.

Trouble investigating.

At the station, the loop in which a leak is located, can be determined by depressing — in turn — the test keys t_1 and t_2 *while watching the indicators.*

If the left indicator shows white and the right one shows black when t_1 is depressed, the trouble will be found to the left of the key t_1, i. e. in the first loop (compare circuit 7 with earth connection on the line). On the other hand, if the left indicator shows black and the right one white (compare circuit 6), the trouble is located in a loop to the right. In this case key t_2 is depressed, etc.

To locate a leak on the line, the same procedure as the one used for locating a break is resorted to, i. e. by observing which telegraph instrument and which indicator receives call signals from different alarm boxes.

When the fault has been remedied, no signal is received at the station, the line being tested by restoring S_2 to normal. If no leak signal is received, this indicates that the leak has been removed in which case S_2 remains in its normal position.

D. *Leak to the left and break to the right.*

When the system is in normal position and both a break and leak occur simultaneously on the line with the leak located to the *left* of the break, the control circuit 1 is broken, LR de-energizes, B_1 starts ringing, S_3 is set (circuit 5) and L_2 glows. The earth connection on the line closes a circuit over M_1 (compare circuit 7), M_1 writes a long, unbroken line and B_2 rings. *The left indicator shows white and the right one black.*

To restore the system to rest position, the levers of both switches S_1 and S_2 are pressed down, causing the negative pole of the control batteries to be switched over from the right line branch to earth. L_1 receives current over contacts in S_1 and S_2.

After this switching operation has taken place, the control current is restored — either automatically or by hand for a part of the line (left line branch between the station and the leak):

13. Earth at station, S_1, S_2, S_6, $-CB_1+$, A, R, winding and contact of LR, S_4, F_1, f_1, J_1, f_4, left part of line, earth on line.

S_3 is restored by hand and L_2 ceases to glow.

The line portion between the station and the break (right branch) is connected to the right telegraph instrument M_2 at the alarm board and is without control current.

In rest position *the left indicator shows white and the right one black* (see figs. 10 & 11).

When an *alarm* is sent in from the *leak side,* the control circuit 13 is broken and the line connected over to the left telegraph instrument M_1; L_2 glows and B_1 rings. The signal is recorded by M_1 and is repeated by B_2 and F_1.

When the signal ceases, the control current is restored automatically or by hand. S_3 is restored by hand.

When an alarm is sent in from the *break side,* the signal is received by M_2; L_2 glows, B_2 and F_2 repeat the signal. The control circuit is not broken.

When the signal has ceased S_3 is restored by hand and L_2 ceases to glow.

Trouble investigating.

When leak to the left and break to the right occur on the line, the loop in which the leak is located, is determined at the alarm board by depressing the test keys t_1 and t_2 while observing the left, white indicator. If the indicator remains white when t_1 is depressed, the leak is located in loop I; if the indicator changes to black, the leak is in one of the loops to the right, in which case key t_2 is depressed, etc.

The break is located by inserting one of the plugs P in the short circuiting jacks J and observing the black indicator, which changes to white when the broken loop is short circuited.

For locating trouble on the line, the same procedure is followed as for locating a single break or leak. Telephone signals from alarm boxes, located to the *left* of the faults, are received by the *left* telegraph instrument and the *left* indicator; signals from alarm boxes to the *right* of the faults are received by the *right* telegraph instrument and the *right* indicator. No signal is received at the station from alarm boxes lying between the two faults.

When the faults have been remedied, *both indicators show white,* M_1 and M_2 write long unbroken lines, G indicates a current and L_2 glows. The trouble switches S_1 and S_2 are restored to normal and the system is again brought to rest position as described in point A.

E. *Leak to the right and break to the left.*

If both a leak to the right and a break to the left occur simultaneously when the system is in normal position, the control current is broken and the right telegraph instrument writes a long unbroken line. L_2 glows, B_1 and B_2 ring. *The right indicator shows white and the left one black.*

To restore the system to rest position, the levers of both trouble switches S_1 and S_2 are pressed down, causing L_1 to glow, and *the lever of the reversing switch S_4 is pressed over to the right*, after which the control current is restored for a part of the line (right branch between the station and the leak):

14. Earth at station S_1, S_2, S_6, $-CB_1+$, winding and contact of LR, S_4, F_2, f_2, f_9, right branch of line, earth on the line.

L_2 is extinguished by hand.

In rest position *the left indicator shows black and the right one white* (see figs. 12 & 13).

An incoming alarm from the *leak* side (right branch of line) breaks the control circuit 14, and the signal is received by the *left telegraph instrument* M_1.

An incoming alarm from the *break* side (left branch of line) is received by the *right telegraph instrument* M_2.

Trouble investigating.

Investigating and locating faults is carried on as already described. We must not forget, however, that the line branches have been reversed by laying over the switch S_4, so that a signal from the left line branch (break side) is received by the *right* telegraph instrument and the *left* indicator, while a signal from the *right* line branch (leak side) is received by the *left* telegraph instrument and the *right* indicator.

Note. When both a break and leak occur, but in different loops, the broken loop is short circuited on the alarm board, and the system is brought to rest position with leak according to point C. Generally, a leak and break occur at the selfsame point, when the line becomes broken and one of the line ends remains insulated while the other is grounded. In such a case, the faulty loop must not be short circuited at the station, but the system must be brought to rest position according to point D or E.

F. *Short circuit on the line.*

A short-circuit on the line is not automatically indicated at the station unless the control current be increased. The fault is discovered when receiving a test signal or an alarm from an alarm box on the shorted portion of the line, in which case the control circuit is not broken and the signal is received on the right telegraph instrument (compare circuit 2).

Signals from that portion of the line which is not shorted, are transmitted as usual (circuits 6 & 7).

When the short circuit has been remedied, this fact can be ascertained only by testing the alarm boxes.

G. *Break in earth connection of alarm box.*

A break in the earth connection of an 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 the line or that portion of the line on which the alarm box is located, is *under electrical control* (compare the all-metallic circuits 6 & 7 without earth connection in alarm box).

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 and situated in one of the faultless loops, reach the station on condition that the broken loop has been *short circuited* at the alarm board and that the control current has been restored in the other faultless loops.

When testing the alarm boxes, a broken earth connection can be ascertained by depressing the earth test key t while the works are in motion and observing the telegraph instruments. If the earth connection is intact, the right instrument will stop functioning while the left one continues to record the signal (circuit 7). If the earth connection is broken, on the other hand, both telegraph instruments will stop functioning.

H. *Two or more simultaneous alarm signals.*

If alarm signals are given from two alarm boxes simultaneously, one will be recorded by the left telegraph instrument and the other by the right instrument without interfering with each other. As a general rule, if several alarm signals are sent in simultaneously, those coming from the two outer alarm boxes will be fully recorded at the station, while those from intermediate alarm boxes will be only partially received or entirely eliminated. Under no circumstances, however, will the signals from the two outer boxes be disturbed by signals from intermediate alarm boxes.

I. *Short circuiting of a loop at the station.*

If two or more faults occur simultaneously on the line, no signal can be received from alarm boxes situated between the two faults. A temporary makeshift is to short circuit one of the loops at the station by inserting one of the plugs P into the corresponding short circuiting jack J, thus connecting the shorted loop directly over to the left telegraph instrument. When a signal is given from an alarm box on a shorted loop, circuit 11 is closed over the earth contact in the alarm box and M_1 registers the signal. In case the loop, in which a leak occurs, is short circuited, the left telegraph instrument will write and the signal bell ring continuously. It is self-evident that a loop in which there is a leak, cannot be short circuited (see fig. 13).

J. *Telephoning from an alarm box.*

A calling signal is given from an alarm box by slowly depressing the *telephone calling key* in the alarm box. This key 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 telephone conversation does not in any way interfere with the reception of *alarm signals.*

A. P. — B. K.

CONTENTS OF THIS NUMBER: The New Interlocking Plant in Malmoe. — The Ericsson Fire-Alarm System. II. With Morse telegraphic signalling.

L. M. Ericsson

THE ERICSSON WIRELESS HEADPHONES

We are now producing a special wireless model of headphone, combining **lightness** with **strength** and **durability,** with a simple adjustment allowing it to fit comfortably to any head.

The double pole watch receivers have cases of aluminium, and are flexibly held together by leather covered steel bands, all other metal parts being of nickel plated brass.

The headphone is supplied with a soft, flexible cord, a metre and a half long.

Total weight: 0,4 kgs.

We manufacture these Phones to the following resistances:

RF 1320. Resistance, **2000 ohms.** Code word: Repmakvoel.

RF 1321. Resistance, **4000 ohms.** Code word: Repmakvoig.

ALLMÄNNA TELEFONAKTIEBOLAGET L. M. ERICSSON

STOCKHOLM

L. M. Ericsson

THE ERICSSON LOW FREQUENCY RADIO TRANSFORMER

Transformer, complete with case.

Transformer, with case removed.

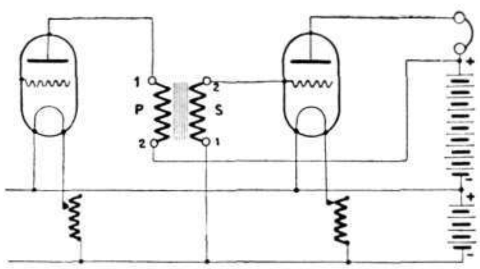
This transformer is of exactly the same construction as our well-known, reliable type with core of nonmagnetic annealed iron wire, bent over so as to completely enclose the wire coils. This method has proven very efficient for the purpose of protecting the transformer from the detrimental influences of neighbouring circuits.

The transformer is enclosed in a beautifully lacquerred 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	1:3.
»	**RM 2101.**	»	1:4.
»	**RM 2102.**	»	1:5.



ALLMÄNNA TELEFONAKTIEBOLAGET L. M. ERICSSON

STOCKHOLM

KURT LINDBERG
Boktryckeriaktiebolag
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R 428

THE VICTORIOUS »ERICSSON» ROWING TEAM OF THE CHILI TELEPHONE Co. IN CONCEPCION.

ENGLISH EDITION

L. M. Ericsson

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The L. M. Ericsson Display Room in the Ericsson Tower Building, Stockholm.

It is now more than twenty five years since a permanent display of the various Ericsson products — both old and new — was arranged in the Stockholm factory building on Tulegatan. The steady growth of the company's output made the demands for increased floor space more and more insistant, however, and after a few years the display room was utilized for other purposes. The most interesting apparatus and models — dating from the time when telephony was in its infancy and from the earlier stages of its development — which formed a part of this collection were loaned to the Royal Telegraph Administration and deposited in their museum.

In the new Ericsson Tower Building, however, necessary floor space was reserved both for the main office of the firm and for a modern display and salesroom, these quarters being ready for occupancy in the fall of 1925. The purpose of this new display is to obtain a representative collection of apparatus and instruments covering the various lines of manufacture in which the company is engaged.

R 429 Fig. 1.
The New Ericsson Tower Building.

As may be seen in fig. 3, the show-room is located on the ground floor and just to the left of the main entrance of the building. Two electric sign arrangements with changing wording, made of jack-strips and signal lamps and having the form of a switchboard multiple, form a very striking feature of the attractive window display.

The attention of a visitor entering the showroom is immediately drawn towards a large glass cabinet or show case, placed between the two windows and enclosing a section of an automatic exchange according to the Ericsson system for higher capacities. There is also a full automatic switchboard — visible to the extreme left in fig. 2 — of the type intended for private exchanges; the one shown is for one hundred lines and serves not only as an exhibit but also as exchange for the private telephone plant of the main office.

The wall shown in fig. 2 has been devoted to modern telephone instruments of varying types, fire alarm apparatus and line material, the show case containing telegraph material and telephone parts. On the opposite wall — not shown in the illustration — are displayed cabel and wire, telephone instruments for army use, radio material, time control clocks, etc.

A historical exhibit, comprising telephone instruments and switchboards of Ericsson's manufacture and covering various stages of development since the art of telephony was in its infancy, was arranged during a few weeks in commemoration of the company's fiftieth anniversary. The centre group in fig. 2 shows part of this exhibit.

R 431 Fig. 2.

R 430 Fig. 3.

A sales division and stock room form a necessary adjunct to the show room, and here the general public may fill its requirements in the telephone or radio branch.

The lively interest evoked by this display, not only from telephone men but also from the public at large, shows clearly how highly it has been appreciated and gives ample evidence of the fact that it fills the purpose for which it was intended. *V. S.*

The Empresa de Teléfonos Ericsson, S. A.

SOME FACTS CONCERNING THE ACTIVITIES OF L. M. ERICSSON'S MEXICAN SUBSIDIARY.

A concession for the operation of a telephone plant within the Federal District of Mexico was granted already in 1887 to Cia Telefónica y Telegráfica Mexicana, a company formed with North American capital. After having operated for eighteen years, however, this company had not succeeded in increasing its number of subscribers to any considerable extent, apparently on account of the more or less unsatisfactory service. In 1903 the government granted a new concession for telephone service within the same district, this concession being taken over in 1904 by an association with L. M. Ericsson as the main shareholder.

R 432

Fig. 1. Operating Room of Main Exchange, Mexico City.

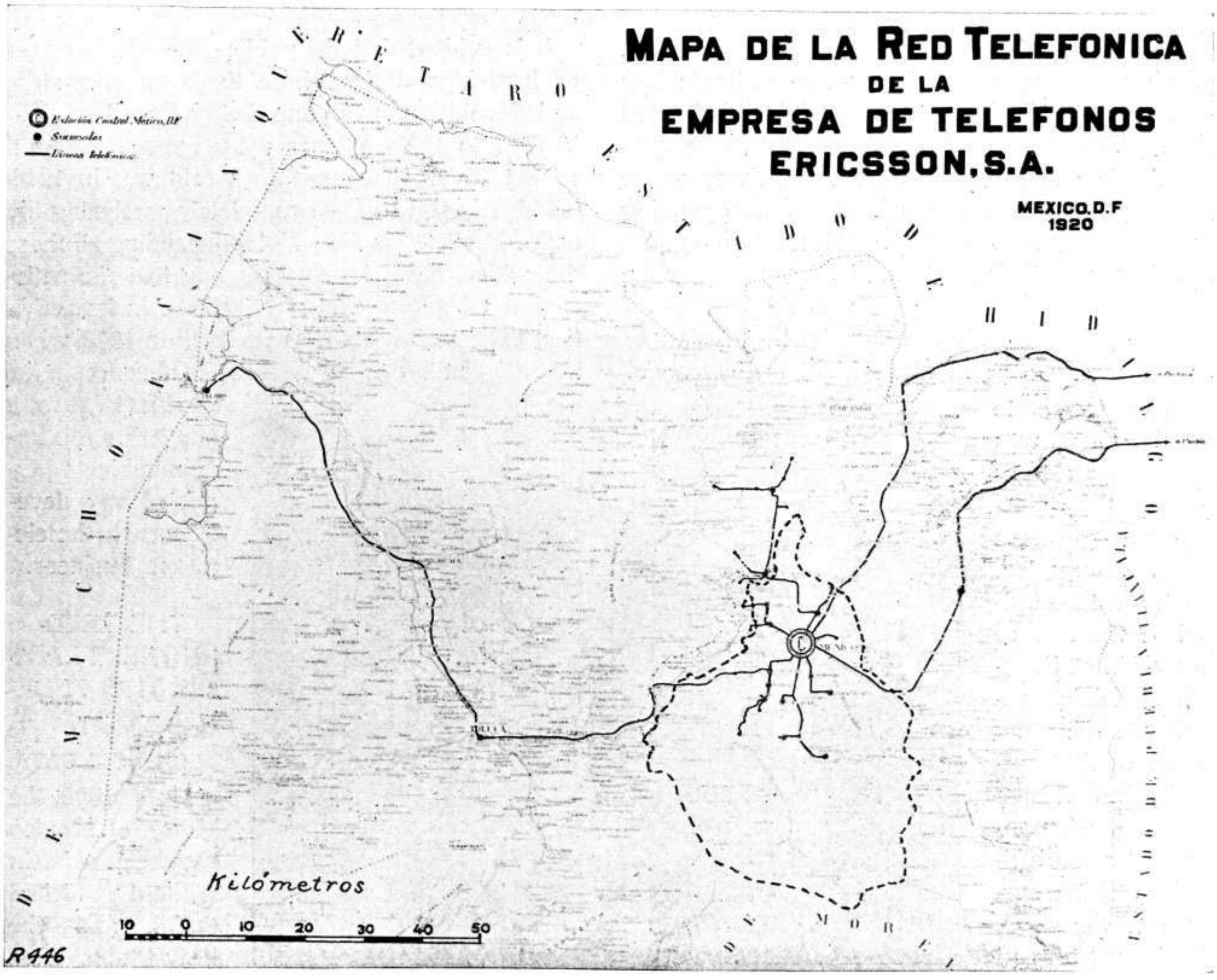
A new telephone system with the main exchange in Mexico City and some ten satellite exchanges within the Federal District was built by this association during the years 1905 to 1907. Later on — in 1909 — a Swedish stock company, Empresa de Teléfonos Ericsson, S. A. (The Mexican Ericsson Telephone Co.), was formed, this company taking over the new concession as well as the operation of the plant.

As soon as the Ericsson company entered the Mexican field a keen competition arose between the two operating companies, the Ericsson company seeking to win the favour of the public by offering excellent service — among other things —, with the result that the new plant experienced a very rapid increase in the number of subscribers.

Thus, already in 1910 this net could boast of over 6000 subscribers, the competing company having about 1000 less.

In 1920 the 13000 mark was passed, about 4000 subscribers in the lead of the American company, while in 1925 the number of subscribers had increased to over 19000 and the lead was doubled.

During the twenty years of its activities, the Mexican Ericsson company has had to pass through several crises. As is well known, the



R 446

Fig. 2. The Ericsson Telephone Net in the Federal District, with Long Distance Lines.

R 442 Fig. 3. Manufacture of Cement Conduits.

R 441 Fig. 4. Coating Ducts of Cement Conduits with Asphalt.

Mexican republic has suffered from a series of revolutions which started in 1911 and continued with more or less intensity until 1920. In 1913, during »La Decena Trágica» — the ten tragic days —, the main telephone exchange, which is located at 2ª Victoria No. 53 and happened to lie right in the line of fire, had to withstand a very severe bombardment. Several shells entered the operating room so that it became impossible for the operators to remain at their posts. A further cause for the interruption of the service was the cutting off of the power supply through the destruction of the feeders of the Mexican Light & Power Co.

The telephone equipment was not so seriously damaged by shell fire as might have been expected. One shell exploded at the rear of a switchboard section, while another struck the front of the multiple, but thanks to the sturdy construction and finely polished surface of the same, it glanced off and exploded against the wall on the opposite side of where it entered.

It is evident that the public suffered all manner of hardships during these times of inner strife and revolution, everyone being forced to limit himself to the most necessary expenses. As a climax to all this came the world war in 1914, unbalancing and almost completely paralyzing the entire business world. Notwithstanding all these difficulties, the Ericsson company had the satisfaction of noting a steady increase in its activities, except during the years 1915 to 1918, when internal conditions as well as the situation in the world at large were altogether too unfavourable to permit of any development in the telephone business.

R 438 Fig. 5. Appearance of the Main Exchange after »La Decena Trágica».

THE TELEPHONE PLANT OF THE FEDERAL DISTRICT.

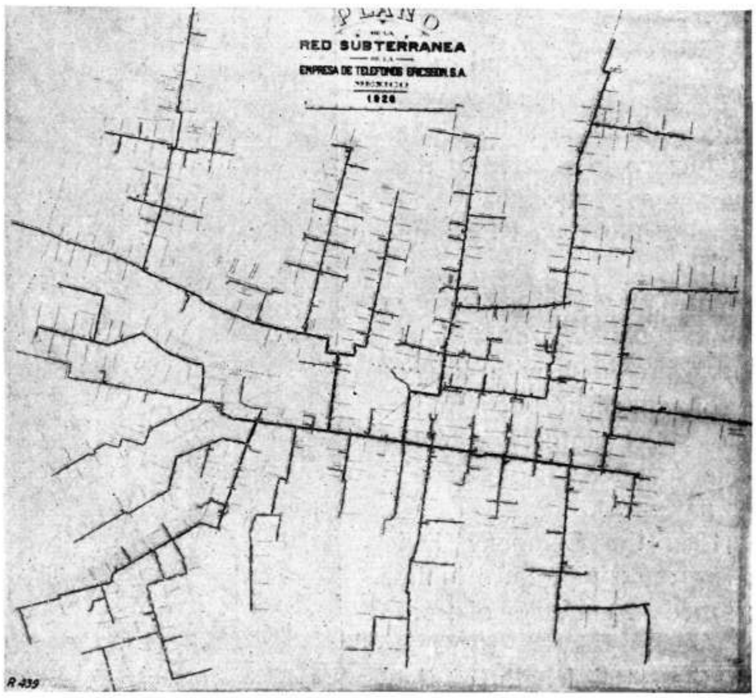
TECHNICAL DATA.

Until 1900 the Valley of Mexico was a closed basin without sufficient outlet, and the heavy rains were responsible for fre-

R 445 Fig. 6. View of Popocatépetl.

quent inundations of the capital city, the capacity of Texcoco Lake being entirely inadequate to receive these large masses of rainwater.

Already during the fifteenth century attemps were made to drain the valley by making a deep cut through the mountain range, and during the colonial era all the prisoners were occupied on this enormous project. These efforts were of no avail, however, and in 1885 work was started on a new project comprising the building of a canal as well as the boring of a tunnel 10 kilometres long through the surrounding mountains, thereby providing Texcoco Lake with the necessary outlet. Thanks to the adoption of modern working methods, this gigantic work could be inaugurated at the beginning of the present century, after which time it has been possible to little by little lower the water level of Texcoco Lake as well as that of the subsoil of Mexico City.



R 439 Fig. 7. Plan of the Underground Net in Mexico City.

Underground plant.

The abovementioned conditions naturally offer serious difficulties for the construction and maintenance of underground telephone plant. The Ericsson company, however, was successful in mastering the difficulties it encountered and its widespread net, consisting of underground cabel laid in conduits, covers nearly the whole Valley of


EXPOSICION COMERCIAL INTERNACIONAL
MEXICO. D.F.-1921

ALEMANIA
BELGICA
DINAMARCA
ESPAÑA
FRANCIA
INGLATERRA
ITALIA
JAPON
NORUEGA
SUECIA

El Consejo de Administración, obrando de acuerdo con la decisión del Comité Internacional de Jueces, y en testimonio de mérito especial, otorga a Cia. Teléfonos "Ericsson"
— MEXICO D.F. —
Por su magnífico servicio telefónico.
ESTE
GRAN PREMIO

PRESIDENTE VICE PRESIDENTE DIRECTOR GENERAL

ARGENTINA
BOLIVIA
BRASIL
CANADA
CHILE
ESTADOS UNIDOS
GUATEMALA
HONDURAS
PERU
URUGUAY

372

R 433 b Fig. 8. Grand Prize Certificate, Awarded at the International Exhibition of Commerce, Mexico City 1921.

Mexico. The conduits are of cement and made according to the method previously described in this journal. The ducts are coated with asphalt, giving them a very smooth and even surface, this process having been adopted for the purpose of reducing friction and of facilitating the laying of the cables.

The Ericsson system for underground cable plant has proved itself to be admirably well suited to the existing conditions, in spite of the fact that the Valley of Mexico is situated at the foot of the two volcanoes Ixtaccihuatl and Popocatepetl and is frequently visited by both earthquakes and landslides.

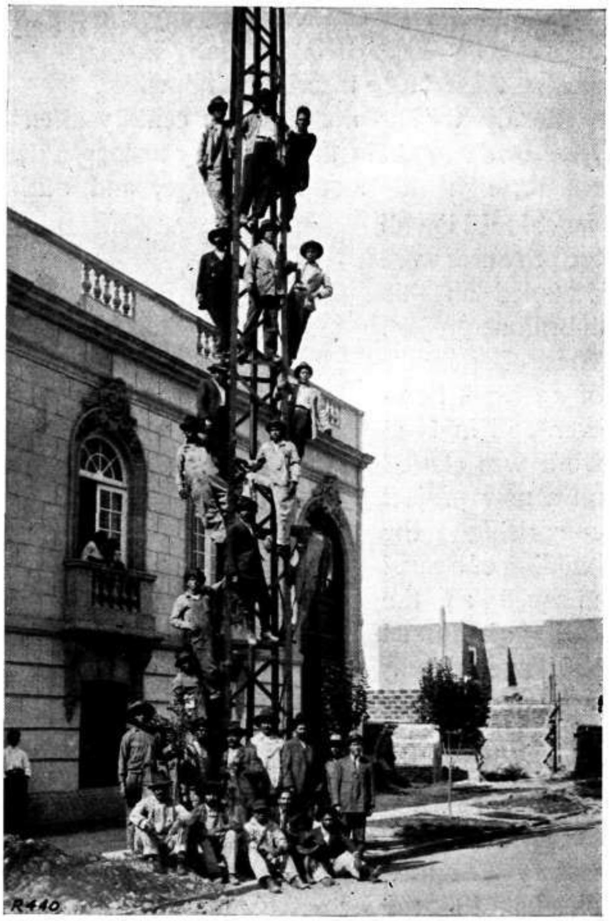
Concrete manholes are placed at a distance from each other of about 100 metres, or at street intersections. They are provided with heavy covers of cast iron of sufficient strength to support the vehicular street traffic, or with lighter ones where the manholes are situated under the sidewalk or pavement.

On December 31, 1924 the Company had 384,940 metres of underground pipe lines in the Federal District, distributed in conduits of from 1 to 37 ducts each.

At the same time the total length of the metallic circuits in underground cables of various sizes, varying between 1-pair and 1000-pairs, had reached a total of 42,199 kilometres.

Electrolysis.

In conformity with other concerns and public utilities owning underground lines or piping of metal, such as telephone cables, water pipes, etc., in Mexico City, the Ericsson company has had great difficulty in protecting these against the destructive electrolytic influence of vagrant currents, these latter being very numerous, due chiefly to the extremely poor condition of the return lines of the tramway power net. However, the worst disadvantages have been remedied by



R 440 Fig. 9. Newly Raised Distribution Mast, with Erection Crew.

connecting the lead sheaths of the telephone cables to the tracks and to earth at certain points.

Distribution.

In the central, more densly populated portions of the city, the telephone lines are distributed by means of underground cable, the individual subscribers' lines which connect the telephone instruments to the terminal cabinets being 1-pair lead sheathed cable.

In the so-called colonies and the residential districts, which are more sparsely populated, a system combining both underground and aerial lines is used. The main cables are carried through conduits to large distribution

Fig 11. Laying Cement Conduits. R 443

R 444 Fig. 10. Distribution Mast.

cabinets with a capacity of from 300 to 600 lines, placed on the sidewalks against the walls of the buildings. From these cabinets the lines continue through smaller underground cables to terminal boxes mounted on distribution towers or masts. These terminal boxes have a capacity of 50 to 100 lines or more and are provided with fuses and lightning conductors. The distribution masts vary in height from 18 to 24 metres, depending on the height of the adjacent buildings, and are crowned with a framework for carrying the insulators, constructed so as to permit a radial distribution of the aerial lines directly to the homes of the subscribers.

Before determining the location of a distribution mast, a preliminary investigation is made as to the number of subscribers which are to receive service from the same, the ideal location of the mast being in the exact centre of the distribution district. For the aerial lines, either bronze wire or Copperweld B. & S. No. 17 is used.

On December 31, 1924 the aerial plant of the Federal District had 2474 kilometres of metallic circuits.

EXCHANGES IN THE FEDERAL DISTRICT.

Mexico City.

The main exchange is situated at No. 53 Calle Victoria and built according to Ericsson's C. B. system, with a capacity of 15,200 lines, this capacity now being utilized to its full extent.

The fact that each subscriber makes an average of fifteen calls a day should be sufficient to give the reader an idea of the intensity of the traffic within Mexico City.

Although it is now more than twenty years since the Mexico City exchange was built — a great part of the equipment dating back to this time —, it is still giving excellent service, and it is comparatively seldom that any of the subscribers' lines within the exchange are out of order. During 1924 the number of line troubles per subscriber amounted to 0.2, equal to one trouble per subscriber every five years. This figure does not refer to cords, plugs, keys, etc., but only to such exchange equipment which forms a part of the individual subscribers' lines.

The necessary power is furnished by two »Tudor» storage batteries, type J 80, with a capacity of 2080 ampere hours each. One of these batteries is always kept ready for use in case of emergency, the charging of the one taking place while the other is in use.

The charging machines consist of two powerful motor-generators, the necessary power for driving the motors being furnished by the Mexican Light and Power Co. Here also one unit is kept for emergencies, should the other one happen to get out of order.

With the experiences from »La Decena Trágica»

R 435 Fig. 12. Operators' Rest and Recreation Room, Main Exchange.

in vivid recollection, a generator plant driven by means of a 33 H. P. »Atlas Diesel» motor has been installed, capable of furnishing the entire building with lighting current and of charging the storage batteries, should at any time the power supply of the city fail.

R 434 Fig. 13. Power Plant of Main Exchange, Mexico City.

Tacubaya.

This C. B. exchange, built according to the same system as the Victoria exchange, was opened for service on December 8, 1924.

The installation of the new telephone instruments and the cut-over from the old local battery exchange at Calle Altamirano to the new exchange at No. 57, Calle Morelos was accomplished in two days time and without any inconvenience whatsoever to the subscribers, the majority of whom were awakened the next morning by a note of greeting from the bells of the new telephone instruments.

The subscribers' lines enter the basement of the exchange building directly from the underground conduits and continue up through the basement ceiling to the first floor, where the main distributing frame with its protective devices is situated. Here the lines are subjected to daily tests, and should any trouble be discovered, either outside or within the exchange, it is remedied with the greatest possible speed.

On the first floor is also situated the power plant, which provides the necessary current for the exchange and for the subscribers' transmitters. The operating room is located on the second floor together with a rest room, lavatories, living quarters for the chief operator, etc.

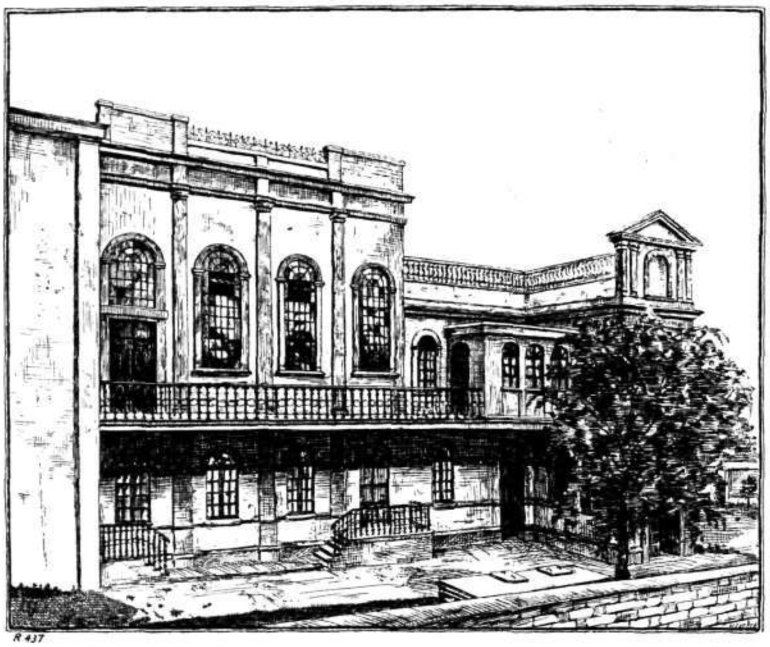


Fig. 14. The Tacubaya Exchange.

The maximum capacity of the exchange is 4,500 lines, 1,800 of which are now connected up, with special boards for handling the junction traffic with the main exchange and with the new full-automatic exchange at Colonia Roma. This latter exchange is now under construction and will be ready for service at an early date.

The generous dimensions of the Tacubaya exchange building are amply sufficient to permit an eventual increase to 10,000 lines. Such a precaution was deemed wise on account of the rapid increase of the population in the Valley of Mexico, specially in the direction of Tacubaya and Mixcoac.

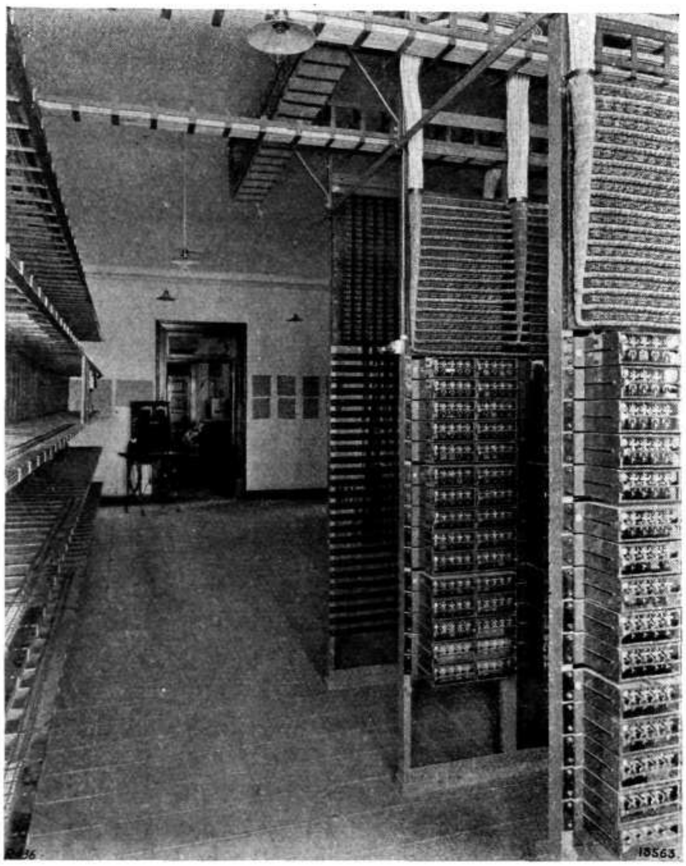
The subscribers of Mixcoac and Colonia del Valle have also been connected to the new exchange in Tacubaya.

Satellites with simplified C. B. system.

When the main exchange began to be occupied to its full capacity, the steady increase in the number of subscribers made it necessary to build some provisional satellite exchanges in the outskirts of the city, to wit: Roma, Insurgentes, Condesa and Santa Maria. These exchanges are built according to a simplified C. B. system, suitable for maximum capacities of from 1,200 to 1,800 lines.

The power plants of these satellites consist of two sets of Edison storage batteries (the one for emergency use), type B 6 H, for a tension of 20 volts and with a capacity of 112 ampere-hours. These storage batteries are charged by means of a »Tungar» rectifier, which transforms the 120-volt, 50-cycle alternating current of the city net into direct current.

These small exchanges are soon to be abolished in conjunction with the inauguration of the new automatic exchange in Colonia Roma. Their equipment being very compact, it will be an easy matter to transfer the same



R 436 Fig. 15. View showing Relay Racks, Tacubaya.

without great expense to other places where it can be used for other satellites or independent exchanges.

Satellites with magneto system.

In addition to the two large exchanges and the four C. B. satellites already described, there are fourteen local battery exchanges in the such as Pachuca, Toluca, Texcoco, El Oro, Puebla, Tlalnepantla and Cuautitlán.

The toll exchange in Mexico City has a capacity af 200 lines. Although the number of toll lines is not very large at the present time, the Company has good hopes of being able to extend this service considerably in the near future.

R 447 Fig. 16. Map of Mexico, Showing Positions of the Federal District and the State of Guanajuato.

Federal District, a large number of junction lines enabling them to communicate with each other as well as with the larger exchanges.

The total number of telephone instruments installed within the Federal District on May 1, 1926 amounted to 20,361.

TOLL LINES.

Toll lines, owned by the Mexican Government, connect the telephone plant of the Federal District with some towns in the neighbouring states,

THE GUANAJUATO TELEPHONE PLANT.

The state of Guanajuato is situated in the very heart of the Mexican Republic and has been noted from time immemorial for its agriculture and its mining. The Ericsson company holds a concession for all telephone traffic within the state and owns the telephone plant, which gives service to about 2,000 subscribers, distributed among 12 exchanges of varying sizes. Two of these are C. B. exchanges, the remainder being L. B., all of them being interconnected by means of junction lines.

The map in fig. 17 shows the more important exchanges as well as the connecting junction lines.

GENERAL AGENCY OF ALLMÄNNA TELEFONAKTIEBOLAGET L. M. ERICSSON IN MEXICO.

Empresa de Teléfonos Ericsson, S. A. has had the agency of the parent company in Stockholm for quite a number of years for the sale of its complete line of manufacture, such as telephone instruments, switchboards, wire, telephone cable and line material. Thus, the Ericsson company has been able to supply nearly all of the private Mexican telephone companies with all necessary material.

The Central American republics also form part of the territory in which the sale of Ericsson material is handled by the Mexican company.

A few years ago the Ericsson company was entrusted with the selling and erection of complete equipment for two telephone exchanges — the one for C. B. and the other for interurban service — in San Salvador for the account of the Government of that country, and at the present moment negotiations are being carried on with the Nicaraguan Government for the modernization of the telephone plant in Managua, capital of that republic.

H. Rost.
Chief Engineer.

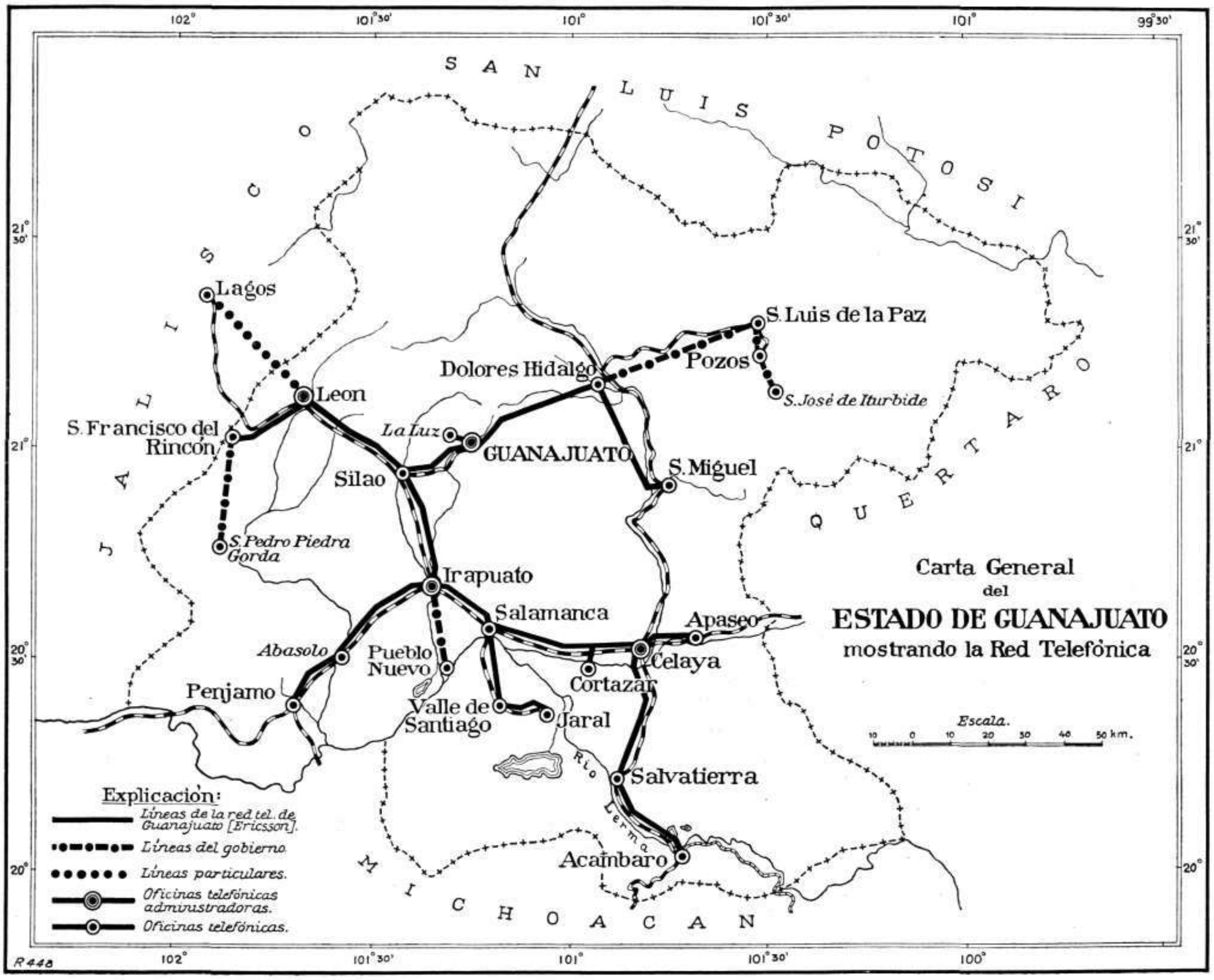


Fig. 17. Map of the Telephone Net of Guanajuato.

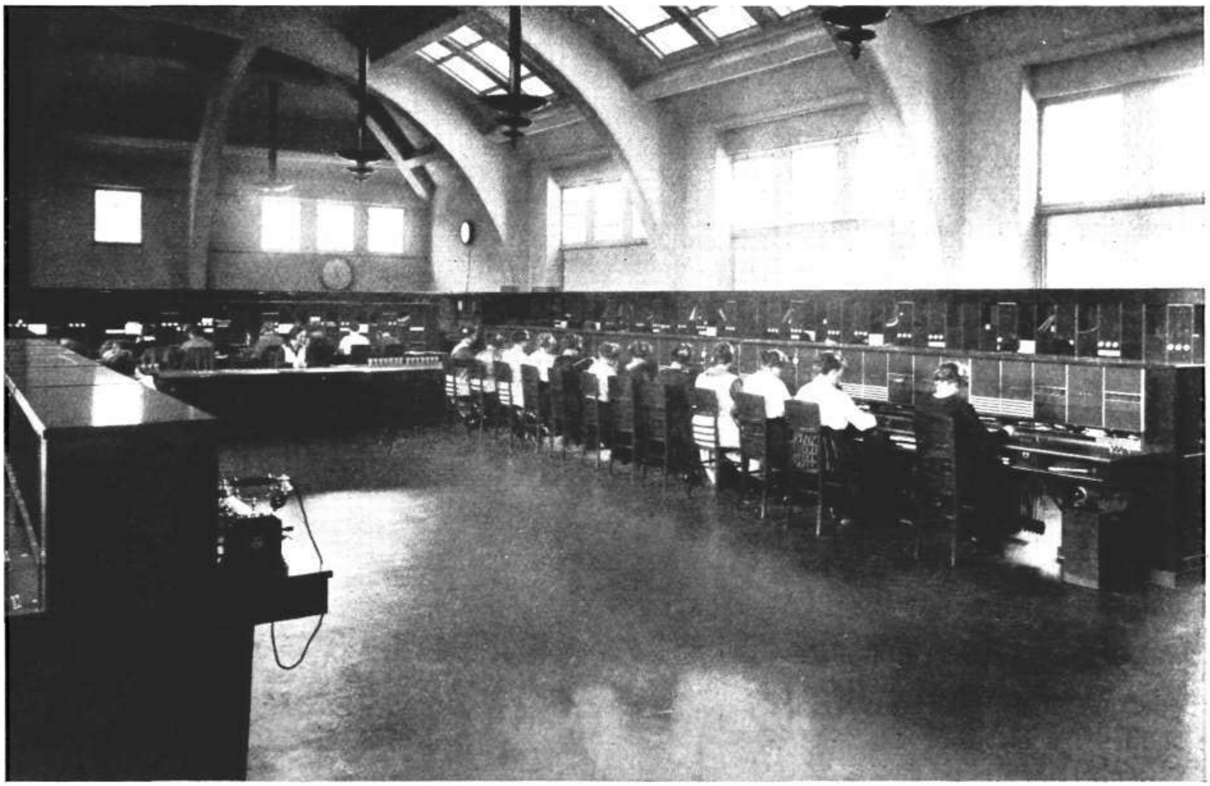
Selling Fish over the Phone.

Wholesale dealers are more and more coming to realise the value of the telephone as an aid in selling their wares. Many a merchant, who previously sent his travelling salesman out on the road to obtain the orders of the customers, now keeps him at home and lets him handle the sales over the telephone. In certain lines of business the telephone is practically indispensable, one of these being the wholesale trade in fresh fish, the perishable nature of this article necessitating its delivery to the retail dealer and the consumer with the least possible delay.

In the following we will give an account of how the telephone has been made to serve the interests of the wholesale fish market in Gothenburg, the main trading centre for the West coast fishery.

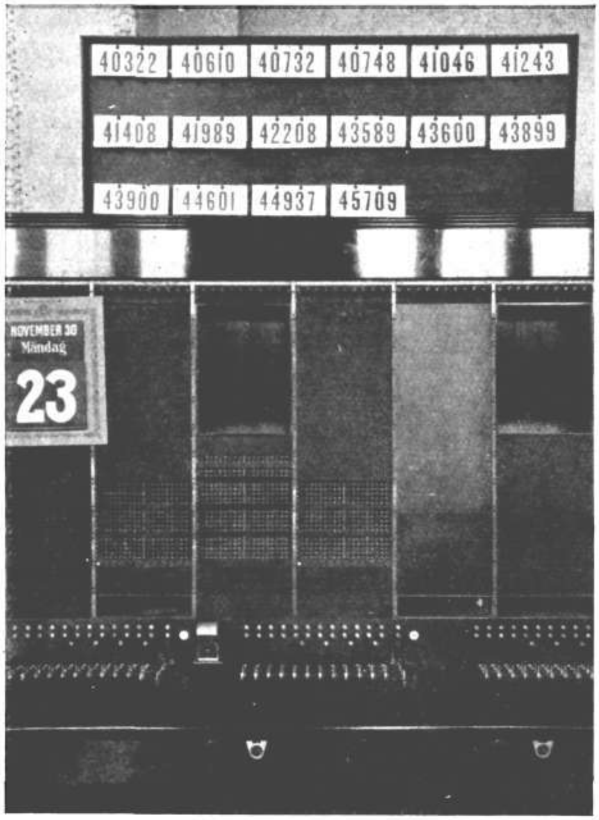
The catches are brought in by the fishermen to the city fish market, where they are sold at regularly held auctions to both exporters and wholesale fish dealers, these latter in turn, selling the fish to a retail market covering the greater part of the country. Exportation, chiefly to Germany, is also carried on, specially during the herring season.

Fish sales by telephone are confined to the early morning hours between 7 and 10 a. m., but already at noon of the previous day the 30 to 40 wholesale fish dealers place their orders for toll calls to be effectuated on the following



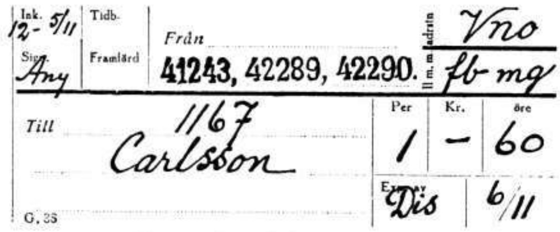
R 413

Fig. 1. Operating Room of the Gothenburg Toll Exchange.



R 412 Fig. 2. Display Board Showing Numbers of the Lines Connected up to Auxiliary Board.

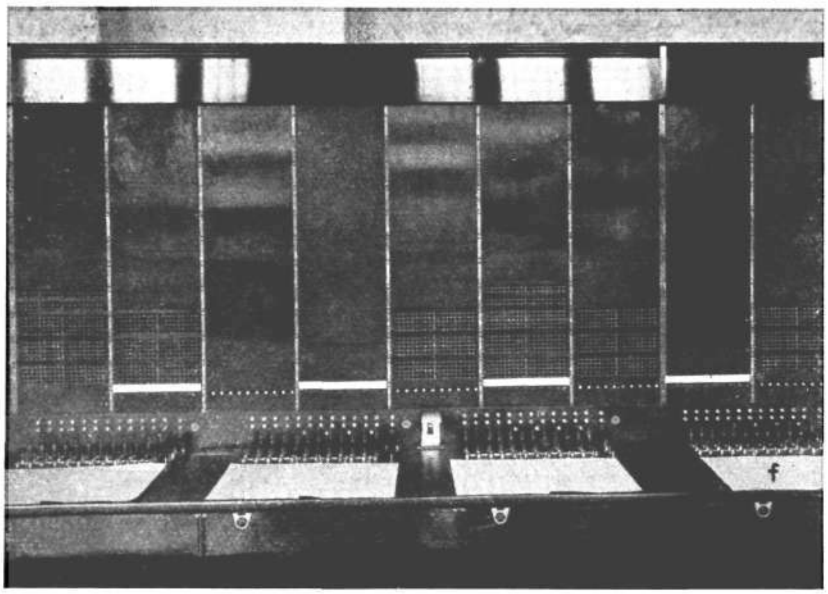
morning. This early placing of orders for calls, necessitated by the existing keen competition, means that the dealer must be guided as to the number of calls by the assumed fish supply on the following morning. If the catches fall below the estimated quantity or if stormy weather has spoiled the fishermens' chances, it sometimes happens that a great number, if not almost all of the ordered calls are cancelled just as they are about to be effectuated. On the other hand, if the supply is greater than the merchant has estimated the sudden placing of orders for large numbers of additional calls is often experienced by the telephone exchange. During the winter, when the fishing fleet sometimes brings in catches of herring of 10,000 to 20,000 hektolitres, it is not unusual for some of the wholesale dealers to place orders for as many as 100 to 200 calls each.



R 414 Fig. 3. Order Slip for Fish-Calls.

Such mass orders cannot suitably be handled by the regular junction operators, a special division having been arranged for this purpose, with operators specially trained for this kind of work. The ordering firm usually has two or three telephone instruments, and when an order for calls is taken, the numbers of the subscriber's telephones are stamped on the order slip by means of a rubber stamp (see fig. 3). Such a stamp is provided for each subscriber who places wholesale call orders.

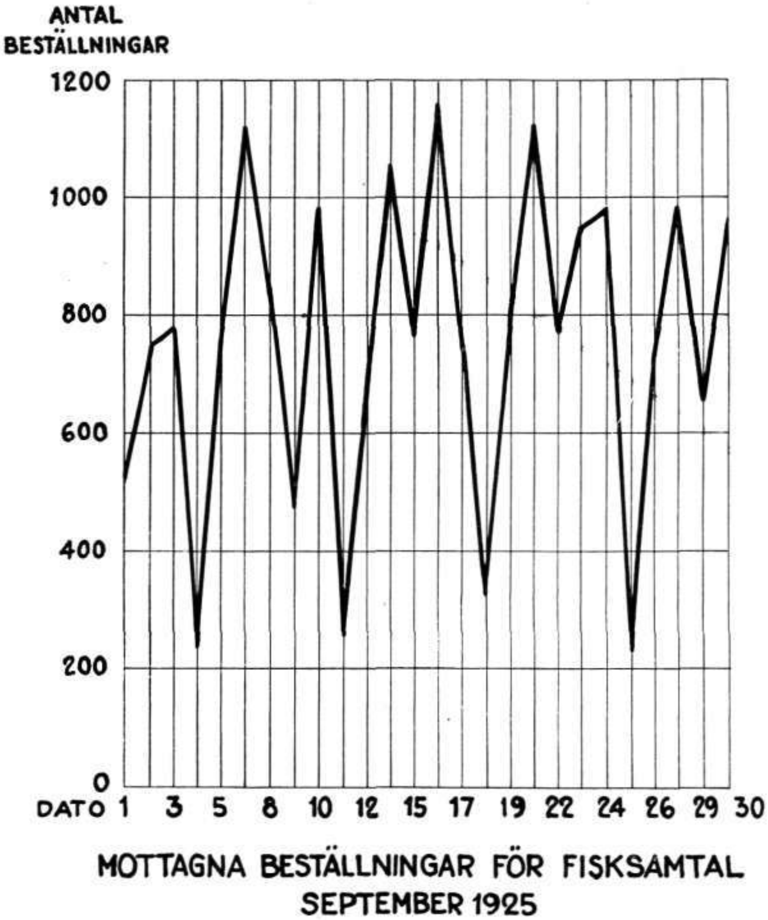
The actual connecting up of the so-called »fish-calls» has been greatly simplified by arranging a special concentration or auxiliary



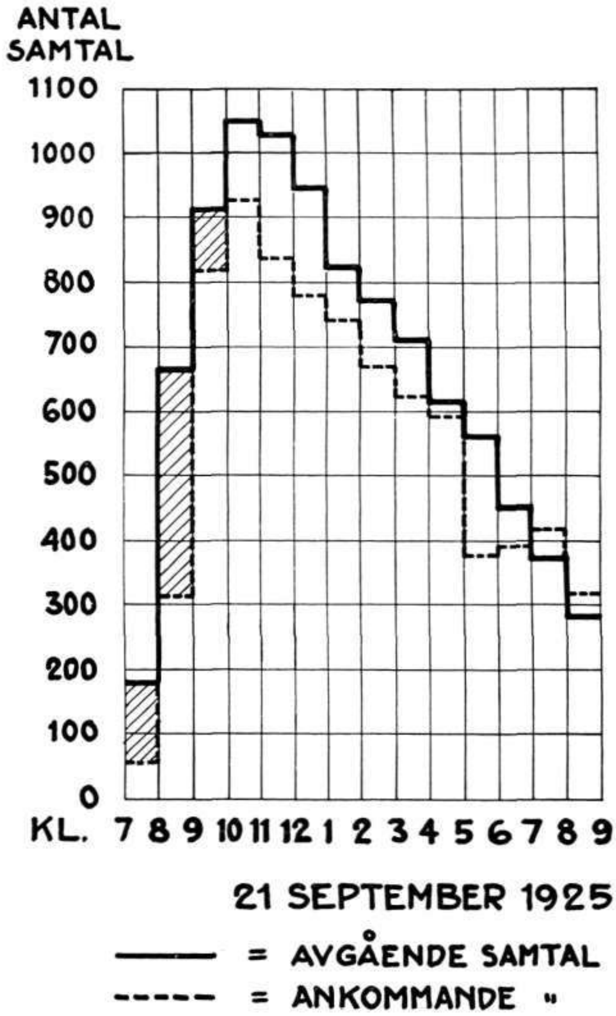
R 411 Fig. 4. Auxiliary Junction Board or Concentration Board for Fish-Calls.

junction board (see fig. 4). The local lines of the fish merchants are connected up to this concentration board during the early morning hours when most of these calls are made. These lines, usually amounting to 40 or 50 every day, terminate in jacks over which are placed designa-

The auxiliary junction service can usually be handled by two or three operators, who distribute the lines of the calling subscribers to the various toll positions for one or two calls, according to a previously arranged schedule (see *f* in fig. 4). As soon as a conversation over such a connection



R 416 Fig. 5. Number of Fish-Calls Ordered During September 1925.



R 415 Fig. 6. Graph Showing Number of Outgoing and Incoming Toll Calls on an ordinary Week Day.

tions giving the numbers of the subscribers' instruments (see *s* in fig. 2). The lines which are connected up for the time being to the auxiliary board, are clearly denoted by means of large number cards mounted on boards, these latter being placed within the toll operating room in such a position that they can easily be seen by the toll operators (see fig. 2).

is terminated and the toll operator takes down the cord, a clearing lamp for the corresponding cord in the auxiliary board glows, and the operator at this board can immediately connect up the local line to another toll position, where the calls ordered by this subscriber are in order to be effectuated. An incoming call for a subscriber whose line is connected up to the auxiliary board is reported by the toll operator to the operator at the auxiliary board over the intermediate junction line. The auxiliary junction operator makes a note of this and surrenders the desired subscriber's line as soon as it is disengaged.

The first and most important advantage gained by the use of a concentration board is a better regulated toll service, it being unnecessary for the toll operator to request the line of the subscriber (fish dealer) from the junction division, often in vain. Another advantage is that the line of the ordering subscriber is more evenly fed with toll calls, thus permitting a more speedy toll service.

On account of the irregular supply of fish, this traffic varies not only from day to day (see fig. 5) but also during the different seasons. Thus, during the winter herring-season this traffic increases most noticeably, the telephone exchange at times being put to a very severe strain.

Fish-calls are generally of very short duration. Their average length is two minutes, against a mean length of $4^1/_3$ minutes for all outgoing toll calls from the Gothenburg exchange.

As already mentioned, most of the fish-calls are dispatched during the early morning hours. The graph in fig. 6, which indicates the number of outgoing and incoming toll calls on an average weekday, gives a good idea of the relation between the regular traffic and the fish-call traffic. The regular outgoing traffic between 7 and 10 a. m. being of about the same intensity as the incoming traffic at the same time, it follows that the shaded portions approximately represent the daily fish-call traffic.

The rates charged for fish-calls are the same as for regular toll calls, but during the hours 7 to 9 a. m. — just when most of the fish-calls are dispatched — a reduced rate schedule is enforced.

The concentrated and often very intense fish trade carried on by telephone requires not only the abovementioned special arrangements at the telephone exchange, but also speed, alertness and expert salesmanship on the part of the wholesale fish dealer. Already some few hours after the fisherman has sold his catch to the wholesaler, this latter, in turn, has divided up and sold the batch, packed it in boxes and loaded it on railway cars, ready to be sent out to various parts of the country by the next departing trains.

Wbn.

Notes of interest from Chile.

Excerpts from a letter by Mr. J. S. Andersson, installation chief at Buenos Aires.

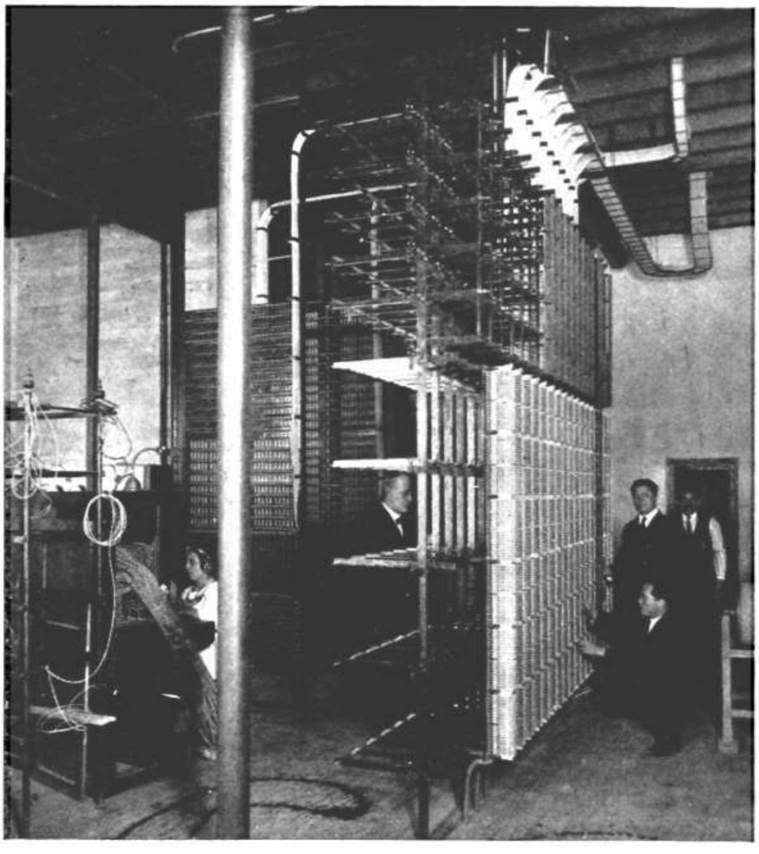
In a recent letter — the contents of which have been placed at our disposal — Mr. J. S. Andersson relates his experiences of a visit to Chile, where he had charge of the installation of a new central battery exchange in Antofagasta. Before returning to Buenos Aires he also visited the cities of Santiago and Valparaiso.

Mr. Andersson arrived at Antofagasta — a city in northern Chile with a population of about 51,000 — in the middle of June 1925 and immediately proceeded with the erection of the telephone exchange, this work being completed on November 9th of the same year.

This exchange is built for 960 lines, with an ultimate capacity of 2,400 lines. It was taken into service on Jan. 16, 1926.

The accompanying illustrations show the exchange in various stages of completion.

Mr. A. retains the most pleasurable memories of both the manager and personel of the Chili Telephone Company, owners of the Antofagasta plant, where a very good spirit of co-operation existed at all times.

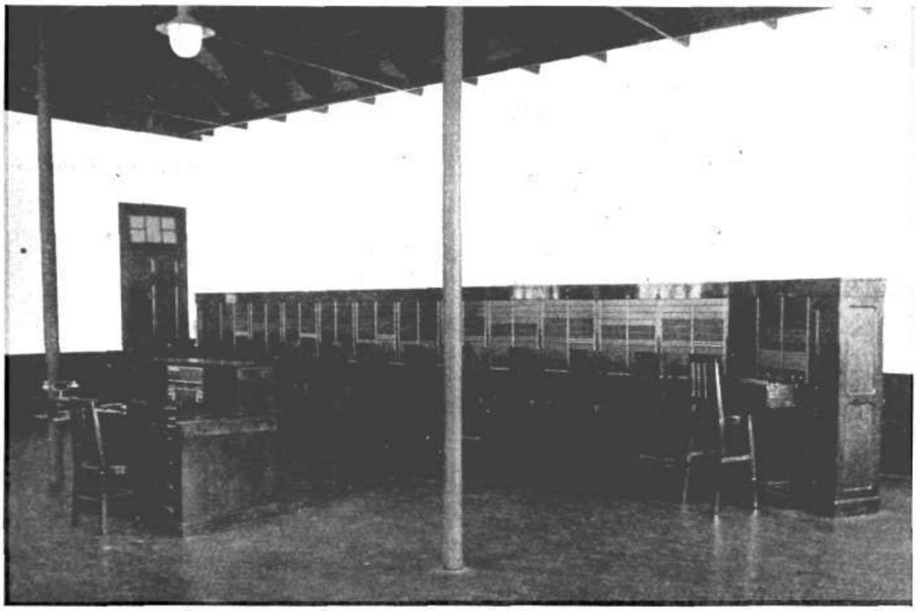


R 426 Fig. 1.

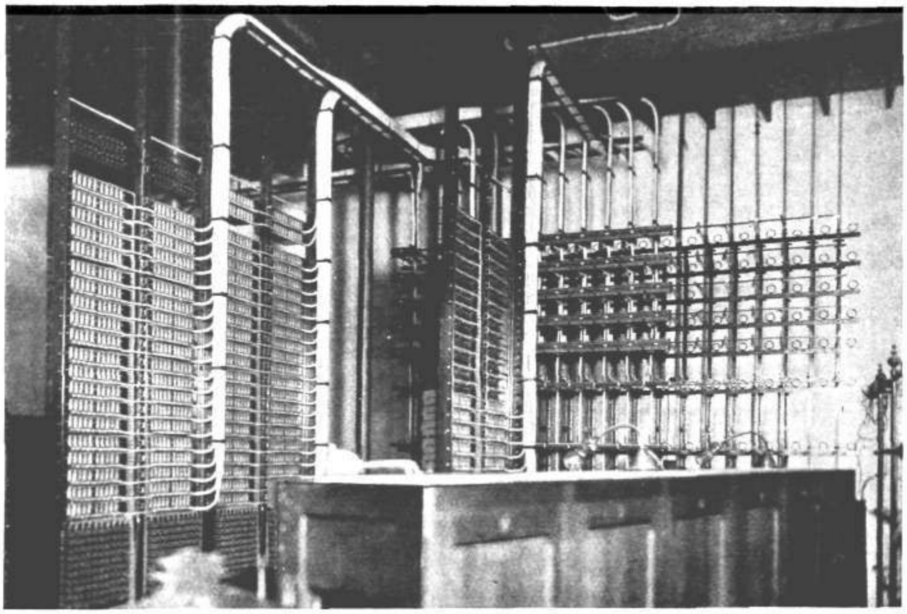
After having assisted with the installation of the cable intakes and the connecting up of the longest rural lines, Mr. A. left for Santiago on the 21st of December.

Here Mr. A. had the pleasure of meeting Mr. Mitchell, the managing director of the Chili Telephone Company, who took advantage of this opportunity to make himself acquainted with the Antofagasta plant, stating that additional common battery exchanges were to be erected in Chile in the near future. In the two largest cities — Santiago and Valparaiso — however, automatic telephone systems have been installed.

On the title page of this issue is reproduced a decidedly unique photograph from Concepción, Chile's third largest city with a population of about 70,000. Here the Chili Telephone Company has installed a common battery exchange for 1,200 lines (ultimate capacity



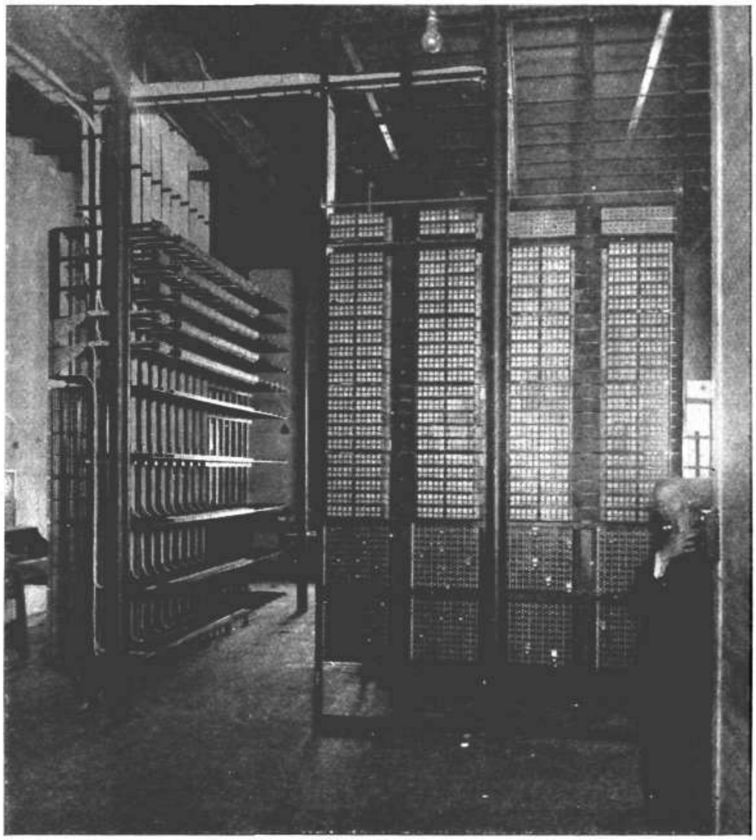
R 424 Fig. 2. Operating Room of the Antofogasta Exchange.



R 425 Fig. 3. Relay Racks and Main Distributing Frame.

2,800 lines) similar to the one in Antofagasta. The high esteem in which L. M. Ericsson material is held by the Concepción employees is convincingly illustrated by the fact that their victorious rowing team have christened their boat »Ericsson» and inscribed the same name on their jerseys. The illustration shows the members of the team grouped about the manager of the company, the trophy being a newly acquired challenge cup.

Mr. A. concludes his letter by expressing the hope — after many years service in South America — of soon being able to again set foot upon the soil of his native country, partly for the purpose of studying new developments within the field of automatic telephony and partly — in spite of everything beautiful and interesting seen and experienced in foreign climes — to revisit »the most beautiful city and the most beautiful country in the world» — the writer's own words.



R 427

Fig. 4.

Ericsson Company Obtains Concession for Toll Traffic in Mexico.

We have the pleasure of announcing the receipt of cabled information from the Empresa de Teléfonos Ericsson in Mexico stating that this company has now signed an agreement with the Mexican government whereby it has obtained a concession for the toll service of the entire country. Co-operation between the Mexican government and the Ericsson company has existed since many years back, the latter having operated and maintained a number of government owned toll lines. The concession now obtained, however, means the building of many new toll lines as well as the modernization of the existing ones; an account of the Company's plans in this respect will be published in a subsequent issue.

In order to provide the necessary capital required for the development of the toll service as well as for the expansion of the local telephone nets — which latter are now experiencing a rapid increase -- the annual meeting held on June 30th passed a decision to double the joint capital of the Company to 10,800,000 Swedish crowns.

New C. B. Exchange for Chile.

The Chili Telephone Co. Ltd., have recently placed an order with L. M. Ericsson for a complete new telephone exchange for Iquique, a city in Northern Chile with a population of about 38,000. This exchange will be built on the same lines as the one recently erected in Antofagasta and will have an initial capacity of 1000 lines.

This is the third exchange ordered in close succession by the Chili Telephone Co., proving beyond a doubt that those previously delivered have been to the entire satisfaction of the customer.

THE ERICSSON WIRELESS HEADPHONES

R 101

We are now producing a special wireless model of headphone, combining **lightness** with **strength** and **durability,** with a simple adjustment allowing it to fit comfortably to any head.

The double pole watch receivers have cases of aluminium, and are flexibly held together by leather covered steel bands, all other metal parts being of nickel plated brass.

The headphone is supplied with a soft, flexible cord, a metre and a half long.

Total weight: 0,4 kgs.

We manufacture these Phones to the following resistances:

RF 1320. Resistance, **2000 ohms.** Code word: Repmakvoel.

RF 1321. Resistance, **4000 ohms.** Code word: Repmakvoig.

TELEFONAKTIEBOLAGET L. M. ERICSSON

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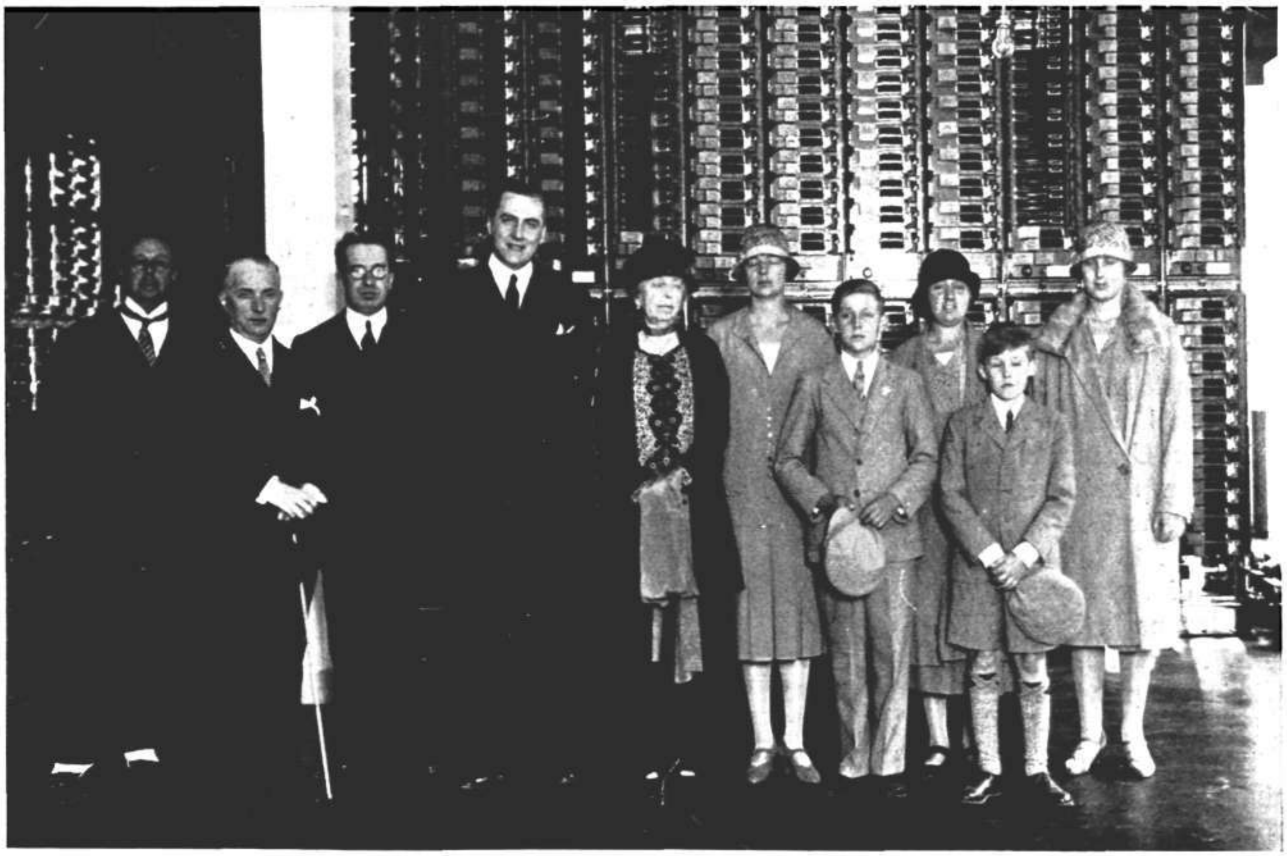

H. M. THE DOWAGER QUEEN MARIA CRISTINA OF SPAIN TOGETHER WITH THEIR R. H. AND SUITE AT THE NEW AUTOMATIC TELEPHONE EXCHANGE IN SAN SEBASTIAN, JULY 6TH 1926.

ENGLISH EDITION

L. M. Ericsson

THE L. M. ERICSSON REVIEW

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The New Ericsson Automatic Exchanges

IN SAN SEBASTIAN AND VICINITY.

On the fifteenth of June last the new telephone exchanges which are to handle the traffic in San Sebastián (Spain) and vicinity were officially inaugurated. These exchanges are built according to the Ericsson full automatic system, the entire installation consisting of a local net — »La Red Telefónica Urbana Municipal» — and a rural net — »La Red Provincial» —, reaching out about 15 kms from the centre of the city and with sub-stations in Pasajes, Rentería, Hernani and Miracruz within the province of Guipúzcoa.

R 464 H. M. King Alfonso XIII.

San Sebastián — a city of about 60,000 inhabitants — is the most frequented Spanish bathing resort, being situated where the little river Urmeas empties its waters into the innermost part Bay of Biscay, about seventeen kilometres from the French border.

A beautiful location, together with imposing buildings, lovely parks and boulevards, and a wonderful bathing beach have all contributed to make San Sebastián a most fashionable summer resort in which the elite of Spain — including the royal family (which resides in the summer palace of Miramar), the cabinet and the foreign legations — spend the summer months. When the season is at its height, the population of this city is often doubled. San Sebastián is an important manufacturing centre and has a flourishing trade, thanks to the well situated and nearby port of Pasajes. The absolute necessity for good telephone service in such an important community is apparent, its leading men having been among the first to acknowledge this fact.

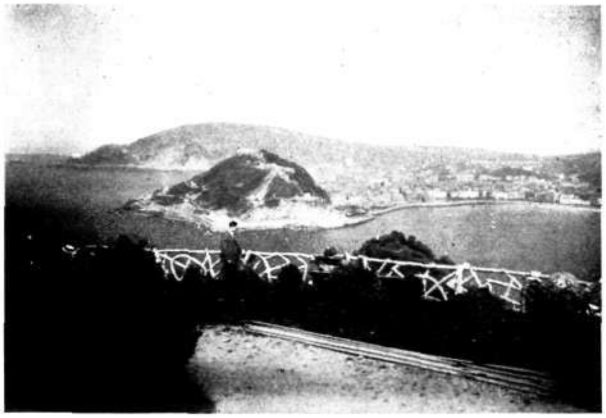
In november 1923 the municipality of San Sebastián succeeded in obtaining from the government a concession for all time for the operation of the city's telephone net. After the cooperation of neighbouring localities had been assured by the signing of an agreement with the provincial government (La Diputación) of Guipúzcoa, it was decided to adopt a full automatic telephone system for the city and its environs instead of the previously existing C.B. and L.B. systems.

This decision was arrived at following a trip made by the city and provincial telephone managers for the purpose of studying the various telephone systems now in use on the continent.

In April 1924 bids were requested from all the leading telephone concerns, such as Standard Electric, Thompson Houston, Peel Connor, The New Antwerp Telephone and Electrical Works (A. T. E. A.) Siemens, and L. M. Ericsson, the tender of the latter firm being accepted on May 26 of the same year on account of its being lowest as well as for the decided technical advantages possessed by the Ericsson system. The completed installation was to be handed over during the year 1926, this having now taken place.

The both exchanges, i. e. Red Urbana and Red Provincial, are housed on different floors

R 466 The Famous Bathing Beach at San Sebastián.



R 467 A Charming View of San Sebastián.

of the same building in San Sebastián. They operate independantly of each other except for the power plant, which is common for both of them.

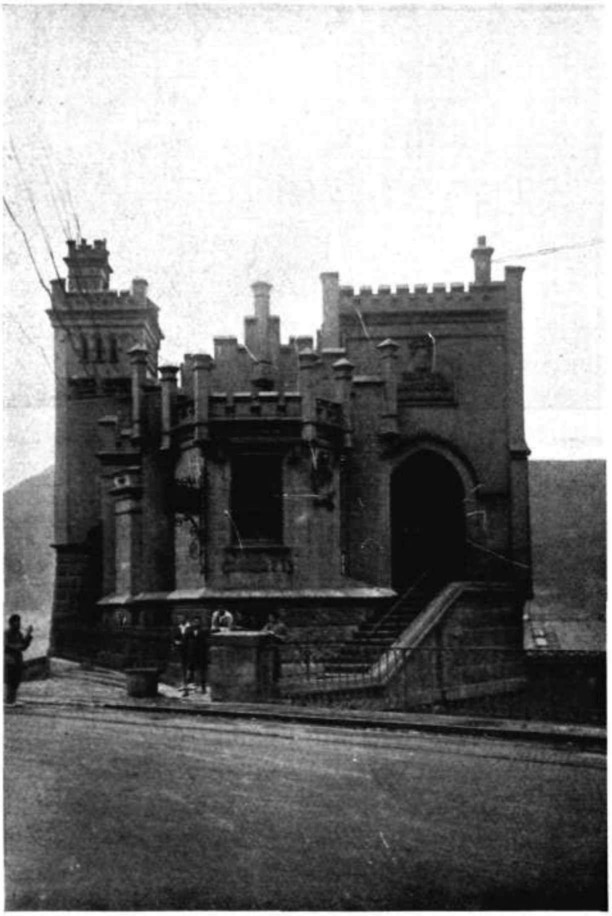
The number of subscribers' lines in the local net is at present about 3200 and will propably be increased to 4000 by the end of the year on account of the large number of applications now waiting to be effectuated. The present capacity of this exchange is 5500 lines, with room for an additional 1500.

The four satellite exchanges of the rural net are built for a present capacity of 640 lines, the total maximum capacity being 3500 lines.

In connection with the change from manual to automatic equipment extensive underground conduit lines have been built for the outside cable plant, thereby considerably increasing the plant built in 1908. This work has been done by the Compañía Española de Teléfonos Ericsson.

San Sebastián was the first Spanish city with underground distribution of cables — a most necessary adjunct to good telephone service in large communities —, and now, also, it is the first city in Spain to obtain a full automatic telephone system.

As already mentioned, the inauguration of the entire plant took place on the 15th of June last, in the presence of the secretary of state, general Martínez Anido, who had come up from Madrid for this purpose. In addition, officials and repre-



R 468 Pasajes.

sentatives from the city as well as from the province, together with representatives from L. M. Ericsson — all together about 150 persons — were present and took part in the inaugural proceedings at the central exchange, commencing at noon.

During the animated luncheon which followed the proceedings, a hearty vote of thanks was extended to all those who had participated in the work and contributed to its successful completion, among whom L. M. Ericsson and their representatives present were given a prominent place.

On July 6th the telephone exchange was honoured by a first royal visit, in that Her Majesty the Dowager Queen Maria Cristina, together with four of the children of the King and Queen, were escorted through the exchange and spent quite some time in being shown its interesting intricacies.

On July 23rd, H. M. King Alfonso arrived to see for himself in what manner L. M. Ericsson had performed its commission in the city to which the activities of his government are removed during the summer months. His Majesty evinced a keen interest in the plant and spent over an hour in a study of the same, including the cable intakes in the cellar as well as the smallest details of the selector and line finder mechanisms, after which he congratulated and thanked all those with whom this fine piece of work had originated and wished them continued success in their work in the field of telephony.

Lastly, we beg to offer some points of information which — without additional comment — will enable our readers to form an opinion of the economical advantages offered the general public

R 470 Hernani.

in San Sebastián after the introduction of automatic equipment of the Ericsson system, as compared with conditions in other large Spanish cities.

For the sake of comparison we will take the subcription rates for a telephone with unlimited service, i. e. a business telephone.

San Sebastián,	annual subscription rate	Pts. 156: —
Santander,	» » »	» 180: —
Bilbao	» » »	» 225: —
Madrid	» » »	» 375: —

1 Peseta = abt £ 0-0-7.6

This shows clearly that the municipal operation of the telephone net has resulted in giving San Sebastián telephone rates which are $13^1/_3$ % lower than those of Santander, $30^2/_3$ % lower than Bilbao's, and 58.4 % lower than those of Madrid.

This last figure, in particular, should be able to give many persons ample food for thought.

A complete description of the San Sebastián plant will be published in a coming issue of this journal.

We will close this little article with a few words from a leading San Sebastián newspaper concerning the manner in which the Ericsson company has fulfilled its commission in this city:

»As concerns the company to whom the construction of this plant was entrusted, on this occasion we will only repeat that it has again given evidence of its high standard of business morals and of its perfect technical organisation.»

G. K.

R 463 Rentería.

The Toll Traffic Problem in Europe with Special Reference to the Organization of the Service

by A. Lignell, Director of Telephones, Stockholm, Sweden.

At the end of the Great War, and after the most serious of its immediate consequences had been removed, the necessity for more satisfactory international telephone communications was seriously felt. The allied countries were soon to realize this fact, and it was France that took the initiative for the forming of a coalition comprising all the nations of Europe, its purpose being the organization of the international long distance telephone service on lines of common interest, from a purely technical point of view as well as with regard to the traffic. Most excellent results can now be obtained with comparative ease over the longest distances in Europe, thanks to the latest technical developments within the field of telephony.

First of all, uniform technical rules and regulations which will insure a perfectly satisfactory technical standard for long distance connections must be worked out and put into effect, after which — but by no means of less importance — uniform and suitable standards of service must be adopted, without which the dreamed of future great international telephone net can never be realized and fulfill its purpose, i. e. to be an easily accessible and excellent means of communication extending over the whole of Europe.

For this purpose the »Comité Technique Préliminaire» was formed in 1923, France, Belgium, England, Italy, Switzerland and Spain being represented in the same. In May 1924 and after the sending out by France of a general note of invitation to all the European countries, this committee developed into the »Comité Consultatif International des Communications Téléphoniques à Grande Distance», to which delegates were chosen by a majority of the European governments. At the World telegraph congress in Paris 1925, the »Comité Consultatif International» (C. C. I.) was entered as a special body belonging to the International Telegraph Union. This committee, which carries on its work with permanent general secretary's offices — the latter located in Paris — and has at its disposal the foremost experts within the field of telephony, has compiled and issued during the past year a large amount of regulations and advice, for the purpose of bringing present as well as future telephone plants to the highest possible standard from a purely technical point of view as well as with regard to the traffic.

When the technical requirements have been filled, not only as concerns the standard of the international telephone lines but also as to that of local plants, the financial basis for an efficient international telephone net must be founded on a sound rate policy, economical operation, and the organizing of the service in such a manner that it will satisfy the demands of the public for speed and efficiency.

The Tariff Policy.

It would be both desirable and advantageous if all European nations could come to an agreement and adopt a common zone tariff for international telephone communications. For the present, however, this solution of the problem is blocked by a number of difficulties. Existing plants are not sufficiently alike and domestic telephone rates, which quite naturally will be compared with those of foreign countries, vary considerably in different countries. For the present, therefore, it will no doubt be necessary to accept an international rate schedule lying within certain limits, meanwhile striving towards the achievement of greater unity in the future.

A seemingly sound basis for a rate policy would be the principle which does not permit more than a reasonable interest being obtained on the invested capital, after having deducted the current expenses and made necessary reductions in values.

The rates, however, are largely dependent on how the service is organized — as is the case with the value derived by the public from the telephone communications. In the following, therefore, we will give a little closer attention to the requirements for a rationally organized toll service, at the same time touching on some technical arrangements which have proved themselves of value in regard to the betterment of this service.

Efficient use of lines.

The manner in which the toll lines can be utilized for communications for which a fee is charged is a factor of great importance with regard to the financial results of the service, and, consequently, on the rates to be charged.

In the first place, of course, this depends on whether there is any traffic at all for a certain toll line. Experience has shown, however, that there need be no want of traffic on condition that the routes followed are suitably planned and laid out.

There now exists a long felt want for telephone communications between the large European business centres, this want being but partially filled. The present users of the existing lines are for the most part recruited from the comparatively narrow circle of large financial and business enterprises. If suitable measures are adopted permitting of a more economical operation of the plants, thus making possible a gradual reduction of the telephone rates, the time is not far distant when this modern means of communication will serve not only the interests of high finance but also those of lesser proportions which already exist between the peoples of different nations, as well as others which would quickly develop as a result of the reduced rates. This argument is applicable in principle also to the domestic traffic, where the demand for means of communication between the various commercial centres is even greater.

Thus, even if there is no reason to fear any lack of traffic under the above mentioned conditions, it is necessary to see what can be done so as to obtain the greatest possible returns out of the existing lines.

Before going into this subject in detail, it may be of interest to touch on the differences between the American and European toll tariff systems, as these lead to decidedly varying results as to the possibility of utilizing the toll lines in the most efficient manner.

The American system is organized on the basis of practically equal and, at the same time, very short waiting time for all calls. Calls with a right of precedence (express calls) do not occur. The mean waiting time for toll calls on all distances is said to be about eight minutes. For distances exceeding 225 kilometres, which about corresponds to the distances in the international European telephone traffic, the mean waiting time is from ten to twelve minutes.

It is apparent that these short waiting times cannot be reached and maintained during intense traffic periods unless a very large number of circuits are available, and it is equally apparent that this large number of circuits cannot but be very inefficiently utilized during less intense periods of traffic.

Since both interest and amortization must be paid on these expensive lines, such a low call frequency per circuit must needs result in high tariff rates. It is this condition which is mainly responsible for the fact the American toll rates are not only many times higher than existing European rates but also much higher than those which need be applied in a fully up-to-date European toll net.

European tariff systems, on the other hand — with the exception of England —, are based on the assumption that all calls do not need to be promoted with equal speed. Calls of a very urgent nature are given the right of precedence at an increased rate, the waiting time for other calls being maintained at a reasonable level. This method of differentiating between the length of time required for promoting calls, together with the maintenance of a waiting time — for ordinary calls — of $^1/_2$, 1 and 1 $^1/_2$ hours for distances of 500, 1000 and over 1000 kilometres respectively (these waiting times are proposed by the Comité Consultatif International as being suitable) permits the use of lines of communication with a much smaller number of circuits than the American method of putting all calls on an equal basis with very short waiting times. In this manner, the lines can be much more efficiently utilized for the transmission of paying toll calls and the rates can be maintained at a decidedly lower level than the American ones; even express calls will not be more expensive — with 3 times the initial rate — than any American calls, either urgent or not.

From the point of view of the public there are naturally no objections against short waiting time for the promotion of a call; but I am convinced that the European traffic is better served by a decidedly lower toll rate for less urgent calls and by promoting really urgent calls — which, with a well balanced supply of circuits, should not exceed 10 to 20 % of the total number — with American speed and at a cost corresponding to the American initial rate for all calls.

The European tariff system allows 4000 call-periods (one call-period = 3 minutes) per circuit and month with satisfactory results as to length of waiting time; the American system will hardly allow more than about 1500. The important part which this fact will play in the setting of the rates cannot be ignored, especially if we consider that rates for calls over very long lines are in proportion to the cost of the line, the cost of the service on the other hand, being of minor importance.

The requirements necessary for the efficient utilization of a circuit with maintenance of satisfactory waiting times are as follows:

1. A steady afflux of calls.
2. Good service, permitting the shortest possible intervals between calls, thus increasing the earning capacity of the circuit.

For the purpose of arriving at a constant traffic load for the existing circuits the Comité Consultatif International has recommended the adoption of tariffs varying during different parts of the day.

It is quite natural that the telephone circuits are subject to the heaviest load during the regular business hours. Thus a circuit which can easily be overloaded during office hours can be almost entirely disengaged outside of these hours, this condition creating a necessity for the removal of traffic from the regular business hours to those hours during which traffic is usually slack, and for the development of new traffic during the last mentioned hours, resulting in a practically constant traffic curve. Reduced rates — so-called night rates — are already in existence in and between some European countries. A reduction of rates during the day is enforced in Belgium, England, Denmark, Norway and Sweden and between the last mentioned countries mutually. The United States has also a sliding tariff with three different rate periods.

The hours most suitable for reduced rates vary in different countries for the domestic as well as for the international traffic. In this respect, the office hours as well the hours when the stock exchange is open play an important part, the widespread use of residence telephones being also an important factor.

As it is undoubtedly of general interest to see how reduced rates — under favourable conditions – can influence domestic telephone traffic, I will take the liberty of mentioning some facts concerning Swedish conditions in this respect.

Already in July 1904 reduced night rates — the percentage of reduction varying with the distance — were introduced in Sweden, being applied during the hours between 9 p. m. and 7 a. m. In 1920, when economic conditions caused by the general depression made it necessary to increase the earning capacity of the toll lines, the toll rates, it is true, were considerably increased during those hours when the traffic was heaviest, but the reduced rate period was simultaneously lengthened to include the early evening hours. Practice had shown that the hours from 9 to 11 p. m. were subject to a heavy traffic load on account of the reduced rates in effect during that time, while during the hours just preceding 9 o'clock, on the other hand, the traffic was comparatively light. For this reason the reduced rate period was moved back so as to include the hours between 7 and 11 p. m., normal rates being again enforced during the hours after 11 p. m. because operating expenses in Sweden are 50 % higher at night than during the day and because it has been proved that no increase in traffic is to be reckoned with by reducing the rates during the late night hours.

It soon became evident, however, that the reduced rate period could be made even longer. This was done on October 1, 1921, after which date it included the hours between 6 and 11 p. m. On October 1, 1922 the reduced rate period was subjected to still another increase, this time by the two morning hours between 7 and 9 a. m.

Since that time there has been no change in the hours during which reduced rates are applied, i. e. 7 to 9 a. m. and 6 to 11 p. m.

Thus it will be seen that rate reductions have taken place gradually and only after experience has shown that the changes would not be accompanied by any disadvantages.

If we do not reckon the hours between 11 p. m. and 7 a. m., during which only about $^1/_2$ % of the entire traffic is handled, we find that normal rates are in effect during 9 hours and reduced rates during 7. Thus, reduced rates — the reduction varying with the distance between 25 and 52 % — are in effect during abt. 44 % of the effective traffic time.

The intention in reducing the rates has been to make the traffic curve as even as possible, thus utilizing the circuits in an efficient manner and at the same time popularizing toll traffic. Also, the aim has been to coax traffic that need not absolutely take place during regular business hours over to such time of the day when traffic is usually light, thus lowering the traffic curve for the busy hour. Further, it has not been deemed wise to segregate certain rush hours with a greatly increased rate, the introduction of express calls allowing the intensity of the traffic itself to determine when the higher rates — express rates — shall be charged. With suitably loaded circuits we find that express calls are really worthy of this name.

Having finished this little summary of the development of the toll tariff, we will now pass on to a scrutiny of the results obtained, and see in what degree the variable tariff has been able to bring us nearer our desired end, i. e. a constant traffic curve, so important from an economic point of view.

Naturally, it is very important to have a sufficient quantity of subject matter at ones disposal to be able to pass competent judgement as to the influence of reduced rates on the traffic. For this reason an investigation covering the entire domestic toll traffic of Sweden for the year 1923 has been made.

During the abovementioned year the toll traffic within the two lowest rate groups — comprising air-line distances within radiuses of 45 and 90 kilometres with fees of 0.20 and 0.30 Swedish crowns respectively — amounted to a total of 29,900,000 conversation periods (one conversation period = three minutes). When considering this figure, it must be remembered that the Swedish free traffic zones are unusually large, as they comprise not only the community proper in which the toll exchange is located but also an area reaching at least 20 and often from 40 to 50 kilometres away from this community. Reduced rates are not applied within the two lowest rate groups, the fees being too low to stand any additional reduction. However, the toll traffic within these two rate groups, during those hours of the day when reduced rates were enforced within the other groups, amounted to 25.1 and 25.2 % of the total traffic within the respective groups.

The following table indicates the distribution of traffic within those rate groups where reduced rates are applied:

Normal rates. Time: 9 to 18 and 23 to 7			Reduced rates. Time: 7 to 9 and 18 to 23.			
Fee per 3-minute period	Number of periods.	Percentage of express and series periods.	Fee per 3-minute period.	Number of periods.	Percentage of express and series periods.	Percentage of total number of periods.
50	5,864,854	4.9	40	2,236,585	1.4	27.6
70	2,507,047	7.9	50	1,051,136	2.8	29.5
90	2,262,474	9.3	60	989,277	1.8	30.4
110	576,454	17.6	70	259,619	2.3	31.1
130	92,733	19.3	80	52,005	3.0	36.0
160	25,002	21.0	90	16,669	6.0	40.0
200	41,218	29.0	100	26,199	8.2	38.9
250	17,515	24.1	120	11,374	4.8	39.9

are in force, this percentage varies between 1.4 and 8.2, the latter also occuring on the distances mentioned.

The accompanying schedules indicate the distribution of traffic with varying rates:

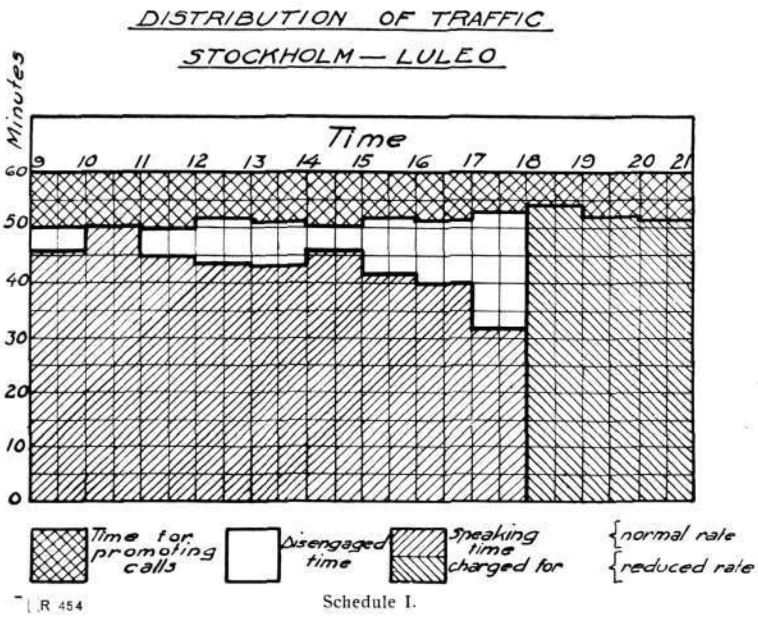
I. On the line Stockholm—Luleo, length 1321 kms.

II. On the line Stockholm—Joenkoeping, length 393 kms.

III. On the line Stockholm—Gothenburg, length 540 kms.

IV. Typical distribution of traffic with unvarying rates.

A system with express calls can well be said



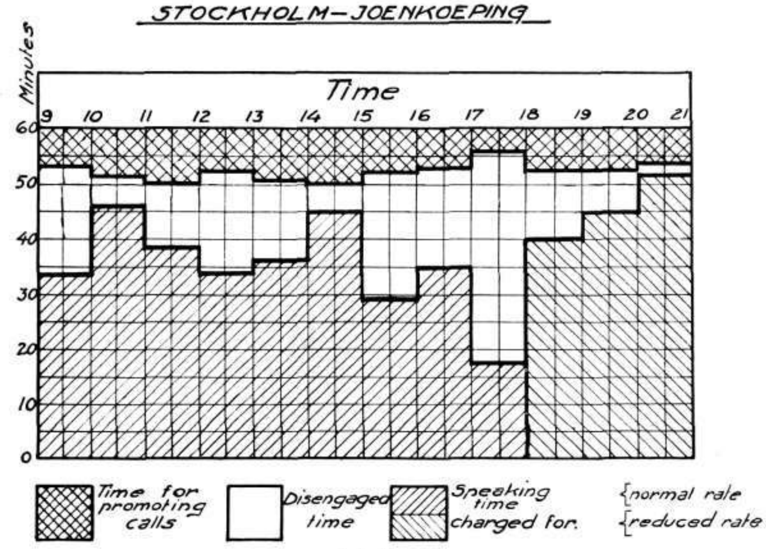
Schedule I.

As indicated in this table the percentage of reduced rate periods increases with the length of the lines and amounts to about 40 % in the three highest rate groups. Since the time during which reduced rates are in effect amounts to about 44 % of the effective traffic time it can well be said that the frequency curve for these longer distances has shaped itself in a most satisfactory manner.

The maximum percentage of express and series periods is 29 and occurs with normal rates and on distances between 720 and 810 kilometres. During those hours when reduced rates to promote an efficient utilization of the circuits. On the line between Stockholm and Luleo, with a length of 1321 kilometres and a traffic load as indicated in schedule I (a daily average of 209 conversation periods between 9 and 21 o'clock), the mean waiting time for express calls was 7 minutes, with a maximum waiting time of 33 minutes. During business hours between 9 and 16 o'clock the traffic amounted to a daily average of 126 normal conversation periods and 11 express periods.

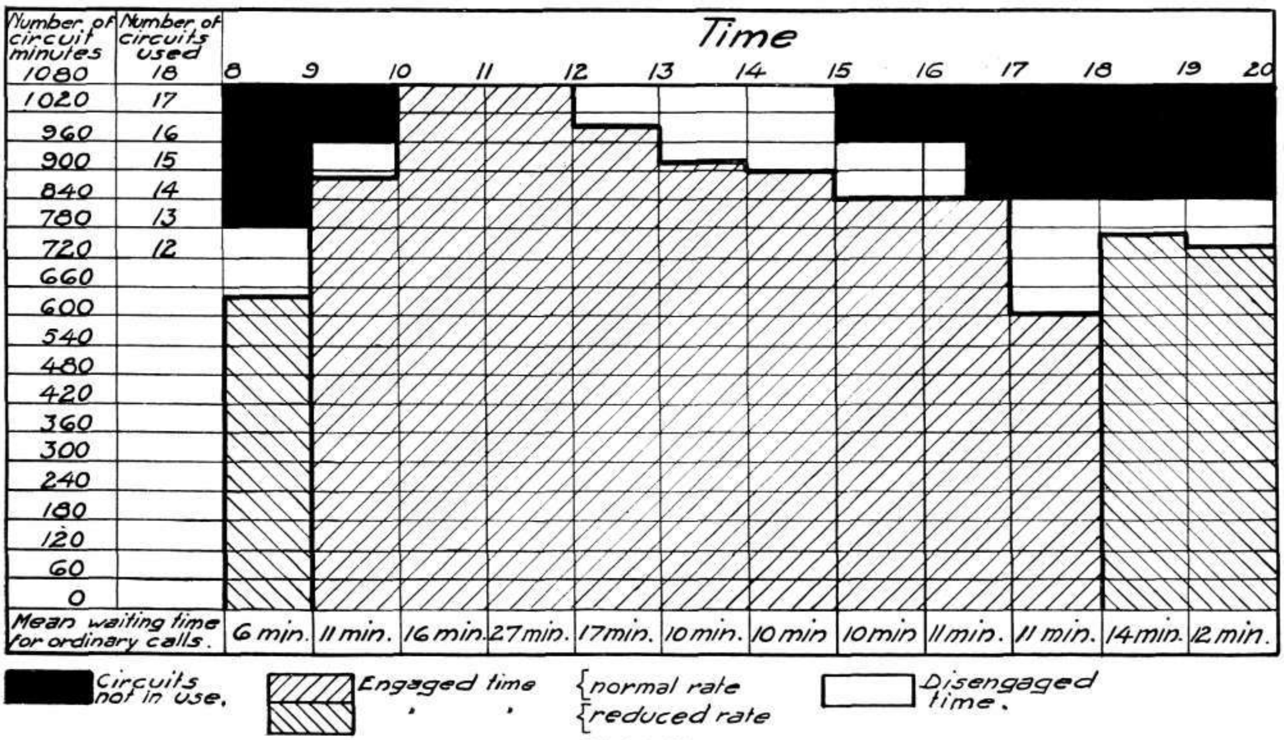
The corresponding figures for the line Stockholm—Joenkoeping (schedule II) are as follows:

DISTRIBUTION OF TRAFFIC.
STOCKHOLM—JOENKOEPING

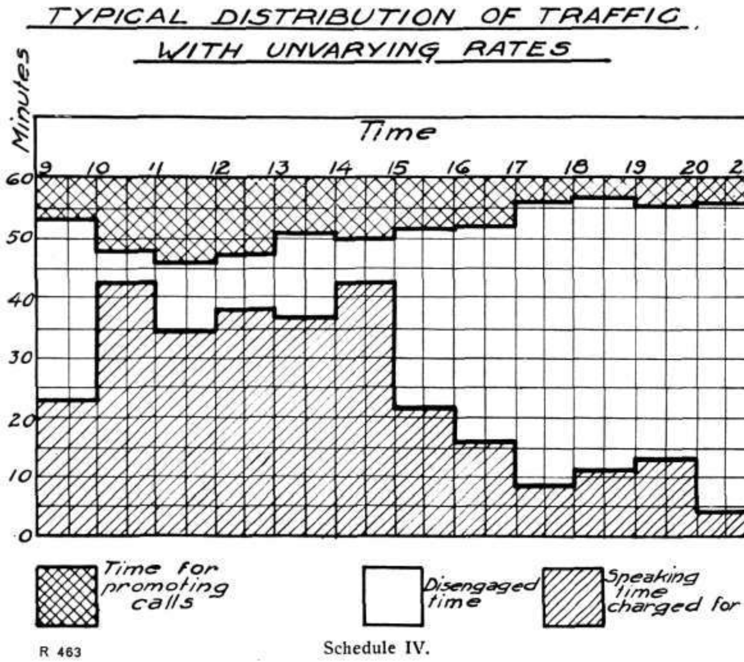


R 457 Schedule II.

DISTRIBUTION OF TRAFFIC
STOCKHOLM—GOTHENBURG
18 circuits



R 460 Schedule III.



Schedule IV.

average waiting time for express calls ... 4 min.
max. » » » » » ... 14 »
number of normal periods occuring between 9 & 16 o'clock ... 109
number of express periods occuring between 9 & 16 o'clock ... 5

There is no question but that the possibility of obtaining necessary quick service by paying a higher rate (the Swedish express rates are only double the normal rates) for only 8 and 4.4 % respectively of the total amount of traffic during business hours is of inestimable value to the public.

A total traffic load of 5400 and 4600 conversation periods for 26 week-days and during the hours between 9 & 21 o'clock — according to schedules I and II respectively — is unquestionably a very satisfactory result.

From what has been said it is undoubtedly evident that varying toll rates in Sweden have been a valuable aid in obtaining a more even loading of the circuits.

In a following article I will take up the subject of operation and the possibility of increasing the earning capacity of the lines.

Magnet Steel for Telephone Purposes.

A deeper study of the magnetic properties of steel has always involved almost insurmountable difficulties, as these properties are closely connected not only with the chemical composition of the steel but also with the heat treatment of the material.

The obvious essential requirements of a permanent magnet for telephone purposes are:

1) to provide as high a magnetic flux as possible so as to obtain the flux required for the instrument in question with a minimum cost of steel, and

2) that the flux obtained be satisfactorily maintained over the life-period of the instrument, namely, that the ageing losses be a minimum.

A very considerable amount of investigation work on permanent magnets has been carried out at our British factory, Beeston, involving studies of chemical compositions, mixing of the elements, rolling and heat treatments of the sections in the steel mills, the state of solid solution, mechanical processes of forming, etc., heat treatment of the finished magnet and magnetisation.

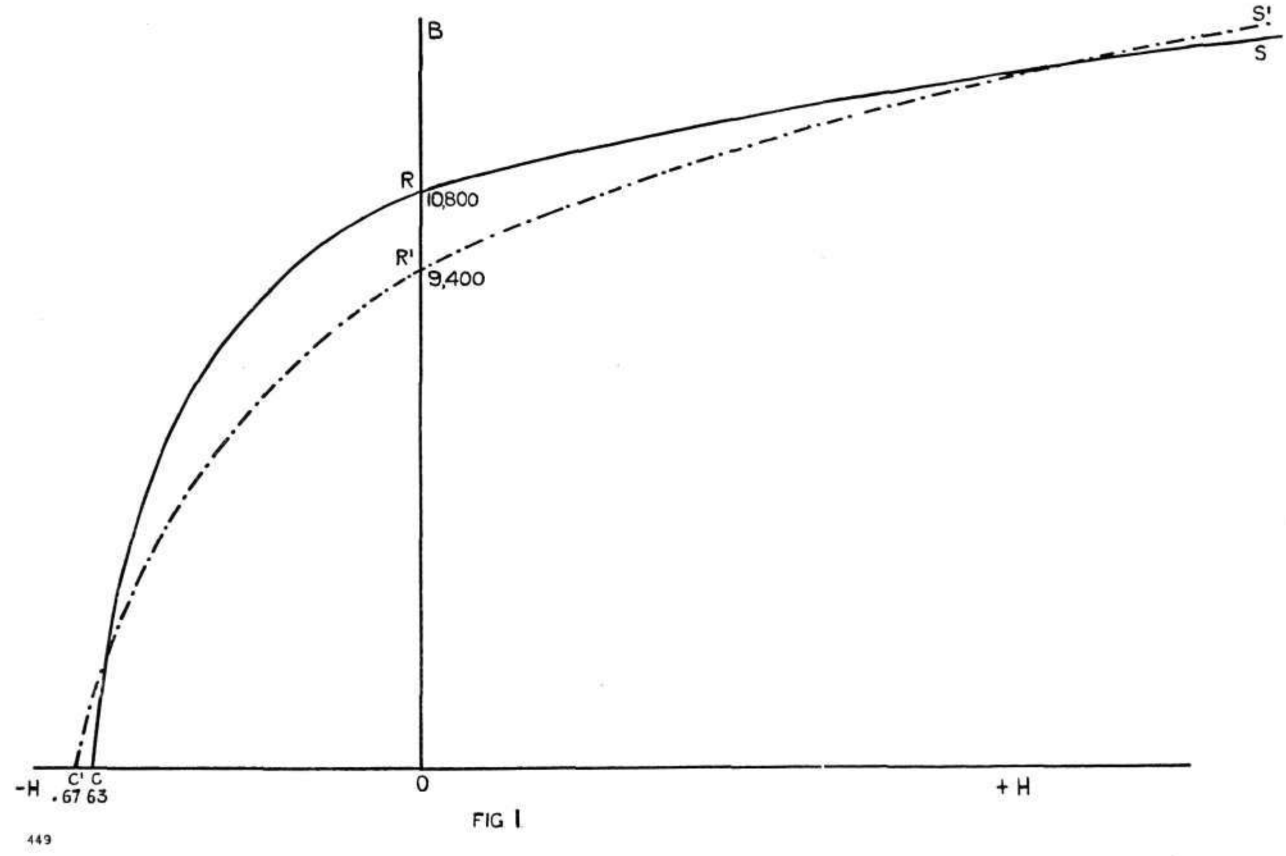


FIG I

In the first instance what criteria form the determining characteristics for the magnet in order to obtain the maximum efficiency from the finished product? Reference to the diagram — fig. 1 — shows a typical curve »*CRS*» for a magnet steel. The curve is the top portion of the ordinary hysteresis loop, the steel being magnetised to saturation »*S*» with a magnetising force »*H*», say 450 lines per sq. c. m. On reducing the »*H*» to zero the remanence »*OR*» is the flux »*B*» retained in the steel assuming a complete magnetic circuit of the material. The coercive force »*OC*» is the reverse magnetising force necessary to annul the remanence. A few years ago the coercive force »*OC*» was the determining feature of quality, and later it was felt that the remanence »*OR*» was possibly equally important. A magnet steel giving the characteristics shown by the dotted line — fig. 1 — may be better or worse than the steel indicated by the full line, depending upon other factors than either the coercive force or the remanence. At present it is considered that the two criteria are the following:

1) The coercive force, and

2) The reluctance or magnetic resistance of the steel.

This latter characteristic, however, is difficult to determine and varies with differing conditions. To a certain extent remanence is a measure of reluctance, but one magnet may have a high coercive force and a low remanence, and another a lower coercive force and a higher remanence. If the instrument has a magnetic path with a large air gap or heavy demagnetising forces, then the former is the better magnet, whereas with a practically closed magnetic circuit the latter may be better.

As a general rule the following should be specified for a permanent magnet for telephone instruments:

1) a minimum coercive force of 63 lines per sq. c. m., and

2) a minimum remanence of 10.800 lines per sq. c. m.,

and in addition a third factor depending upon the conditions of service and design of instruments, viz. the maximum value of the product of the *B* & *H* values at any point of the curve between *C* & *R*. Such values are given in fig. 2 for various points, the maximum value in the case of the full line of fig. 1 being 305.000, and in the case of the dotted line 224.000. This shows that the steel represented by the full line is superior in quality. A useful value to specify for the minimum value of *BH* maximum is 300.000. The figures suggested above are for a hardened 6 % tungsten magnet steel in *CGS* units.

The British Engineering Standards Association

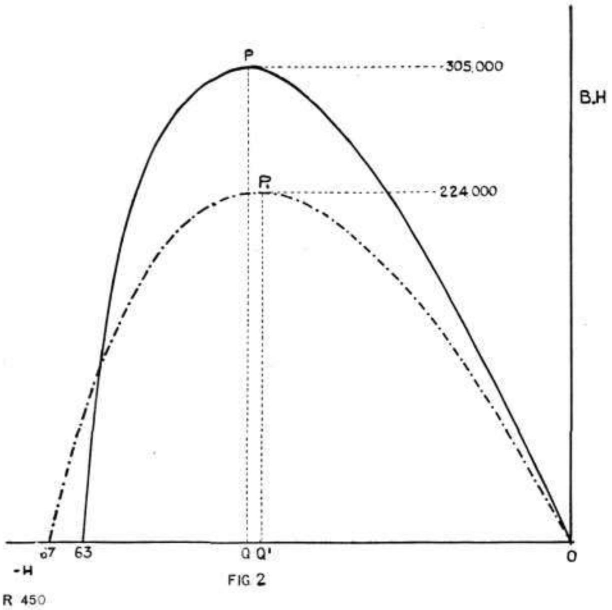


FIG 2

has recently standardised for the use of British manufacturers a measuring instrument for permanent magnets which was developed at our Beeston factory. By means of this instrument measurements of the above mentioned three factors can be taken by an unskilled operator within one minute to an accuracy of 3 %.

There are at present 4 steels manufactured for permanent magnets:

A) *Tungsten Steel* — usually 6 % tungsten, .65—.70 % carbon, giving minimum figures of the order of:
Coercive force 63.
Remanence 10.800.
BH maximum 300.000.

This steel, which is a water hardening steel, is the most important for telephone work, because the ageing properties are sufficiently low under even the most stringent conditions, whilst the cost of the steel is reasonable.

B) *Chrome Steel* — usually 2 % chromium, 1 % carbon, water or oil hardening steel giving minimum figures of the order of:
Coercive force 56.
Remanence 9.500.
BH maximum 240.000.
This steel, whilst being appreciably cheaper is not generally considered of sufficiently high quality for telephonic purposes, principally because the ageing losses are relatively high.

C) *Cobalt Chromium Steel* — say 14 % cobalt, 9 % chromium, .9 % carbon, giving average figures of the order of:
Coercive force 200.
Remanence 8.600.
BH maximum 600.000.
This steel, which is an oil hardening steel, is extremely interesting, giving remarkable magnetic properties, but it has a more complicated heat treatment involving three processes and is more difficult to machine than A or B. As A is of sufficiently high quality for telephone instruments as at present designed, there is no advantage in changing over to steel C except in special cases such as headgear receivers where the question of reduction in weight outbalances any other consideration.

D) *Cobalt steel* — of high cobalt of 35 % with say 4 % tungsten, 2 % chromium and .8 % carbon — oil hardening. This steel has remarkable properties, giving average figures of the order of:
Coercive force 350.
Remanence 9.000.
BH maximum 800.000.
The price of that steel is practically double that of steel C, hence it can be considered as of theoretical interest, only excepting for very special purposes where abnormally high demagnetising forces are existent.

The adoption of cobalt chromium steel C is occupying the attention of engineers in various branches of the electrical industry, but it may be stated that for telephone instruments the use of this steel will give no improvement in efficiency, flux or ageing proporties but the length of the magnet may be generally reduced to one third providing that the section is increased, by say five to four, to allow for the decreased remanence. The relative costs of the two steels are of the order of 5 or 6 to 1, so that it is not commercially economical to use steel C unless the redesign of the apparatus, utilising a straight bar smaller cobalt magnet, causes outbalancing simplifications. There does not appear to be any usual telephone apparatus where such a change to cobalt chromium steel would be of advantage unless the price of such steel is at least halved. The monopoly in cobalt is taking precautions to prevent such occurrence.

The further scope of the present article will be restricted to the question of steel A, namely Tungsten Magnet Steel.

The study of the effects of various elements in magnet steel is extremely complicated and can only be carried out as a result of summarising years of general work on various steels. The results of some of these investigations may be given briefly.

1) *Tungsten.*

The best results are given with approximately 6 % of this constituent, but, contrary to what might be expected, appreciable variations appear to have little vital influence on the magnetic characteristics of the steel within a range from say 5.5 % to 6.5 %, and suppliers do not appear to have much trouble in keeping to within these limits.

2) *Carbon.*

Taking everything into consideration, the best percentage appears to be from .65 to .70, for a water hardening steel with 6 % tungsten and low chromium.

The higher the carbon, within limits, the higher the coercive force and lower the remanence. This question is linked up with the magnetic design of the apparatus on which the magnet will be used. For example, on ringers, where proportionally large air gaps are given, the coercive force of the magnet is of greater relative importance than it is on generators or receivers. This suggests that a high carbon steel should be used for ringer magnets or the large coercive force obtained in some other manner. A higher carbon requires a lower quenching temperature during hardening.

3) *Chromium*

may or may not be used, but, if present, is usually of the order of .2 % to .5 %. This element greatly increases the sensitivity to quenching and also the rolling difficulties, but if present under suitable conditions of solution the magnetic properties are somewhat improved. The question of chromium is, however, linked up with the carbon content and also with that of water and oil hardening.

4) *Manganese.*

This element, apart from overcoming the ill effect of sulphur on the mechanical properties, appears to have no appreciable influence on the magnetic behaviour when present in the usual quantity of .20 % to .40 %.

5 & 6) *Sulphur and Phosphorus.*

These elements appear to have no detrimental magnetic effect, but, as with ordinary steels, they are undesirable from a mechanical point of view. It is desirable that these should not exceed the order of .03 %.

7) *Silicon* is present in quantities usually found in steels, and does not exceed .15 %.

8) *No Other Constituents* should be present.

Microstructure of Magnet Steels.

This is a valuable guide both from an investigation standpoint and also as laboratory tests on the incoming deliveries of steel. The following investigations were only possible in respect to unhardened magnet steel, namely, steel as received from the rolling mills. In the hardened condition the structure is so fine that only ultramicroscopic examination could show any real results. It would appear, however, that the most valuable study is in the unhardened condition, as this being correct, the final result is only a matter of correct heat treatment. Decarbonisation and the presence of undissolved constituents can be seen in the hardening condition, however, even on a magnification of 800.

The carbon and tungsten in magnet steel may be present in two or more of the following forms:

1) Pearlite.
2) Iron Tungstide.
3) Tungsten Carbide.
4) Iron Tungsten Carbide.

In steel that is in the best condition as regards magnetic properties the constituents are, as far as can be at present determined

pearlite and

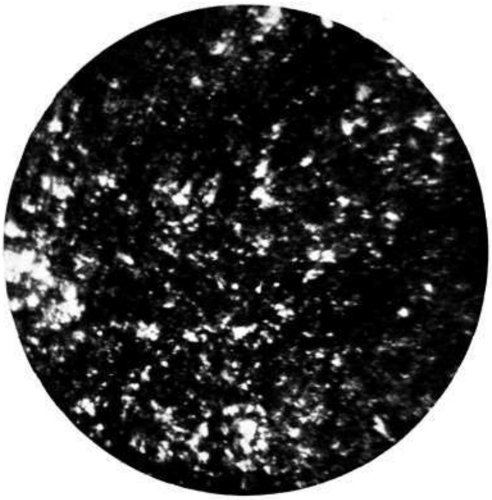
iron tungstide or tungsten carbide.

The former dissolves in the iron (solid solution) at the usual decalescence point (say 780° C., depending upon the carbon content), while the latter dissolve at a somewhat higher temperature, say 850° C., which is therefore, the suitable quenching temperature for the steel. (This is probably the reason for the difference from tool steels for which the decalescence is the correct temperature for quenching). If the steel as described is heated for a period at a temperature in the region of 900° C. and allowed to cool slowly from such a temperature such as would be given during the rolling of the bars, a change of structure takes place and the tungsten carbide and iron tungsten carbide appear as small white patches in the pearlitic ground structure. If at a later period magnets made from such a steel are hardened in the normal manner, these white patches do not dissolve at the usual quenching temperature and, therefore, as far as can be determined, owing to this lack of solution, their magnetic effect is partly lost. The metal is rendered less sensitive to (i. e. less affected by) quenching and the hardness is diminished. Such a steel would be said to have been spoiled during rolling. The worse this spoilation the greater the amount converted to iron-tungsten carbide.

On reheating the faulty steel to a temperature of 1150° C. the double carbide dissolves and, providing the steel is taken through the 900° C. zone fairly rapidly, the constituents re-appear as pearlite and iron tungstide on cooling.

Rolling of Magnet Steel to Bar Form by Supplier.

During rolling of Magnet Steel, the special precaution necessary is that working in the region of 900° C. (800°—1050°) must be avoided or carried through as quickly as possible. If it is necessary that this temperature should be passed through, the cooling should be fairly rapid to prevent the formation of double carbide (see under Microstructure). Care must also be exercised during the rolling processes to minimise decarbonisation, scaling, etc.



R 451 Magnet Steel. 6 % Tungsten. Spoiled during rolling. 800 diameters.

Fig. 3. Magnet Steel. 6 % Tungsten. Unspoiled. 800 diameters.

Manufacturers are able to recover steel spoiled by rolling (except when also badly decarbonised) by heating for a short time to 1150° C—1200° C., followed by a fairly rapid cool. This treatment dissolves the double carbide present which assumes the correct condition as iron tungstide and iron carbide, but the problem is to prevent spoilation and not to attempt to remedy its bad effects.

Magnet Steel — Heat Treatment of Completed Magnets.

During treatments in the course of manufacture of magnets at the works previous to hardening, the magnetic properties should not be impaired. Heating for bending purposes or for the relieving of strains can be successfully carried out at a temperature which does not affect the structure of the steel. In any case, the degree of heat should not exceed 750° C., which allows a safe margin from the spoiling or danger zone of 850° C.—1050° C. (See under Microstructure and Supplier's Treatment.)

Hardening.

There are two main classes of steel which demand different treatments, these being controlled by the composition. In making a definite statement concerning these steels it is assumed that the carbon is present as pearlite and the tungsten as iron tungstide or tungsten carbide (the presence of double carbide reduces the sensitivity of the metal and also reduces the coercive force very considerably).

Water Hardening Steel.

Carbon tungsten steels (with up to about .3 % of chromium) are water hardening when the composition is normal (that is tungsten approximately 6 % and carbon not more than .7 %). The best quenching temperature is approximately 70° C. above the decalescence point. Plain C—W steel gives marked magnetic changes with variations of quenching temperature, which, when low, gives high remanence and low coercive force, but when high gives lower remanence and higher coercive force. Few cracking troubles occur with the correct composition steel and rolling treatments, and normalising or annealing have very little real influence on the cracking during the quenching, excepting where the latter treatments are employed to relieve mechanical strains. The addition of chromium increases the cracking difficulties. Providing other features are normal, a chromium content higher than .4 % begins to give difficulties, assuming the steel is 'unspoiled'.

A steel composition of .7 %—C, 6 %—W & .56 %—Cr. gave a high percentage of cracks with water hardening, whilst an interesting steel was one of composition .56 %—C, 6 %—W. & .69 %—Cr. in a delivery which, according to composition should have cracked freely, but which could not be made to crack even with quenching in water from as high as 920° C. The reason appeared to be, on investigation, that the presence of a proportionally large quantity of the double carbide reduced the sensitivity so much that cracking was not given.

Oil Hardening Steel.

The usual composition for this class is

Carbon	.7—.8 %
Tungsten	6 %
Chromium	1—1.5 %.

The distinction between the two classes is not very definite, but a .63 %—C steel with .4 %—Cr. and 6 %—W was found to be suitable for either oil or water quenching. Another having .7 %—C., 6 %—W, and .56 %—Cr. gave excellent results in oil and poor results in water. With oil hardening material the best quenching temperature is about 100° C. over decalescence. Cracks result when high chrome steel is quenched in water.

The explanation of the necessity for oil quenching is probably this. When the chromium in a .6 %—C—6 %— W alloy reaches .6—.8 % the steel becomes very sensitive to quenching, and sudden chilling in water gives an austensitic instead of a martensitic structure, giving the attendant poor magnetic properties. Chrome steel is mechanically harder when quenched in oil than when in water because of this fact.

A. Brookes.
Laboratory Manager, Ericsson Telephones Ltd., Beeston.

The Rotterdam Toll Exchange.

R 471 Fig. 1. The New Dutch Telegraph Station and Toll Telephone Exchange in Coolsingel, Rotterdam.

On July 28th, the new toll exchange in Rotterdam, delivered and installed by L. M. Ericsson, was duly handed over to the Dutch Government by the representatives of this company. These proceedings took place in the presence of the director general of the Post Office and Telegraph Administration — functioning as the representative of the government — and of a number of higher officials and experts in the fields of telephony, telegraphy and of postal communications. On this occasion, the sincere satisfaction felt in Holland as a result of the thirty years co-operation with the Swedish telephone company was given adequate expression in an authoritative statement by the government representative, dwelling upon the many and important plants executed by this company throughout the country and on the fact that it has accentuated its international character by establishing a factory of its own in Holland.

On August 1:st the country's entire toll traffic — international as well as domestic — was cut over to this new exchange, this procedure being carried out without the least difficulty. During the few weeks that the new installation has been in operation, it has functioned in a most satisfactory manner and according to the most sanguine expectations. In this connection, the fact that inter-traffic between the local telephone net in Rotterdam -- which is being completely rebuilt according to the Ericsson full automatic system — and the new toll exchange has given most satisfactory results is worthy of special mention.

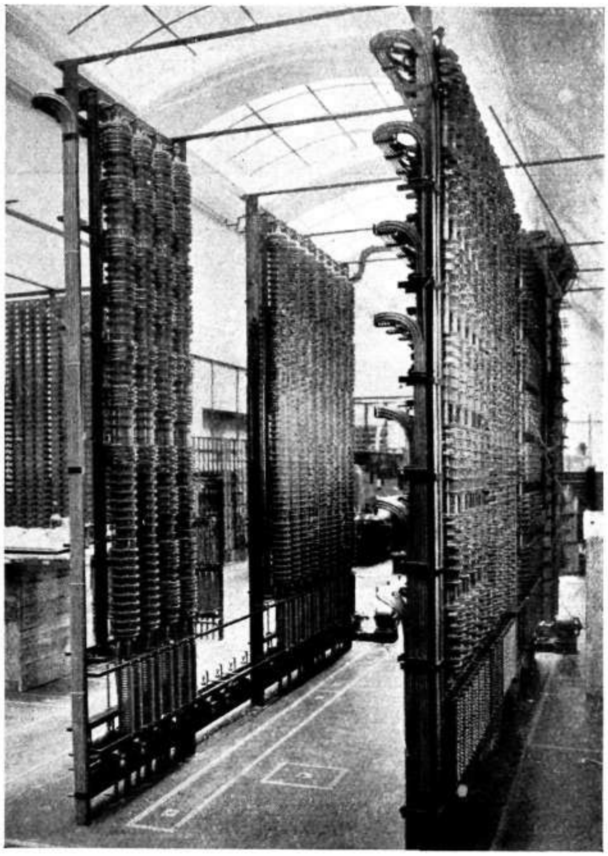
R 472

Fig. 2. The Operating Room.

Rotterdam is a lively business centre and the most important seaport on the European continent from a mercantile point of view. This, in addition to its location in a thickly populated and highly cultured country, makes it a place in which several international routes of communication run together, and it is evident that such an important centre must needs demand a great deal of its toll telephone service in the way of speed and capacity. Also, the new toll exchange is undoubtedly the most modern as well as one of the largest in Europe, with a present capacity of 1000 lines. From the very beginning, a high degree of centralization has been enforced in the development of toll traffic in Holland, the construction of the new exchange having been planned with a view towards the further development of this method. Also, the problem of establishing efficient means of communication with and between full automatic local telephone plants has been met and satisfactorily solved by the Ericsson company. Automatic devices have been adopted in all cases where it has been possible and expedient to do so. Thus, incoming calls are handled according to the automatic distribution system, whereby a subscriber who desires to place an order for a toll call is automatically connected up with a disengaged operator.

All transportation of messages between the various departments within the exchange is handled by means of automatic electrical or mechanical devices, making messengers or verbal intercourse of any kind unnecessary except where directly concerned with the connecting up of subscribers to the desired exchanges and numbers. This method makes it possible to secure an accurate record of the exact time and duration of toll calls, the cost being determined and entered in a card index almost as soon as the call itself has been cleared.

The arrangements by which these results are obtained consist of an electrical transportation system with small cars or baskets, and a specially designed pneumatic tube system, enabling the different operators to communicate with each other.

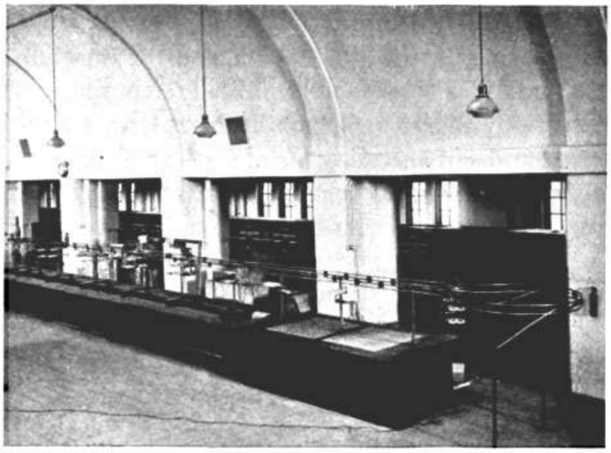


R 479 Fig. 3. Selector Racks, for Automatic Distribution of Incoming Calls.

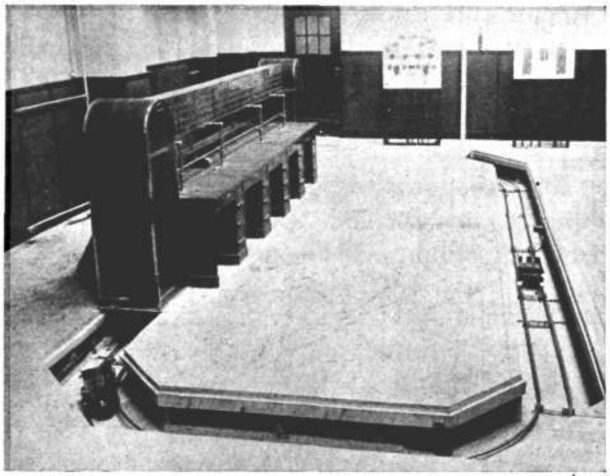
A detailed description of this exchange from a technical point of view will be published in a coming issue of this journal; let it suffice here to state that this method of message transportation works in such a manner that when a subscriber puts in an order for a toll call at the ordering central, it is noted on an order slip which, when its turn comes, is sent on to a distributing central by means of a belt carryer system, and from here to a toll position by means of pneumatic tubes. When the call is terminated the duration of the same has been automatically recorded on the order slip, which is then sent on to the charging department by means of small electrically driven cars, the charges for each call being thereupon entered in the comprehensive but still very concentrated card index.

A special large room has been equipped for receiving outgoing telegrams over the telephone and for sending them on to the telegraph station in the same building, this being also automatically taken care of by small, electrically driven cars and elevators, the endless track system running along the table tops and down under the floor.

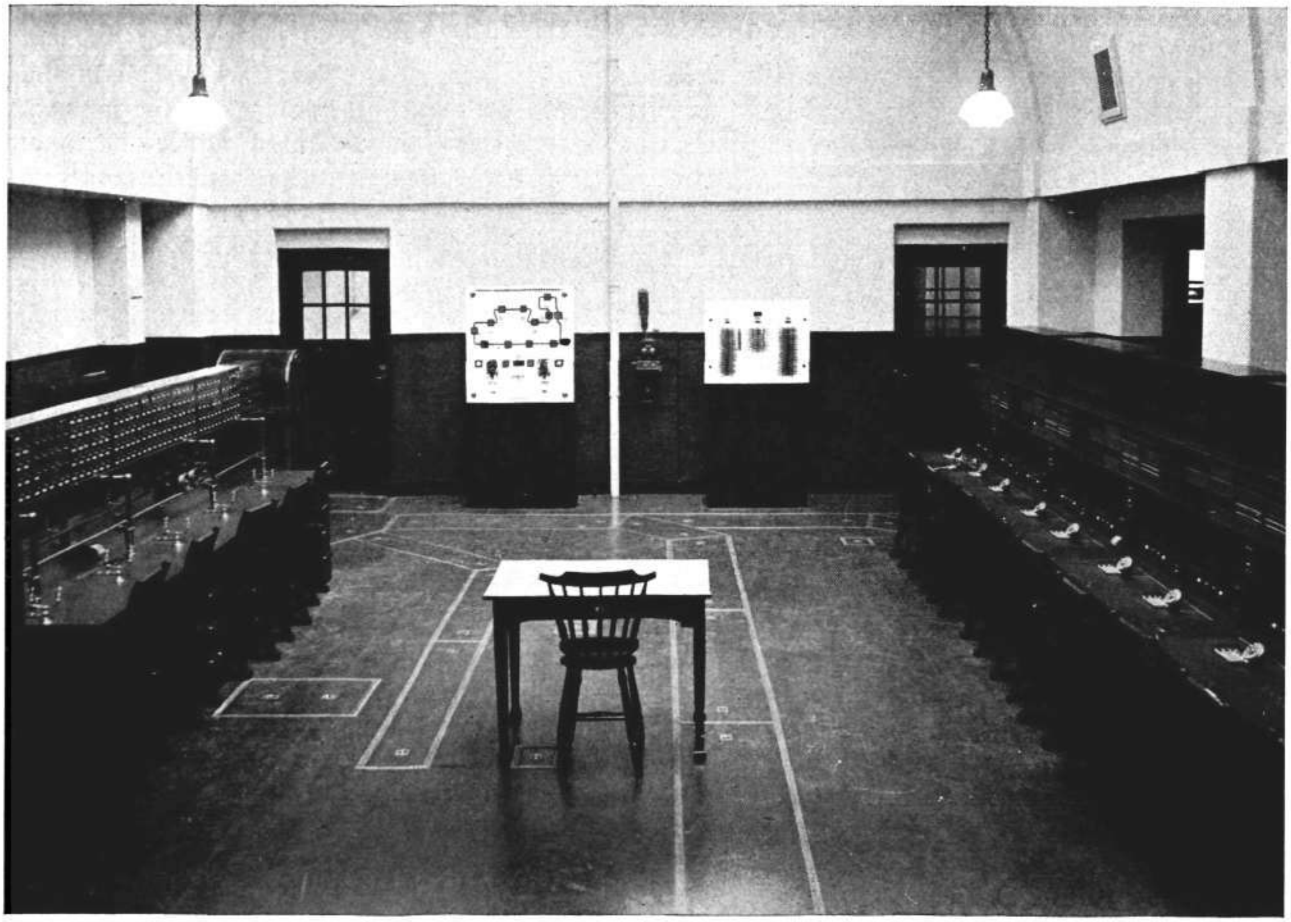
The entire transportation system is easily accessible for inspection and possible repairs which may eventually be made necessary by tampering or some such cause. The manner in which collisions between the messenger baskets or cars are avoided is of special interest. Such an accident is out of the question, even if someone should find it necessary to detain a car for a few moments, or if it should be held back in some other way, since the following car automatically stops at a suitable distance and does not start until the car ahead of it has been again set in motion.



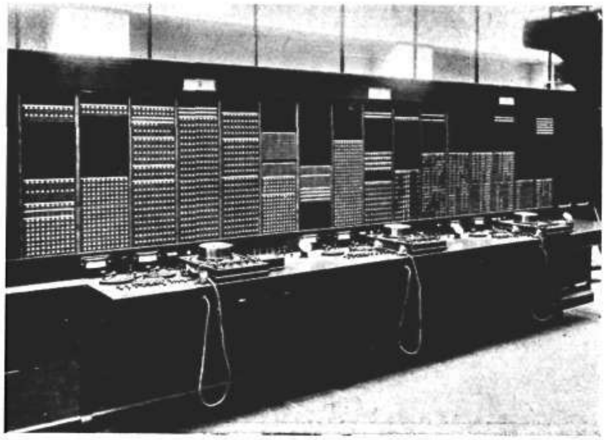
R 481 Fig. 4. Distributing Central.



R 482 Fig. 5. Charging Department.



R 474 Fig. 6. Charging Department (left) and Information Bureau (right).



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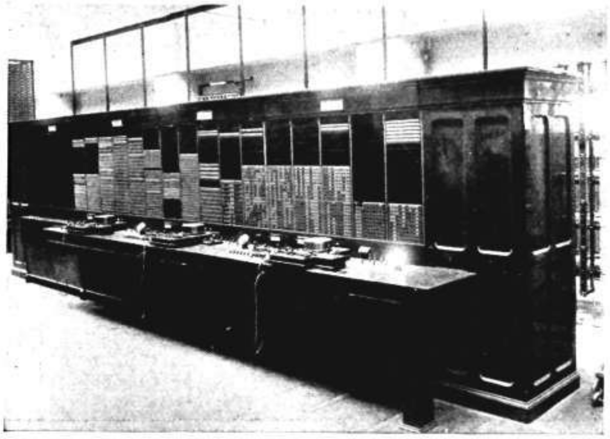
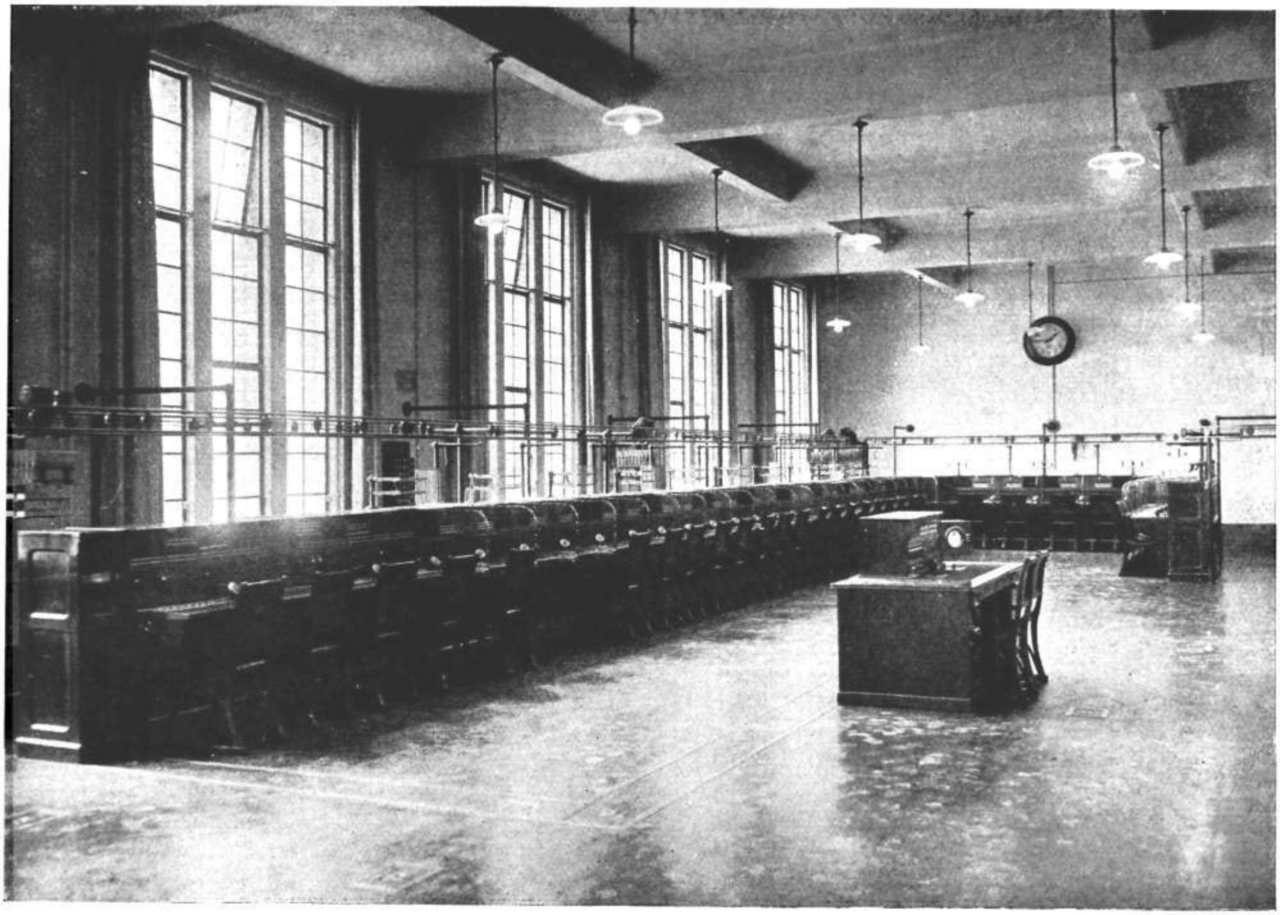


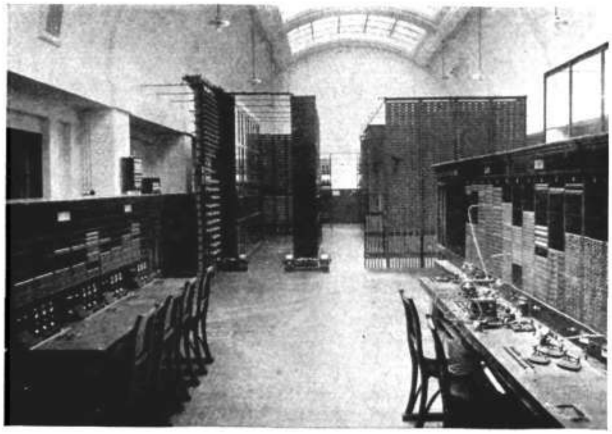
R 475

Figs. 7 & 8. Line Testing.

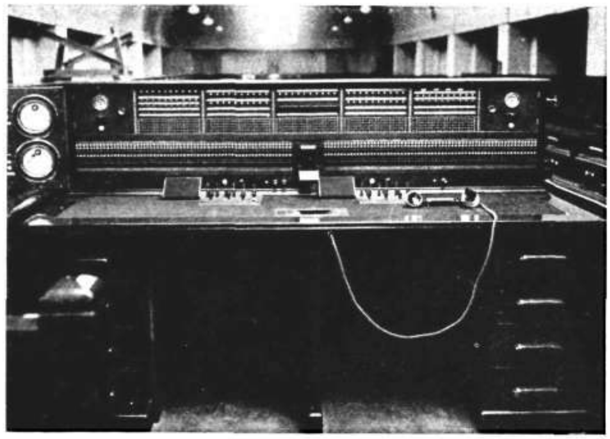


R 473

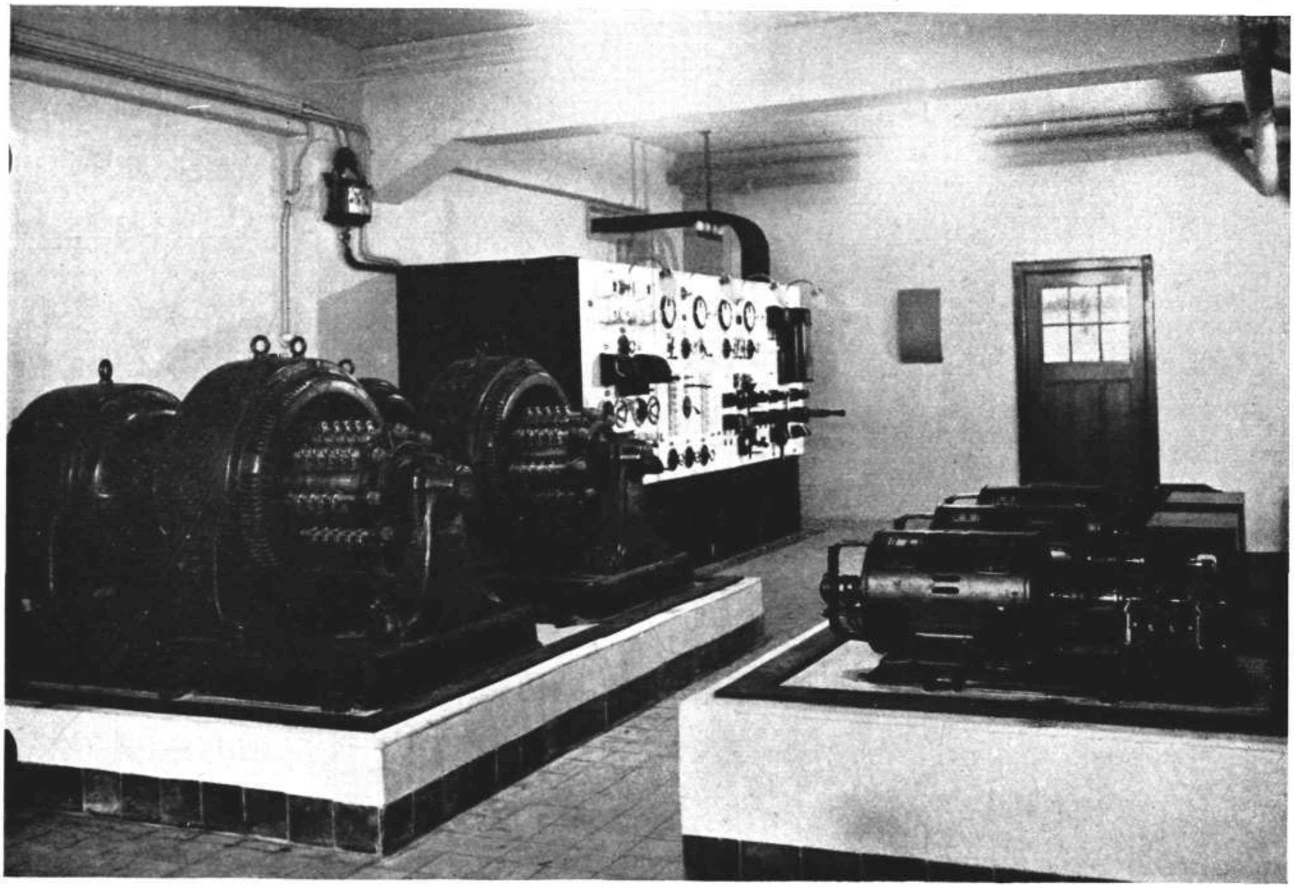
Fig. 9. Telegraph Service Bureau.



R 477 Fig. 10. Supervisors' Board to left, Line Testing Board to right, Relay and Selector Racks in Background.



R 478 Fig. 11. One of the Boards for Supervision of the Service.



R 480 Fig. 12. The Power Plant.

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 construction		
Sweden:				
Stockholm, Norra Vasa	5,000	—	Jan. 1924	
» » »	5,000	—	Nov. 1925	250,000
» Jericho	—	20,000	—	
» Kungsholmen	—	15,000	—	
Gothenburg	—	12,000	—	110,000
Norway:				
Hamar	1,200	—	Aug. 1923	5,000
Kristiansund	1,500	300	Dec. 1923	5,000
Holland:				
Rotterdam, West	5,000	—	May 1923	
» North	4,000	—	March 1925	80,000
» Central	—	7,500	—	
France:				
Dieppe	800	—	Sept. 1924	1,500
Spain:				
San Sebastián	5,100	—		
Mira Cruz	110	—		
Pasajes	250	—	June 1926	26,000
Rentería	200	—		
Hernani	180	—		
Italy:				
Verona	1,000	—	April 1925	10,000
»	1,000	—	July 1926	
Brescia	—	3,000	—	5,000
Novara	—	2,000	—	5,000
Cremona	—	2,000	—	5,000
Mantova	—	1,000	—	5,000
Naples, Borsa	—	10,000	—	
» P. Nolana	—	2,000	—	60,000
» Amedeo	—	2,500	—	
Messina	—	2,000	—	10,000
Catania	—	4,000	—	10,000
Palermo	—	6,000	—	10,000
Vercelli	—	1,000	—	3,000
Poland:				
Cracow	—	5,000	—	60,000
Turkey:				
Angora	1,000	—	Aug. 1926	10,000
China:				
Shanghai, East	700	—	May 1924	50,000
» »	300	—	Sept. 1924	
Mexico:				
Mexico City, Colonia Roma	5,000	—	April 1926	60,000
South Africa:				
Johannesburg, Rosebank	400	—	Oct. 1924	1,000
» Parkview	400	—	Dec. 1924	
» »	100	—	—	1,000
» »	—	200	—	
Total	38,240	95,500	—	782,500

New Interlocking Plant for The Danish State Railways.

Signalbolaget — a subsidiary to L. M. Ericsson — have received an order through their agents in Copenhagen, Bonnesen & Danstrup, for the delivery and installation of an electric interlocking plant for the Bramminge station on the Danish government railways, this plant to be built according to the patented Ericsson system with both central and local setting of points.

The plant will be governed by one single interlocking machine, controlling 38 points, 1 skotch block, 4 incoming signals with distance signals, 3 incoming track signals and 7 outgoing signals. As indicated above, the points can be set either locally or from the interlocking machine, this latter being connected to clearing apparatus on the respective platforms for the clearing of tracks and signals.

Automatic Telephones in Russia.

The Governmental Low Tension Electrotechnical Trust in Sovjet Russia has signed a contract with the People's Postal and Telegraph Commissariat for the delivery of an automatic telephone exchange for the city of Rostoff, this exchange to be constructed according to the Ericsson system, with a capacity of 10,000 lines and with two satellites for 1000 lines each.

Rostoff is one of the principle commercial centres in South Russia, situated on the Black Sea at the mouth of the river Don. The local battery exchange with lamp calling signals and automatic double clearing lamp signals now in use in Rostoff was delivered and installed thirty years ago by our branch company, The Russian L. M. Ericsson Telephone Company, Ltd.

THE ERICSSON LOW FREQUENCY RADIO TRANSFORMER

Transformer, complete with case.

Transformer, with case removed.

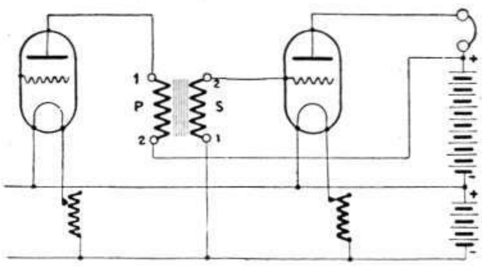
This transformer is of exactly the same construction as our well-known, reliable type with core of nonmagnetic annealed iron wire, bent over so as to completely enclose the wire coils. This method has proven very efficient for the purpose of protecting the transformer from the detrimental influences of neighbouring circuits.

The transformer is enclosed in a beautifully lacquerred 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 1:3.
»	**RM 2101.**	» 1:4.
»	**RM 2102.**	» 1:5.



TELEFONAKTIEBOLAGET L. M. ERICSSON
STOCKHOLM

L. M. Ericsson

THE ERICSSON WIRELESS HEADPHONES

R 101

We are now producing a special wireless model of headphone, combining **lightness** with **strength** and **durability,** with a simple adjustment allowing it to fit comfortably to any head.

The double pole watch receivers have cases of aluminium, and are flexibly held together by leather covered steel bands, all other metal parts being of nickel plated brass.

The headphone is supplied with a soft, flexible cord, a metre and a half long.

Total weight: 0,4 kgs.

We manufacture these Phones to the following resistances:

RF 1320. Resistance, **2000 ohms.** Code word: Repmakvoel.

RF 1321. Resistance, **4000 ohms.** Code word: Repmakvoig.

TELEFONAKTIEBOLAGET L. M. ERICSSON
STOCKHOLM

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VOL. 3 JULY—AUGUST 1926 Nos. 7 & 8

Anton Ryberg †.

Our staff abroad has recently suffered a severe and grievous loss in the death, after some months' illness, of Anton Ryberg, manager of our branch in Rio de Janeiro.

R 516 Anton Ryberg.

Mr. Ryberg, born February 20th 1884, became lieutenant in the Swedish Royal Engineers in 1908. This same year he transferred his activities to the Argentine and joined the staff of our subsidiary company in Buenos Aires in 1921.

When L. M. Ericsson decided to establish a branch in Brazil, Mr. Ryberg accepted the position of manager, and has conducted his duties in this capacity in a most capable and efficient manner up to the time of his recent decease.

Those who knew him will retain the memory of an unusually sympathetic and energetic personality, who furthered the interests of the firm most capably, working at times under very trying circumstances.

Mr. Ryberg leaves behind him a sorrowing wife and child.

ENGLISH EDITION

L. M. Ericsson

THE L. M. ERICSSON REVIEW

ENGLISH EDITION.

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The Toll Traffic Problem in Europe with Special Reference to the Organization of the Service

by A. Lignell, Director of Telephones, Stockholm, Sweden.

(Continued from previous issue.)

Measures for obtaining an efficient utilization of toll lines.

When striving towards an efficient utilization of the toll lines, the measures adopted should first of all be directed towards obtaining the shortest possible laps of time between the close of one conversation and the beginning of the next one. The length of this time, which is the time required for promoting calls, depends on several factors. In the first place, the mechanical arrangements should be of such character as to make the manipulations of the toll operator as simple as possible, a subject to which I will revert in a following article. The qualifications of the personel handling this traffic is a subject requiring the very closest attention, neglect in this respect causing the loss of time to result in serious economical losses. Here only the very best should be accepted.

The length of the time required for promoting calls is determined by two separate operations, viz: the placing of two subscribers in actual communication with each other — an operation which, in a manner of speaking, takes place outside of of the toll line — and the exchanging of the necessary service information between the operators. The first operation is by far the most tedious and troublesome of the two, and the possibility of making efficient use of a line, therefore, depends chiefly on what can be done to obtain quick connections between the subscribers and the toll line.

Instructions for service without telegraphic ordering should be planned so that both the above described operations coincide to the greatest possible extent, i. e. so that the sending out of a calling signal to an already notified subscriber and the checking up of the length of the previous call, together with communications with the other exchange concerning the same, be taken care of at the same time, i. e. immediately following the clearing signal, and that, as soon as the service communications have been given, the toll line be connected up with the subscriber's line, where the already called and waiting subscriber is informed that his call may proceed.

The work of bringing the subscribers in communication with each other consists in the notification of the two subscribers that their call is about to begin — this being done while the previous call is taking place —, the sending out of calling signals to the notified subscribers as soon as the previous call is terminated, and the notification of the called subscribers that the conversation may proceed, this being given as soon as the length of the previous call has been checked up and the necessary orders for a new call have been exchanged between the two operators.

To be able to utilize a circuit in a satisfactory manner, it is essential that these last three points be taken care of each one at a given time and as promptly as possible. The double calling signal used in Sweden for toll calls is an efficient aid in obtaining quick answers from the subscribers.

As already stated, the manner of handling the mutual arrangements with the subscriber for the connecting up of the call is of the utmost importance, since the average time required to get the subscriber on the line has a tendency to exceed the time required for the various communications between the operators. In Sweden, this fact has led to the abolishment of the telegraphic ordering of toll calls, this reform having been unaccompanied by any disadvantages. Besides obtaining just about as good a utilization of the lines, a saving of the various expenses connected with telegraphic ordering of calls has been effected. For the foreign traffic, however, the use of telegraphic ordering is amply justified, especially on account of linguistic difficulties as well as because of the difficulty in achieving the necessary ideal cooperation between the operators.

In case the order telegraph is used for the transmission of communications between the dispatching operators — thus keeping these communications off the speaking circuit —, the utilization of the toll line is almost entirely dependent on the time required to bring the two subscribers for the next call in touch with each other, counted from the clearing of the previous call.

The operator who *sends* a message by the order telegraph can usually choose the time for this purpose when she is not busy with her subscribers. At the receiving station, on the other hand, these messages are liable to arrive just while the operator at this end of the line is occupied with *her* subscribers, thus interrupting her work or causing the message to be misunderstood.

Consequently, if the telegraphic receiver consists of a sounder, it is impossible for an operator to receive such a message while occupied with her own subscribers, without serious detriment to her work. On the other hand, if she has a Morse receiver which prints the message on a tape, she can break off the reading of the message to take care of the momentarily more important local work, and when this is done return to the tape without having had to break off the receiving of the message. In addition, it is possible for an operator with a Morse receiver to handle all the telegraphic ordering for several connection routes. In Stockholm, for instance, there is one order telegraph operator for four circuits — two to Copenhagen and two to Oslo — and the arrangement with two telephone operators sharing one line of communication has never been accompanied by any disadvantages in this country. This is the reason why a sounder is never used in Sweden for receiving telegraphic orders, but special switchboards will be used for foreign service, with a Morse receiver mounted under the table top.

As it may be of interest to see to what extent toll lines with this kind of service are utilized for actual speaking time, with full traffic load and *without telegraphic ordering*, I will give an abstract from the results of the investigation covering mixed traffic with fully loaded circuits, held in 1924. Observations were taken on 101 of the longer lines, the number of operators under observation in Stockholm being 191.

The actual number of conversations during the time of observation amounted to 5398
the number of connections made amounting to 5766

This means that 368 connections, for some reason or other, did not result in conversations, i. e. these connections had no speaking time. If these calls had been completed, therefore, the actual speaking time would have been longer. The time for promoting each call or, in other words, the time which expires from the clearing of the line until the operators have the subscribers ready for the next call, had an average length of

30 seconds for Stockholm
38 » » other exchanges

the total average length of time from the beginning of one call to the beginning of the next being 45 seconds.

The average speaking time amounted to 48 min. 13 sec. and the number of promoted calls to 13.4, all per hour. Of the checked calls, 1691 or 31.3 % were previously ordered, i. e. either personal or to a certain telephone instrument.

The table here below shows the distribution of the obtained figures over the different months of the year.

	Actual speaking time per hour			Average time per hour for promoting calls not under investigation.	Number of	
	Maximum	Minimum	Average		hours under observation	promoted calls
Jan.	53'59"	40'49"	48'11"	1' 4"	37	499
Feb.	53' 2"	40'17"	47'56"	1' 3"	30	382
March	56'12"	43'19"	50'46"	1'53"	63	785
Apr.	53'50"	39'47"	47'50"	1'15"	42	568
May	52'26"	38'22"	48'20"	1'27"	45	599
June	52'45"	38'45"	47'32"	1'	23	310
July	52'42"	43'27"	47'44"	2'1"	24	325
Aug.	52'31"	40'12"	47'50"	44"	23	301
Sept.......	53'28"	36'54"	46' 6"	53"	32	455
Oct.	52'44"	40'31"	48'13"	53"	46	636
Nov.	54'40"	41'22"	48'40"	1'14"	34	483
Dec.	54' 9"	45'42"	49'30"	1'23"	32	423
Average and total			48'13"	1'17"	431	5766

During the minimum utilization in September, amounting to 36' 54", seventeen connections had been completed although not more than ten resulted in conversations, thus giving a low value for the length of the actual speaking time through no fault on the part of the operator.

An average of two circuits is handled by each operator, the orders for calls put in by the subscribers being received direct by the same operators who handle the service. A central order bureau has not yet been introduced, the subscribers being connected over a record junction board directly to the toll board, where they give their orders. On some more heavily loaded traffic routes the orders for outgoing calls are dispatched by two operators who also handle the toll service on one circuit each. In no case is one operator required to handle one toll circuit only.

For the purpose of reducing the waiting time for a subscriber's answer to a toll call, it will probably be necessary to adopt certain rulings in regard to firstly, an obligation on the part of the exchange, to repeat the calling signal in a suitable manner, and secondly, the placing of a limit on the time the exchange is required to wait for the subscriber's answer.

The above viewpoints have been taken into consideration in the proposed service regulations concerning the preliminary calling of subscribers, submitted in Dec. 1925 by the standing committee of the C. C. I.

The report of the committee on this subject is as follows:

The following rules and regulations are recommended for service on international lines:

1. A preliminary signal is given the subscriber by the operator immediately following the opening of the previous conversation. The subscribers are instructed in the following manner: »Be ready to talk to X (name of exchange), I'll call again».
2. It is desirable that the lines of the notified subscribers remain blocked.
3. The notified subscriber is given a signal immediately following the close of the previous call.

4. As a general rule, service information shall be exchanged between the operators during the time which expires between the giving of a calling signal and the answering of the subscriber. This information consists of
   a. checking up of the lengths of calls exceeding three minutes,
   b. ordering data for at least one new call.
5. Immediately following the exchanging of this information, the toll line is connected up with the local line of the already called subscriber, and the following statement is made over the open circuit (audible on the toll line as well as on the local line):
   »X on the wire» (name of called exch.), or »Y calling» (name of calling subscriber's exchange).
6. If the subscriber does not answer a preliminary call within one half minute, the operator will proceed with the promotion of the next call in the same direction.
7. Immediately following the beginning of this last mentioned conversation, a new preliminary call is made. If this call also remains unanswered during one half minute, the order is cancelled and the operator informs the other exchange: »Number X no answer».

With the use of a telegraphic order wire, all communications between the operators are exchanged telegraphically while the calls are taking place.

Devices for simplifying the work of the operators.

In order that the operator shall be able to perform her duties with the greatest possible speed, it is necessary that the switching devices be as simple and convenient as possible.

In consequence, each international circuit shall be fitted with two local cords with one two-way key, enabling the operator to connect up either of the cords to the international circuit by means of one single manipulation. Thus, while one international call is proceeding, the operator can connect up the subscriber for the next call with the other cord, so that when the first call is ended, she need only press the key over in the other position to connect up the already notified subscriber to the international circuit.

There must also be a speaking and ringing key for each local cord, enabling the operator to come in on the different connections.

In addition, each operator's position shall be equipped with two selective keys, one for the international circuit and one for the subscribers' lines, each key to have both speaking and ringing position.

These selective keys have the following function:

After the speaking and ringing key for the cord connected up with the international line has been pressed over in speaking position, the selective key for the subscribers' lines, in speaking or ringing position, will permit speech or the giving of a signal over the subscriber's line only. Likewise, it is possible for the operator to speak or give a signal over the international line only, by means of the selective key for the international line. The correct manipulation of these keys will give the following advantages for the utilization of the lines, viz:

a. Immediately following the previous call and after the operator has connected up the notified subscriber to the international line by means of the cord key and pressed the speaking and ringing key for this cord over in ringing position, the operator commences the exchange of service information with the other exchange, *simultaneously* giving the double calling signal for toll calls by means of the selective key for the subscribers' lines.
b. While waiting for the subscriber to answer, service communications concerning the next call are exchanged over the open line, i. e. the subscriber's line connected up with the international line. Should the subscriber answer meanwhile, the operator begs him to wait a moment and cuts him off from the international line by pressing the selective key for the international line over in speaking position.

We take it for granted that the junction lines between the toll exchange and the local exchanges are of sufficient number to permit the preliminary notification proceedings to be effectively carried out.

With the automatization of the local nets, the problem arises as to how the toll operator had best secure the subscriber's line for the toll call. This can be done either manually over a B position — in the usual manner —, or by equipping the toll positions with calling dials or, possibly, key sets, enabling the toll operator to secure the subscriber directly, in which case she must also be able to test the subscriber's line and eventually break a local connection.

By using a B board connected before the local multiple and arranged so that the local exchange facilities are cut out of the circuit either at the order position or, better still, by the toll operator — in which latter case it should be optional for the operator to block the subscriber's line or leave it open for local connections —, we obtain a number of advantages, for which reason we have retained manual setting up of toll calls in Sweden also at our automatic exchanges.

These advantages are:

1. The subscriber's line is secured outside of the automatic system, so to speak, thus making it unnecessary for the toll call to pass through the selectors and over their contacts.
2. The work of the toll operator — who must devote all her time to the handling of the toll line and for whom the moments are precious — is simplified, besides which the connection with the subscriber's line is more quickly obtained. If a calling dial is used, it takes the toll operator at least twelve seconds to dial a 6-digit number. Key sets take up a lot of room in a toll position, they are expensive, and they do not aid in reducing the long time required for obtaining a connection. By means of speaking and junction circuits the subscriber receives a signal in an average of 5 seconds, while with a dial or key set and 6-digit numbers the time can be estimated at 17 and 12 seconds respectively.
3. On condition that the international call is connected up with the local net over a special junction multiple, it is possible for the toll junction operator, at the request of the international operator, to break a domestic toll call in favour of a long distance foreign call which is more difficult to establish.
4. The toll junction board can serve as an information board for the toll traffic. Thus, by plugging up in the multiple of this board, the toll operator can obtain the following information without any undue loss of time:
   a. new number when a change has been made (this occurs often when subscribers' instruments are moved in large nets),
   b. cancelled and vacant numbers,
   c. numbers that for one cause or another are cut off from traffic,
   d. numbers that are cut off from toll traffic only,
   e. whether a number is occupied by another toll call or, eventually, by an international call.

In order to obtain efficient utilization of telephone lines it quite naturally is necessary, that simple and distinct service regulations be adopted for common use on the international lines. In this respect the C. C. I. has recommended that each operator handle one line only, that telegraphic ordering be used wherever technically possible and where the loading of the circuits makes it desirable, and that both cooperating operators work under similar conditions to the greatest possible extent. Regulations for telegraphic order service have already been worked out, the compilation of international service regulations now being contemplated.

It is my intention, in a following article, to touch on the training of toll service employees and on measures which will permit the public to derive the greatest possible benefit from the telephone service.

On Various Principles of Receiver and Loud-Speaker Design.

See page 92 for reference notes.

The telephone, or receiver — from a technical point of view — is understood to include every form of device whereby variations in electric currents or tensions can be reproduced acoustically. One special form of receiver is the loud-speaker, for reproducing sound at such strength as to be audible although the apparatus be placed at some distance from the ear. The early receivers with resonance chambers of wood constructed by Reis may be classified in this group. Later, loud-speakers were used almost exclusively for signalling purposes, their widespread popularity not having been attained until later years, when broadcasting had been successfully established. At the same time, more rigorous demands were made on the quality of tone reproduction for receivers as well as for loudspeakers. It is true that articulation also plays an important role in the field of telephony, but only in sofar as it influences the intelligibility of speech. With a radio receiving set, the purpose of the reproduction has not been fulfilled simply by the fact that we recognize the melody that is being played or sung; here, on account of the entertaining character of the program, the requirements include the acoustical qualities as well. Even though a certain acoustical coloration may make a favourable impression in rare cases, it must be admitted that, as a general rule, any deviation from the original sound is undesirable. The reproduced sound shall, as far as possible, be a true copy of the original sound.

The construction of a receiver and, in a still higher degree, of a loud-speaker which will fill these requirements has proved a difficult problem, probably the most difficult in the field of modern wireless telephony. However, inventive genius is always optimistic and quick to find new ways and means where the old have proved unsuccessful. Also, with respect to the receiver, there are a number of various principles of design to choose from. Most of these have been known for a long time, it is true, but only a few of them have as yet been more thoroughly developed. Many of these principles of design have recently been made the subject of further experimental research, but much still remains to be done before it can be said that their possibilities of development have been exhausted. It is the intention of this article to give a review of the known principles for telephone receivers, at the same time pointing out their respective advantages and disadvantages. Lack of space will not permit a more detailed analysis of special types, details of construction, etc.

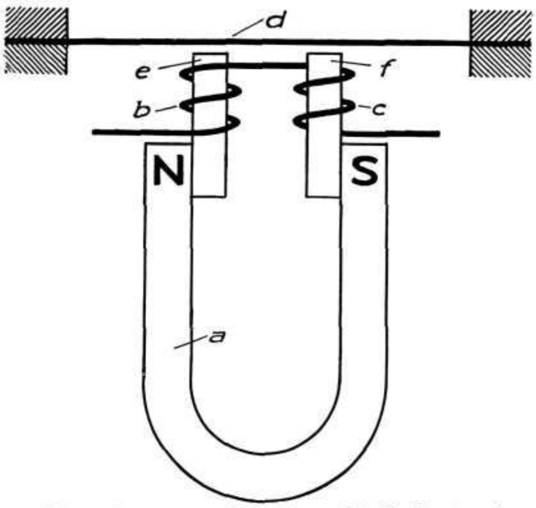
By far the most common fundamental type of receiver is the one with a sound producing diaphragm which, in some way or other, is made to vibrate by the action of a sound current, the *electromagnetic* receiver occupying a dominant position within this category. In principle an electromagnetic receiver consists of a winding for the speech current, a mobile member being located within its magnetic field and linked with the other parts of the magnetic circuit by means of one or more air gaps. The magnetic force of attraction which exists in the air gaps varies with the strength of the current passing through the winding, giving rise to vibrations of the mobile member, this latter being either in the form of a diaphragm or mechanically connected to such.

The force of attraction in the air gaps is proportional to the square of the strength of the magnetic field, this latter, again, varying practically in proportion to the strength of the speech current. Figured per unit area of the air gap, with a strength H of the magnetic field, the force of attraction F will be

$$F = \frac{H^2}{8\pi}.$$

If H were sine shaped ($h \sin \omega t$), which would occur if there were no other magnetic field in the air gap but that formed by the speech current, F would have double the frequency of H. This is readily explained by the fact that since the force does not depend on the direction of the field, an attraction of the mobile member must occur at each *half period* of the speech current. Mathematically expressed, the relation will be

$$F = \frac{h^2 \sin^2 \omega t}{8\pi} = \frac{h^2}{16\pi}(1 - \cos 2\omega t).$$



R 493 Fig. 1. Simple Magnetic Receiver of Bipolar Construction.

A receiver made in this way would not reproduce an impressed tone in its correct pitch, but one octave higher. In order to avoid this and make the variations in the force of attraction a true copy of those of the speech current, a strong, steady magnetic field, a *field of polarization,* is introduced, over which the weaker alternating field, produced by the speech current, superimposes itself. If the strength of the field of polarization is indicated by H_0, the total strength of the field will be

$$H = H_0 + h \sin \omega t$$

and the magnetic force of attraction

$$F = \frac{(H_0 + h \sin \omega t)^2}{8\pi}$$

$$= \frac{1}{8\pi}\left(H_0^2 + \frac{h^2}{2} + 2 H_0 h \sin \omega t - \frac{h^2}{2} \cos \omega t\right).$$

It is true that we have here the same h^2 terms as with the unpolarized receiver, but in addition thereto two new terms, the one constant and the other variable in exactly the same manner as the alternating magnetic field. Both increase with the strength of the steady field and can, therefore, be made to predominate completely with a sufficiently strong polarization. The second harmonic then becomes imperceptible by the side of the fundamental tone, the steady component of attraction simultaneously obtaining a constant value, which is not the case with the un-polarized receiver. Omitting the negligible quantities, we get the following expression for the magnetic force of attraction

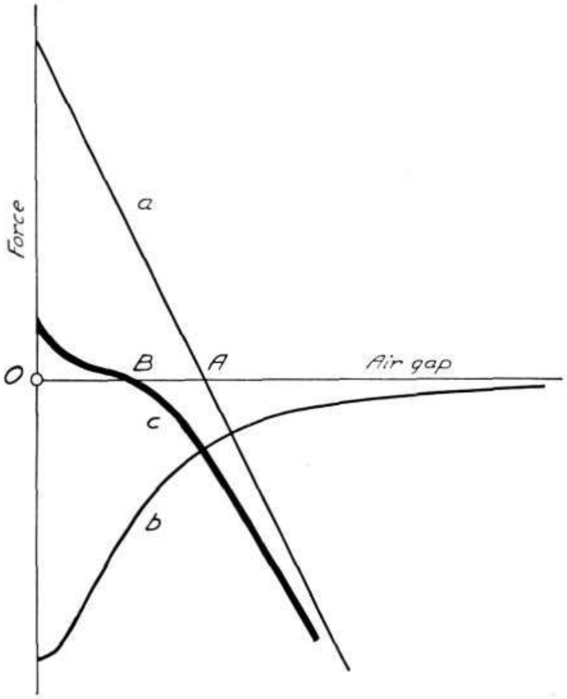
$$F = \frac{1}{8\pi}(H_0^2 + 2 H_0 h \sin \omega t).$$

The force component which varies with the speech current and which produces the sound vibrations is in direct proportion to the field of polarization — assuming other conditions to be constant. Thus, a strong field of polarization is desirable with regard to the strength as well as to the clearness of the sound. Naturally, it can not exceed a certain limit, ultimately determined by the reaction of the moving parts on the electric circuit.

The field of polarization is usually obtained by means of permanent magnets; electro-magnets are also sometimes used, however.

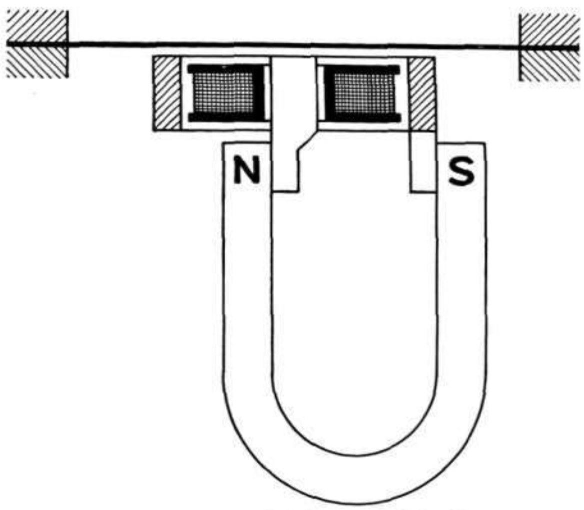
The electromagnetic receiver offers a greater variety in design than any other type; also, inventors and designers have been prone to devote themselves to its development. The most typical designs are shown in principle in figs. 1 to 19. Fig. 1 shows the simple magnetic receiver of bipolar construction used in ordinary telephone practice, consisting of a permanent magnet *a* with two coils *b* and *c*, and a diaphragm *d* of soft iron which functions as an armature. The windings are usually mounted on a pair of pole shoes *e* and *f*, attached to the poles of the magnet. These are also of soft iron and are often laminated[1] to lessen the eddy current losses.

The magnet is seldom laminated, as it can never be subject to as great eddy current losses as the pole shoes on account of the greater resistivity of magnet steel. In order to simplify their manufacture, however, magnets are often built up of several thinner layers[2].



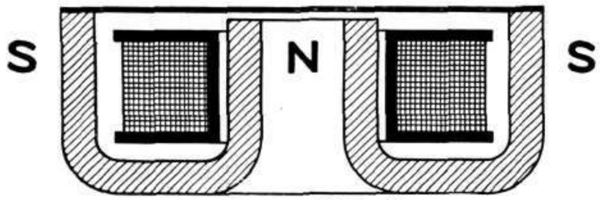
R 494 E Fig. 2. Stationary Forces Acting on Diaphragm in Various Positions.

The diaphragm is held in tension, under the influence of the steady field of polarization, in a definite position of equilibrium, about which the speech currents cause it to vibrate. The stationary forces which exert an influence on the diaphragm in its various positions are graphically shown in fig. 2. The point *A* indicates the position of repose of the diaphragm under the absence of any magnetic attraction, and the curve *a* the restoring elastic force which arises whenever the diaphragm is deflected to one side or the other out of its position of repose. The curve *b* indicates how the magnetic attraction varies with the width of the air gap. The resultant force which acts upon the diaphragm is represented by the curve *c*. The true position of equilibrium of the diaphragm is indicated by the point *B*, in which the elastic and the magnetic forces are equal and acting in opposite directions. As indicated by the diagram, the magnetic force of attraction acting on the diaphragm causes

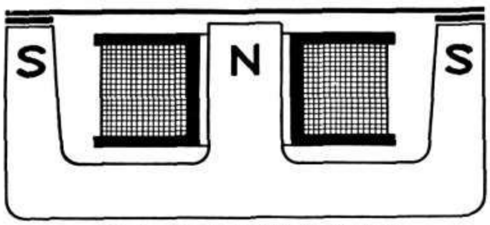


R 495 Fig. 3. Receiver with Concentric Pole Shoes.

its elasticity to be apparently diminished, resulting in a lowering of the resonance frequency. This latter, on the other hand, is influenced also by the surrounding air, being heightened by a thin air cushion[3] against the diaphragm. There are three possibilities with regard to the position of the resonance frequency in relation to the frequency range of speech, i. e. within, above or below, all three having been tried out. In wire telephony it is usual to place the resonance within the speech range, this condition being also often encountered in loud-speakers. It is apparent, however, that in such cases the articulation cannot satisfy very stringent demands unless the diaphragm is not heavily damped. In this respect, the two remaining alternatives are more advantageous, although they also have certain weak points. With a very high resonance frequency, it is quite natural that the lower tones are noticeably suppressed; if the opposite condition prevails it will be the higher tones that are suppressed, in addition to which a series of overtones in the diaphragm will be within the speech range. It is possible to reduce the phenomena of resonance by making the diaphragm of an iron alloy with large internal friction losses[4] or by the use of special arrangements for damping the diaphragm[5], but only at the expense of the volume of the sound[6]. From the point of view of articulation a thin diaphragm is more satisfactory than a thick one[7] because with an equal amplitude its vibratory energy is



R 496 Fig. 4. Receiver with Pot Magnet.

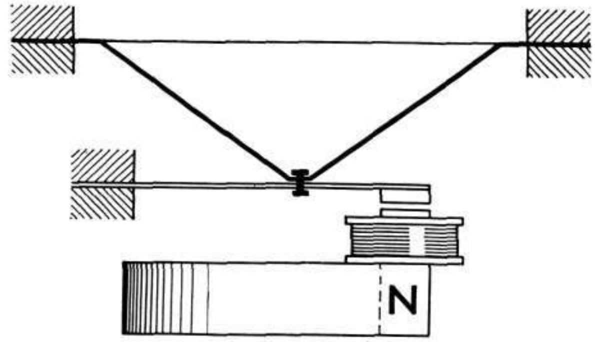


R 497 Fig. 5. Receiver with »E« Magnet.

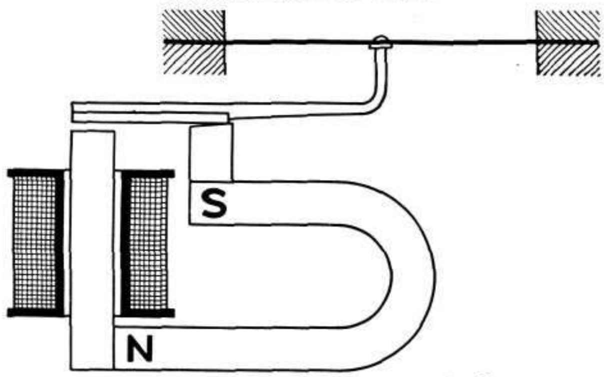
less, thus increasing its damping by the reaction of the air. On the other hand, to be able to use a strong field of polarization — which, as already mentioned, is very desirable —, it is necessary that the diaphragm be rather thick, partly to avoid its becoming magnetically saturated, and partly so as to give it the necessary elasticity. The problem is to strike a happy medium between these opposing requirements[8].

Figs. 3, 4 and 5 show three familiar modifications of the ordinary magnetic receiver, a common feature being that only one coil is required and that the attracting force is symmetrical in its action on the diaphragm. The arrangement in fig. 3[9] provides for two air gaps, the others for only one, the passage through the diaphragm of the lines of force, on the other hand, being so much the longer. The pot magnet in fig. 4[10] offers manufacturing difficulties and its magnetization is less stable than that of a more elongated shape. These two weaknesses have led to the construction shown in fig. 5, i. e. with an E-shaped magnet[11]. An intermediate ring of soft iron is used to spread the magnetic field from the outer poles around the edge of the diaphragm.

A better and more rational way of meeting these opposing demands as to the thickness of the diaphragm arising in connection with the above mentioned simple receiver design is to distribute its various functions among different mechanical elements. Thus, it is possible to use a special armature[12] in conjunction with a very thin diaphragm, the material of this latter being then absolutely a matter of choice. The required elasticity can be obtained by means of

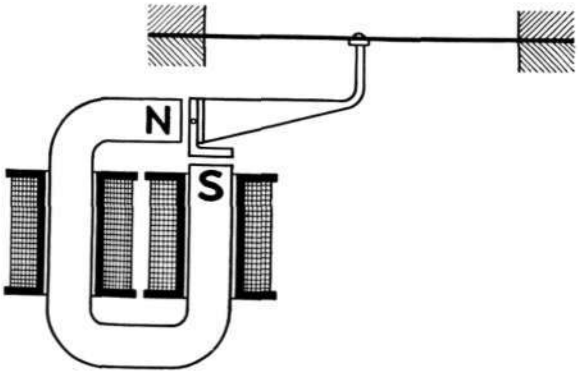


R 498 Fig. 6. Receiver with Special Armature Attached to an Elastic Tongue.



R 499 Fig. 7. Receiver with Lever Arrangement for Transferring Vibrations to Diaphragm.

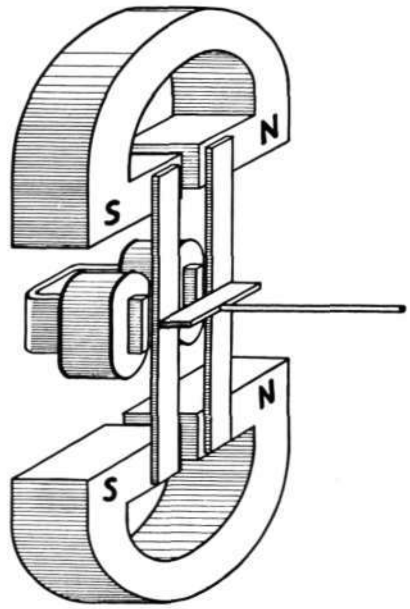
some suitable stretching method for the diaphragm[13] or by the aid of a light spring. The last-mentioned case offers the added advantage of securing a piston-like movement[14] whereby the whole of the surface is able to exert an equal pressure on the surrounding air. For this purpose, the diaphragm should be as stiff as possible in the direction of the movement, being yielding only at its periphery. A simple and frequently used method of obtaining a both light and stiff diaphragm is to make it conical or cupped[15] and of very thin sheet aluminium, about 0.05 m/m in thickness, a receiver of this type being shown in fig. 6. The force which is exerted on the armature by the diaphragm depends on the location of the fixing point on the spring. Thus, by choosing this point judiciously one can apply this load to the best advantage. This same principle has formed the basis of a number of patented receiver designs[16] with more or less efficient lever arrangements, two of which are shown in figs. 7[17] and 8[18]. The mechanical deve-



R 500 Fig. 8. Receiver with Lever Arrangement for Transferring Vibrations to Diaphragm.

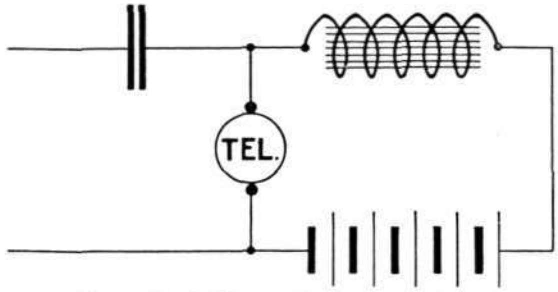
lopment of the magnetic circuit can naturally vary considerably[19] without abandoning the principle of the simple magnetic receiver. In opposition to the previously mentioned designs, we find that in the one shown in fig. 9[20] it is the mobile system that is polarized. This consists of two parallel iron strips whose ends are joined together by means of two permanent magnets placed in such manner that opposite poles are formed at the centres of the strips. The coils are placed on a fixed, U-shaped core which serves as armature for the permanent magnetic field.

As already stated, it is possible to obtain magnetization by means of direct current[21] as well as with permanent magnets. If the magnetizing current is led through the same winding as the speech current, the battery may be connected up in series with the receiver — naturally provided that the external circuit transmits the direct current. An alternative to this is shown in fig. 10, where the battery is placed in a circuit to which the speech current is barred by means of a choke coil, the direct current being barred from the speaking circuit by means of a condenser. Should a special magnet winding be introduced, care must be taken that it shall not function as a short circuited secondary winding for the alternating field.



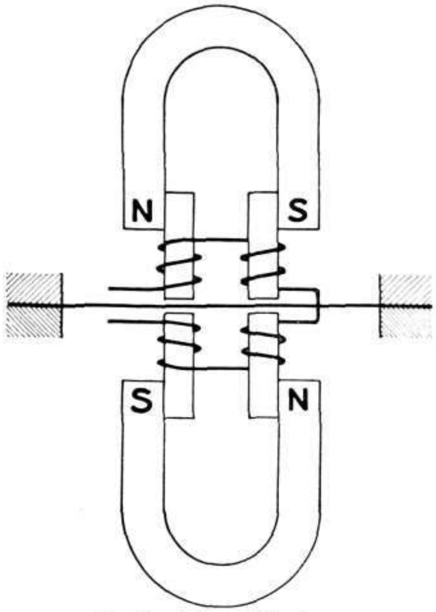
R 501 Fig. 9. Receiver with Polarized Mobile System.

The receivers shown in figs. 1 to 9 all function simply, i. e. the diaphragm or armature is influenced from one side only. This condition has a number of disadvantages. As already mentioned, the varying force component due to the speech current produces an overtone, which



R 502 Fig. 10. Circuit Diagram for Receiver Polarized by means of Direct Current.

appears whether the diaphragm is held fixed or permitted to vibrate, but can be reduced to a negligible quantity by means of a strong field of polarization. Much more disturbing is that series of harmonics, which arises during the vibration of the diaphragm, partly on account of the fact that the driving alternating force depends upon the momentary width of the air gap, and partly because the restoring force is not absolutely proportional to the displacement from



R 5C3 Fig. 11. Balanced Receiver.

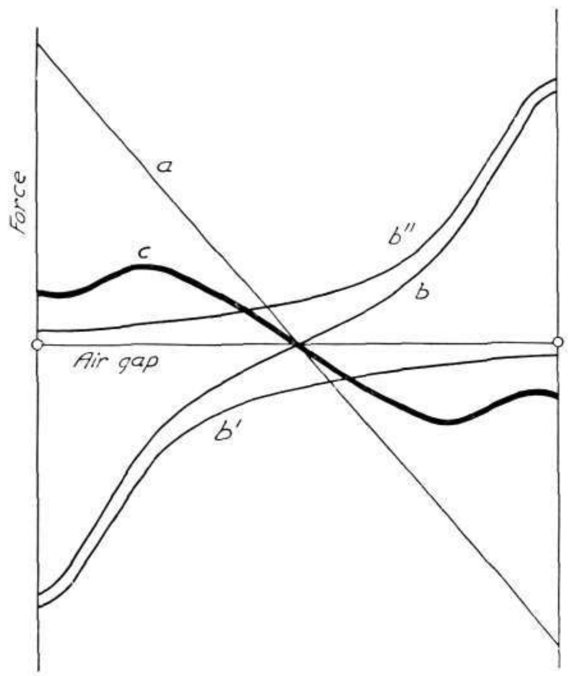
the position of equilibrium (see curve *c* in fig. 2). The greater the amplitude of the diaphragm vibrations, the more serious will the distortion be.

A decided improvement in these conditions can be secured by using a double-acting or balanced arrangement. The easiest way of realizing this idea is to place a magnet on each side of the diaphragm with opposing poles opposite each other, so that a strengthening of the field in the two air gaps on one side is accompanied by a corresponding weakening of the field on the other side (see fig. 11)[22]. With the same notations as previously used, the strength of the field on the sides of the diaphragm will be $H_0 + h \sin \omega t$ and $H_0 - h \sin \omega t$ respectively. The formula for the magnetic force of attraction per unit area then becomes

$$F = \frac{1}{8\pi}\left[(H_0 + h \sin \omega t)^2 - (H_0 - h \sin \omega t)^2\right]$$

$$= \frac{1}{2\pi} H_0 h \sin \omega t.$$

Here, both the steady component of force and the second harmonic have disappeared. This is applicable only when the diaphragm is exactly equidistant from both poles. Any deflection towards one side or the other will cause an increase in the attraction of the corresponding magnet, and therefore the equilibrium of the diaphragm becomes unstable unless it possesses sufficient elasticity to counteract the attraction of the magnet poles. The force curves for a balanced receiver are shown in fig. 12, corresponding to those shown in fig. 2 for a simple acting receiver. The curve *a* represents the elastic restoring force of the diaphragm, and the curves b' and b'' the attracting forces of the two magnets. The resultant of these two last is represented by *b* and the resultant restoring force acting on the diaphragm by the curve *c*.



R 504 E Fig. 12. Force Curves for Balanced Receiver.

A comparison of this graph with fig. 2 will show that the approximately straight lined range in the neighbourhood of the point of equilibrium is larger for the balanced receiver.

Among those harmonics — as already mentioned — which are caused by the vibrations of the diaphragm, those of the even order numbers are eliminated in balanced receivers. This notable condition is applicable to all balanced physical devices. If cause and effect, with reference to some certain device, are not exactly proportional, a simple harmonic causative quantity

$$A = A_1 \sin \omega t$$

will bring forth an effect which can be generally expressed by the formula

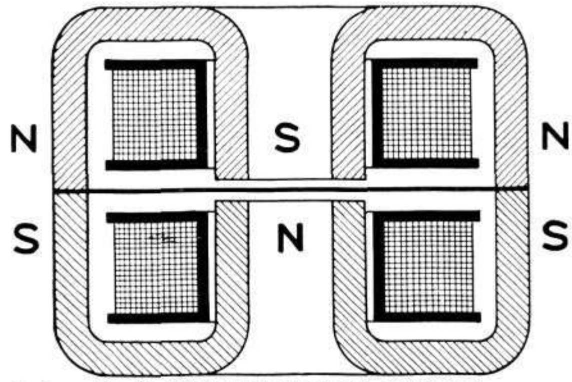
$$B = \sum B_\nu \sin (\nu \cdot \omega t + d_\nu),$$

in which ν is an arbitrary whole number, 1 for the fundamental tone and the respective order number for any certain harmonic. Assuming the device to be balanced, the following equation will hold on account of symmetry,

$$B\left(t + \frac{T}{2}\right) = - B \cdot t$$

in which T is the period for the fundamental tone. This means that for each value of ν

$$B_\nu \sin (\nu \cdot \omega t + d_\nu + \nu \pi) = - B_\nu \sin (\nu \cdot \omega t + \alpha_\nu).$$

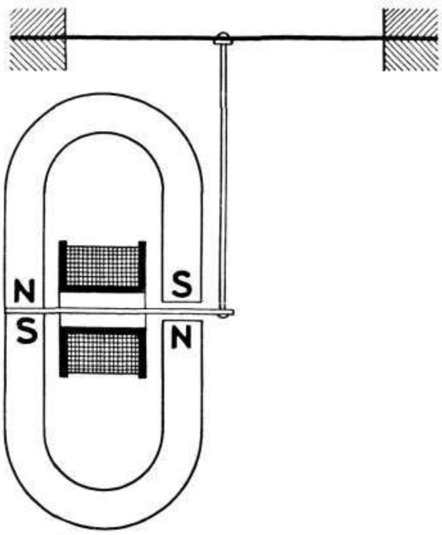


R 535 Fig. 13. Balanced Receiver with Pot Magnets.

This equation is identically satisfied for all odd values of ν, but for even values it holds good only in the case when $B_\nu = 0$; thus the even harmonics are eliminated.

Still another advantage possessed by the balanced receiver in fig. 11 is that the field of polarization passes principally straight through the diaphragm. Only an insignificant quantity of the same passes in alternate directions along the diaphragm and between the poles of the magnet, mingling itself with the relatively weak alternating field from the speech current. Thus, it is apparent that there is no danger of magnetic saturation of the diaphragm caused by the use of a strong field of polarization.

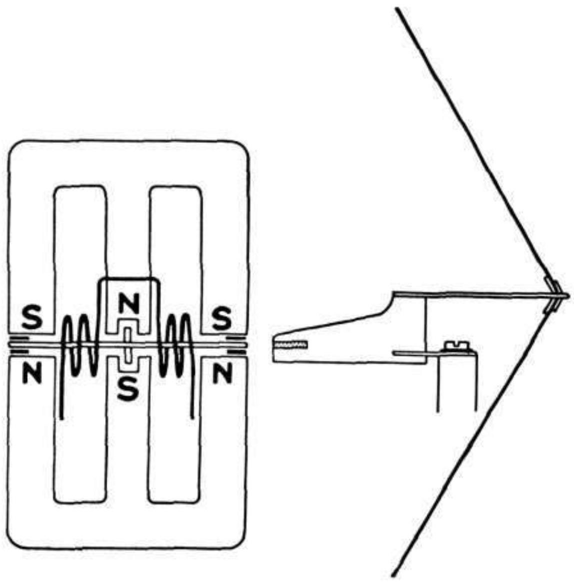
Since, quite naturally, it is necessary that the magnets be given a central location as compared with the diaphragm, the sound duct for this type must be located near its edges[23]. This has an unfavourable effect on the higher tones, especially if the diaphragm is large, a disadvantage which, however, can be counteracted by leading converging sound ducts out from several points on the diaphragm.



R 506 Fig. 14. Balanced Receiver with Armature in Form of Tongue.

Other similarly balanced magnetic systems are shown in figs. 13, 14 and 15[24]. The first (fig. 13) is a concentric modification of the one shown in fig. 11, with two pot magnets of opposite polarization placed one on each side of the diaphragm. Naturally the advantages and disadvantages mentioned in connection with the simple pot magnet occur here also. The centre hole of the pot magnet here serves the purpose of a sound duct.

The construction shown in fig. 14 is derived from the foregoing by replacing the diaphragm with an iron tongue rigidly fixed at one end — the other end being mechanically connected to a separate diaphragm — and by placing the entire winding around this tongue. This gives us the following advantages: only one coil, simpler and sturdier magnets, lighter vibrating parts, absolute freedom in the choice of a suitable arrangement of the diaphragm and in the adaptation of the diaphragm load.

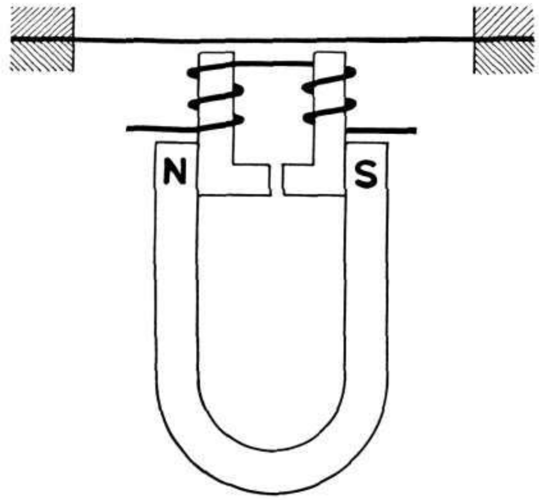


R 507 Fig. 15. Balanced Receiver with »E» Magnets.

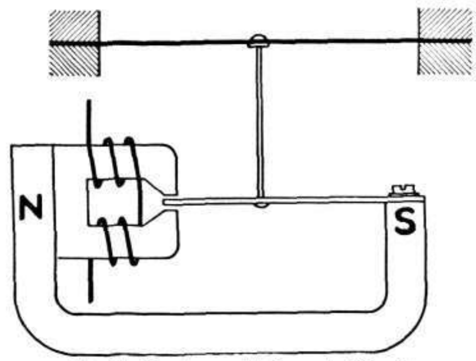
The magnet system illustrated in fig. 15[25] is in principle but a twin form of the previous with a special transfer lever arrangement.

In the various magnet systems hitherto described, the permanent magnets form a part of the magnetic circuit of the alternating field. However, since they are subject to high magnetic resistance and considerable hysteresis losses, efforts are being made to lead the alternating field in a path where the magnetic properties are more favourable. In the ordinary, simple-acting receiver this is achieved — to a certain extent, at least — by the aid of an air gap acting as shunt for the magnet[26] (see fig. 16). Naturally, this leads away a large part of the permanent field, for which reason it is necessary to make the magnet correspondingly stronger. This is comparatively easy with loud-speakers, but in telephone receivers the size is limited by the weight of the magnet. With a given magnet the width of the air gap is a matter of compromise.

Another way of avoiding an alternating magnetic field through the magnet and to obtain, at the same time, a balanced magnet system, is shown by the arrangement in fig. 17[27]. One of the poles of a permanent magnet is equipped with a pole-shoe with two arms bent towards each other, between which a flexible iron tongue, fixed to the other pole of the magnet, can move freely.

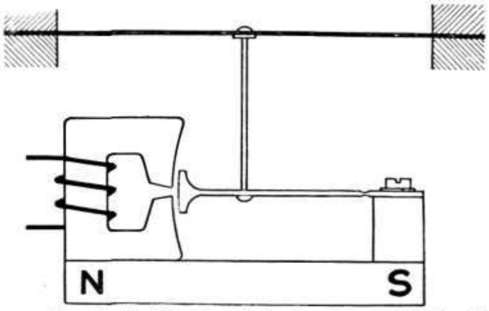


R 508 Fig. 16. Receiver with Magnetic Shunt.

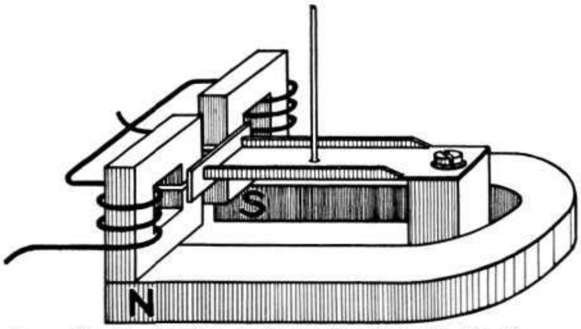


R 509 Fig. 17. Receiver with Separate Circuits for the Polarized and Alternating Fields.

The vibrations of the tongue are transferred to the diaphragm by means of a rod. The coils for the speaking current are placed around both arms of the pole-shoe, and turned so that the resulting alternating field passes around through the pole-shoe, across the air gaps and through the iron tongue. While the polarized field passes in opposite directions across the air gaps on both sides of the tongue, the alternating field crosses both in the same direction, thus establishing a differential effect in the same manner as with the balanced magnetic systems previously described. Fig. 18[28] shows a somewhat modified construction, the purpose of which is to give the tongue ample freedom of movement in spite of a very small air gap, and to permit the constant magnetic attraction to be applied in a direction parallel with the tongue instead of at right angles to it. A drawback possessed by both these last-mentioned magnetic systems is that the polarized field is forced to pass along the moving tongue. Since this last must be made quite thin so as not to give the moving parts too great a moment of inertia, the flux of the



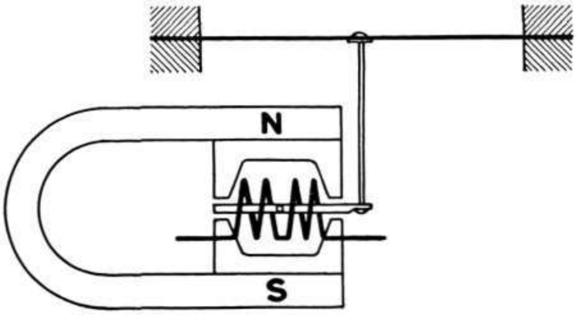
R 510 Fig. 18. Modification of Receiver Shown in Fig. 17.



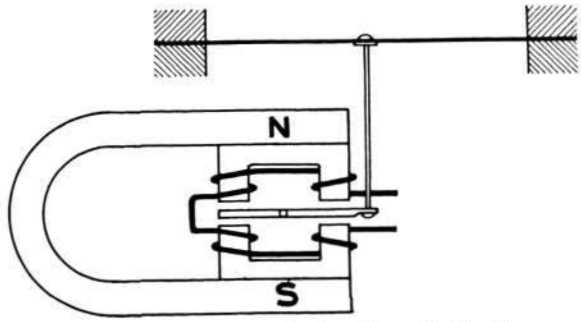
R 511 Fig. 19 Receiver, Similar to One Shown in Fig. 18, but with no Magnetic Circuit through Tongue.

polarized field will be limited. A somewhat more favourable magnetic system — similar to the one in fig. 18 — is shown in fig. 19[29]. In this case the entire tongue is not included in the magnetic circuit, but only an armature fixed to its free end. This arrangement permits the tongue to be made very light, although it must possess sufficient stiffness to transfer the vibrations to the diaphragm. In view of the direction of the magnetic attraction, the fixing point does not have to possess any great amount of elasticity.

The magnetic system shown in fig. 20[30] — which, probably, is one of the most satisfactory designs for electromagnetic receivers — is still more favourable as regards the passage of the field of polarization through the armature. Here, both



R 512 Fig. 20 Balanced Receiver with Pivoted Armature.



R 513 Fig. 21. Modification of Receiver Shown in Fig. 20.

magnet poles are furnished with two-armed pole-shoes turned towards each other, one on each side of an armature pivoted about its centre point. In similarity with the balanced receiver in fig. 11, the field of polarization passes mainly right through the armature. The coils are usually placed around the armature as shown in fig. 20, but can also be located on the pole-shoes (see fig. 21). By using a suitable supporting spring for the armature it is possible to lessen the distance between the curves representing the elastic force and the magnetic attraction[31] (compare fig. 12), giving the diaphragm a low natural frequency and making the resultant restoring force within a large area proportional to the displacement of the armature from the position of equilibrium.

It has already been stated that a field of polarization is required to prevent the variations of the magnetic force of attraction in electromagnetic receivers to rise one octave higher than those of the speech current. For the sake of completeness, however, it should be stated that another method has been tried for obtaining the same result, i. e. the one shown in fig. 22[32]. This arrangement consists of a balanced receiver similar to the one shown in fig. 11, but with unpolarized cores for both of the electro-magnets, which are connected in parallel, each one in series with a rectifier. These last are turned so that the current is admitted to the electromagnet on one side during one half-period and to the opposite one during the other half-period, resulting in a fundamental frequency for the diaphragm equal to that of the speech current. However, since the relation between the force of attraction and the speech current is not linear, the curves for the vibrations of the diaphragm are distorted, a very pronounced third harmonic being especially noticeable.

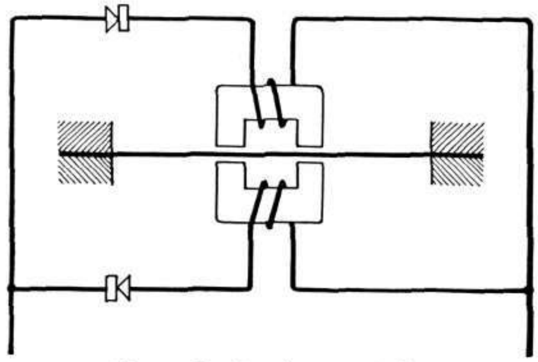


Fig. 22. Rectifier Arrangement, for Replacing Polarization.

(To be continued.)

Reference Notes.

1 Swedish patent 31 496. Compare Sw. pat. 56 391 and German. pat. 379 109, 380 329, 397 759.
2 Concerning most favourable proportions for magnetic system, see Germ. pat. 321 778, French pat. 571 381 and 589 792, U. S. A. pat. 1 273 351.
3 Germ. pat. 377 920, U. S. A. pat. 1 402 546.
4 Stalloy plate, for instance.
5 Germ. pat. 422 994, Fr. pat. 587 943.
6 Other ways of avoiding strong resonance described in Germ. pat. 217 435, 409 953, 410 304.
7 Sw. pat. 34 151.
8 Wietlisbach: Handbuch der Telephonie, Vienna and Leipzig 1910, p. 16.
9 Sw. pat. 25 466 and 31 496, Fr. pat. 595 119. Compare Germ. pat. 10 854 and 8 522.
10 Germ. pat. 2 363. Comp. U. S. A. pat. 1 036 805.
11 Germ. pat. 164 759, U. S. A. pat. 998 161. Comp. Sw. pat. 2 939, Germ. pat. 262 053.
12 Sw. pat. 18 482 and 30 486, Germ. pat. 422 581.
13 Sw. pat. 29 825, Germ. pat. 281 804 and 421 276.
14 Sw. pat. 34 151, Germ. pat. 263 071, Fr. pat. 587 627.
15 Sw. pat. 29 295, British pat. 160 244, Fr. pat. 382 260. Comp. Sw. pat. 29 591, Br. pat. 192 404.
16 Germ. pat. 325 489, U. S. A. pat. 954 931, 1 124 401 and 1 140 366.
17 Sw. pat. 33 330, U. S. A. pat. 1 030 550. Comp. Sw. pat. 396.
18 Germ. pat. 353 756.
19 Germ. pat. 2 355, 11 477, 24 263 and 35 995, Fr. pat. 564 285.
20 Used in a loud-speaker from Tefag (Telephon-Fabrik A. G.).
21 Sw. pat. 31 033 and 58 419, Germ. pat. 116 391, U. S. A. pat. 1 027 494 and 1 421 015.
22 Sw. pat. 42 425, Fr. pat. 575 494. See also *Hanna:* Design of Telephone Receivers for Loud-speaking Purposes; Proceedings of the Institute of Radio Engineers, vol. 13, p. 437.
23 See aforementioned paper by Hanna.
24 Comp. Germ. pat. 2 355, 50 313 and 207 989, U. S. A. pat. 1 034 200.
25 Fr. pat. 597 037. Used in a loud-speaker from Crosley.
26 Germ. pat. 301 391, 317 779 and 342 138, Fr. pat. 583 504 and 588 290, Br. pat 116 201. See also ETZ 1922, p. 269. Comp. Fr. pat. 556 729.
27 Comp. Sw. pat. 28 533.
28 U. S. A. pat. 1 318 535.
29 U. S. A. pat. 1 318 535. Comp. U. S. A. pat 905 781.
30 Sw. pat. 28 533, Germ. pat. 217 541, U. S. A. pat. 957 403 and 1 153 593.
31 Norw pat. 41 988.
32 Germ. pat. 373 450.

Literature on the theory of the electromagnetic receiver:
Wietlisbach: Handbuch der Telephonie, 2d edition, Vienna and Leipzig 1910.
Poincaré: Études du récepteur téléphonique; L'éclairage électrique 1907, vol. 50, nos. 7, 8, 10 and 11.
Breisig: Theoretische Telegraphie, 2d edition, Brunswick 1924.
Hahnemann and *Hecht:* Der mechanisch-akustische Aufbau eines Telephons; Annalen der Physik, 1919, vol. 60, p. 454.
Hahnemann and *Hecht:* Eine Theorie des Telephons; Annalen der Physik, 1920, vol. 63, p. 57.
Kennelly: Electrical Vibration Instruments, New York 1923.

Description of the New Ericsson Automatic Exchanges in San Sebastián and Vicinity.

The prefatory description of the above mentioned exchanges contained in the previous issue of this journal will now be followed by an article of more technical character, devoted to a detailed description of the system and its manner of functioning.

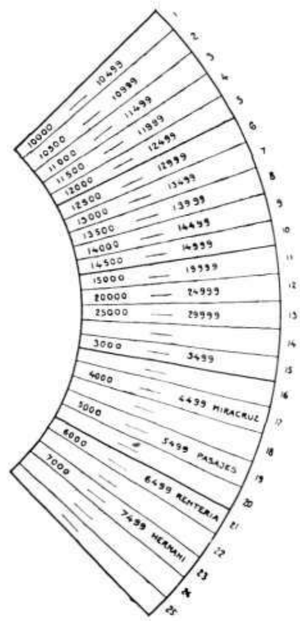
As already mentioned in the article referred to above, the complete plant comprises a central automatic exchange for the city of San Sebastián (La Red Telefónica Urbana) and another automatic exchange for the city's environs (La Red Telefónica Provincial). The traffic over this last exchange is distributed among four other smaller exchanges, viz: Miracruz, Pasajes, Rentería and Hernani. The entire plant is designed for a capacity of 26,000 lines, 20,500 being for »La Red Urbana», 3500 for »La Red Provincial», with 2000 for future extension.

For »La Red Urbana», or the municipal net, the initial capacity is 5000 lines, while for the provincial net it is 2000, i. e. 500 lines for each of the above mentioned four exchanges.

The plant is also equipped with a toll board and a record board — this last for traffic from the automatic exchanges to previously existing provincial manual exchanges — as well as a transfer board for handling the traffic between the provincial manual exchanges, and another board for traffic from these manual exchanges to automatic subscribers in the city as well as in the suburbs.

The most interesting feature of this plant is that it has been built on the satellite principle, i. e. the four suburban exchanges Miracruz, Pasajes, Rentería and Hernani are satellites to a central exchange over which all subscribers on the satellite nets are connected to each other as well as to city subscribers, and vice versa. Like city subscribers they are also able to obtain toll service, give telephonic instructions for the sending of telegrams, and place their orders for calls to manual provincial exchanges, these last mentioned calls being then distributed over the key set at the automatic provincial exchange to the various groups of automatic subscribers.

In this case, the satellite principle means that these exchanges are equipped with line finders and connectors only, the group selectors being concentrated at the central exchange, where they co-operate directly with the group selectors of the municipal exchange.



R 519 Fig. 1.

The junction lines in the multiples of the first group selectors at the provincial and municipal exchanges are grouped and distributed as shown in fig. 1, which represents a cross section of the twenty-five multiple frames of the group selector *1 GS* (see figs. 2 & 3).

Each such frame contains twenty junction lines terminating in connectors *C* (see figs. 2 & 3) with a capacity of 500 lines each.

Thus, multiple frames numbered 1 to 10 contain junction lines to connectors representing ten five hundreds groups in the city net, making a total of 5000 lines numbered from 10000 to 14999.

Multiple frame no. 15 contains lines to a connector for a *PBX* group (see fig. 3). This group contains 500 lines for the ordering of toll calls and calls to manual rural exchanges, and for telephoning in telegraphic messages. At present not more than 160 of these lines — representing the present needs of the traffic — are connected up. This group is numbered from 3000 to 3499.

Multiple frames nos. 17 to 23 contain junction lines to the connectors at the satellite exchanges. The subscribers' lines which terminate in these connectors are numbered as follows, viz: Miracruz 4000 to 4499; Pasajes 5000 to 5499; Rentería 6000 to 6499, and Hernani 7000 to 7499, making a total of 2000 lines, frames no. 19, 20 and 21 being reserved for future extension of Pasajes, Rentería and Hernani respectively to a capacity of 1000 lines each.

Thus, all city subscribers have 5-digit numbers while all the provincial subscribers and *PBX*-lines have 4-digit numbers.

Frames no. 11, 12 and 13 are also reserved, each one for a group of 5000 connecting lines which are to terminate in second group selectors *2 GS* for the municipal net (indicated in fig. 3 with dotted lines). The frames of these second group selectors, in turn, will contain connecting lines terminating in connectors *C*. Consequently, frames no. 11, 12 and 13 represent a total of 15,000 lines for future extension of the net.

Of the twenty-five multiple frames of the first group selectors, nos. 14, 16, 24 and 25 still remain for further extension and represent the reserve of 2000 lines mentioned in the beginning of this article.

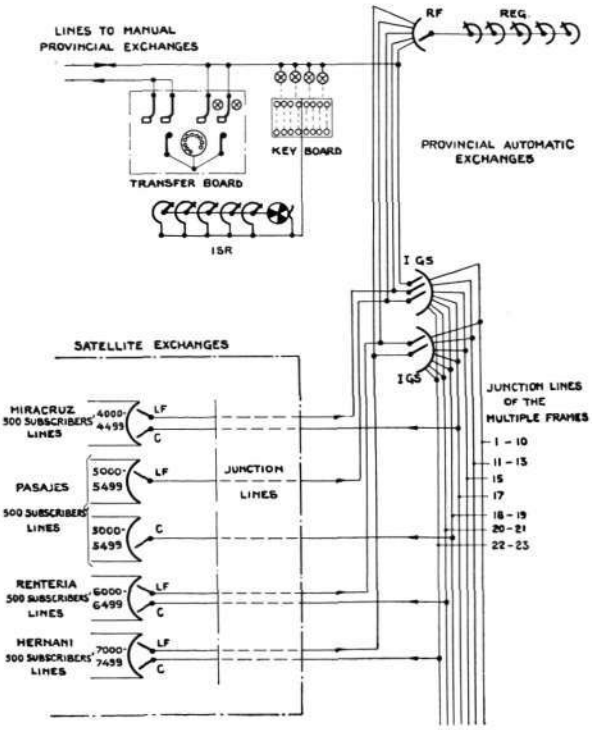
We will now turn our attention to figures 2 and 3, both together representing a schematic diagram for the entire plant. Fig. 2 covers the automatic provincial net with the four satellite exchanges Miracruz, Pasajes, Rentería and Hernani, together with their common central exchange in San Sebastián and arrangements for connecting up calls to manual provincial exchanges. In reality, the provincial record board for handling calls from automatic to manual provincial subscribers is also located here, although it is shown at the bottom of fig. 3. in order to facilitate the description of the switching process. Fig. 3 covers the automatic municipal exchange with provisions for toll service and for receiving telephonic orders for outgoing telegrams.

The continuity of the connecting lines between the first group selectors *1 GS* of both nets is plainly shown. These group selectors are connected in parallel so that the twenty connecting lines in the first multiple frame of each group selector are connected to the connectors in the five hundreds group 10000 to 10499, the lines in the second multiple frame to the five hundreds group 10500 to 10999, and so on (see fig. 1). The numbering of the multiple frames, according to fig. 1, and of the connecting lines is indicated to the right in fig. 2, the arrows showing the direction of the traffic.

Thus, according to figs. 2 and 3, it is apparent that the subscribers in the municipal net can be connected up with each other as well as with those in the provincial net, similar facilities being obtainable by subscribers in the last mentioned group.

The local exchange, here called the municipal automatic exchange (see fig. 3), has been built on practically the same principle as the exchanges previously delivered by L. M. Ericsson for Rotterdam West and Rotterdam North, and which have already been described in this journal.

The initial capacity of this exchange, amounting to 5000 lines, requires 10 racks for each of the following switching devices, viz: line finders, group selectors and connectors, together with the necessary sequence switch racks. The line finder and group selector racks can accomodate sixty switches each, only forty-eight being mounted in each rack for the present, however, as specified by the telephone administration. The connector racks have the same capacity but are mounted with only fifty-two switches each. The *PBX* group comprises one rack of each kind mounted with thirty switches each. In addition, there is one group selector rack mounted with thirty switches *SOTG* for the toll junction lines.



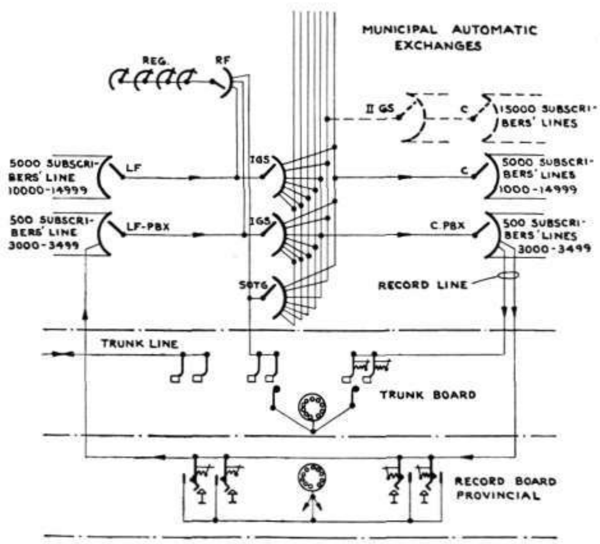
R 520 e

Fig 2.

The automatic satellite exchanges in Miracruz, Rentería and Hernani are housed in buildings specially built for this purpose, while the one in Pasajes is located in the same building as the post and telegraph offices (see illustrations in Nos. 5 & 6, Vol. III of this journal). The initial capacity of each of these exchanges is 500 lines with provisions for a possible increase to 1000 lines.

As already mentioned in our previous issue, the central exchange for the provincial net, here called the provincial automatic exchange, is housed in the same building as the municipal exchange in San Sebastián, this very favourable circumstance permitting a considerable saving in the cost of junction lines between the two exchanges.

According to the schematic diagram in fig. 2, the satellites are equipped with line finders *LF* and connectors *C* only, the necessary group selectors *1 GS* and register finders *RF* being located in the provincial exchange in San Sebastián. Further, these exchanges are equipped with main distributing frames, line testing apparatus, charging and ringing machinery, a tone producing machine, power switchboard and storage batteries, in the same manner as any other exchange. The line finder *LF* at the satellites and the first group selectors *1 GS* at the provincial exchange are directly inter-connected by means of 2-conductor junction lines. This, also, is the case with the connectors *C* at the satellites and the multiple frames in the group selector racks at the provincial and municipal exchanges.



R 521 e

Fig. 3.

In order to reduce the cost of installation the line finders *LF* and the connectors *C* — wherever traffic conditions permit — have been placed in the same racks, as shown in fig. 2 for Miracruz, Renteria and Hernani. At Pasajes, on the other hand, the plant has been designed to meet much heavier traffic conditions; consequently separate racks have been provided for these switching devices. The number of switches and junction lines required to meet subsequent increases in traffic is regulated by the telephone administration. In this connection it is to be observed that only a small fraction of the traffic remains within the respective satellite zones (see below).

Those switches which are common for all the exchanges, i. e. the register finders *RF* and registers *REG*, are located in the main exchange (the provincial exchange), thus considerably reducing their number as well as the cost of in stallation and upkeep. Another decided advantage afforded by this arrangement is that the traffic for all the satellites can be supervised at one and the same place. The inspection trips of the repair-men usually constitute an item of no small importance in the cost of maintenance; here, these trips are reduced to a minimum, chiefly for the charging of the batteries, etc.

The actual control of these exchanges takes place at the provincial exchange in San Sebastián, where constant supervision is provided for this purpose. The observation desk at this exchange is equipped with lamp signals for following the various switching operations and alarm devices for giving warning when a fault occurs. There is also a starting device for the switching motors, so that they do not have to be kept continuously running while the traffic is low — as during the night, for instance. This starting device, also, is controlled from the observation desk at the provincial exchange by the repair-man on duty.

Switching process for local calls at satellite exchanges. When a subscriber, belonging to one of the satellites — Hernani, for instance, with numbers running from 7000 to 7499 — desires to call another subscriber within the same net, and with say number 7339, a line finder *LF* at this exchange is connected up to his line in the usual manner as soon as he removes his microtelephone (see fig. 2). The dial tone then indicates that a disengaged register *REG* has been connected up over a register finder *RF* and that the dialling of the desired number may proceed.

The calling subscriber then dials the number in question, 7339. This is registered by a register at the provincial exchange, causing the group selector *1 GS*, to be set by its rotary movement to multiple frame no. 23 (see fig. 1), containing junction lines to the line group numbered from 7000 to 7499. The radial movement of this group selector then seeks out and connects up the first disengaged junction line to Hernani and corresponding connector *C* at this exchange. The same register then directs the rotary movement of the connector at Hernani to multiple frame no. 17, containing subscribers' lines numbered from 7320 to 7339, and thereafter the radial movement to the 20th line, where subscriber's line number 7339 is located.

Different buzzer tones are used to indicate whether a ringing signal has been sent out or if the called subscriber's line is busy. If the line is disengaged, the conversation takes place over the calling subscriber's lines and a line finder *LF* at Hernani, the corresponding junction line to a group selector *1 GS* at the provincial exchange, a line in multiple frame number 23 at this same exchange, back again over a corresponding junction line to a connector *C* at Hernani and over the 20th line of the 17th multiple frame, which is the called subscriber's line (see figs. 1 and 2). When the call is finished, the various switching devices are restored to normal in the customary manner.

As indicated in the foregoing, a local conversation between two subscribers belonging to the same satellite — both to and from the provincial exchange — takes places over two 2-conductor junction lines. This arrangement has given very satisfactory results, since it is only the speaking current that travels the entire distance. Current for the subscribers' transmitters is furnished by the exchange to which the subscriber belongs.

Switching process for calls between two satellite exchanges. The switching operations for calls between subscribers belonging to different satellite exchanges are similar to those just described for local calls. Let us assume that the calling subscriber in this case also belongs to the Hernani exchange, lines number 7000 to 7499, and wishes to call no. 4100 at Miracruz, where the lines are numbered from 4000 to 4499. The registering of the number and the setting of the switches takes place in exactly the same way as before, but now the register directs the group selector *1 GS* at the provincial exchange to multiple frame no. 17 containing junction lines to the line group numbered 4000 to 4499, (see figs. 1 & 2) where the radial movement of the group selectors *1 GS* seeks out and connects up the first disengaged junction line to Miracruz with the corresponding connector at that exchange, this connector now being set to the first line in the sixth multiple frame.

Thus, calls belonging to this category are connected up over the line finder *LF* at the home exchange, group selector *1 GS* at the provincial exchange, and the connector *C* at the exchange of the called subscriber. In this case, the junction lines are of the same number and length as if the exchanges were not built on the satellite principle.

Switching process for calls between the provincial and municipal exchanges. The switching operations for calls between the provincial and municipal nets are similar to those already describer, with the exception that here the group selector *1 GS* is directed to one of the multiple frames numbered 1 to 10, whose junction lines terminate in connectors at the municipal exchange. After one of these connectors has been set to the desired subscriber's line by the same register which actuates the group selector, either a calling or busy tone is given in the same manner as previously described.

Thus, the connection is completed over the line finder *LF* and the group selector *1 GS* at the provincial exchange, the connector *C* being located at the municipal exchange.

For calls in the opposite direction, i. e. from the municipal to the provincial exchanges, the line finder *LF* is connected up to the line of the calling subscriber, after which the corresponding group selector is actuated by means of a register at the municipal exchange. After the group selector har been set to a multiple frame containing junction lines which terminate in a connector at one of the satellite exchanges, the setting of this connector is directed by the same register. Such a call is then connected up over a line finder *LF* and group selector *1 GS* at the municipal exchange, and over a connector *C* located at one of the satellite exchanges.

For such calls also, we find that the junction lines are of the same number and length as for exchanges not built on the satellite principle.

From the above it is apparent that the only argument which can be sustained against the satellite principle is the cost of the extra junction lines between the satellite exchanges and their main exchange required for local calls.

However, since this principle is adopted only in such cases where but a small fraction of the total traffic remains within the local net — the main portion going to other exchanges —, only a small number of such lines need be reserved for the local traffic.

On the other hand, this increase in junction lines is only apparent, since all direct lines from one exchange to all the others are eliminated, the entire traffic from a satellite exchange being carried over only one exchange, i. e. the provincial exchange.

The important advantages gained by the concentration of those switching devices which are common for all connections, i. e. registers and register finders, constitute an additional important saving in the first cost as well as in the maintenance of the plant.

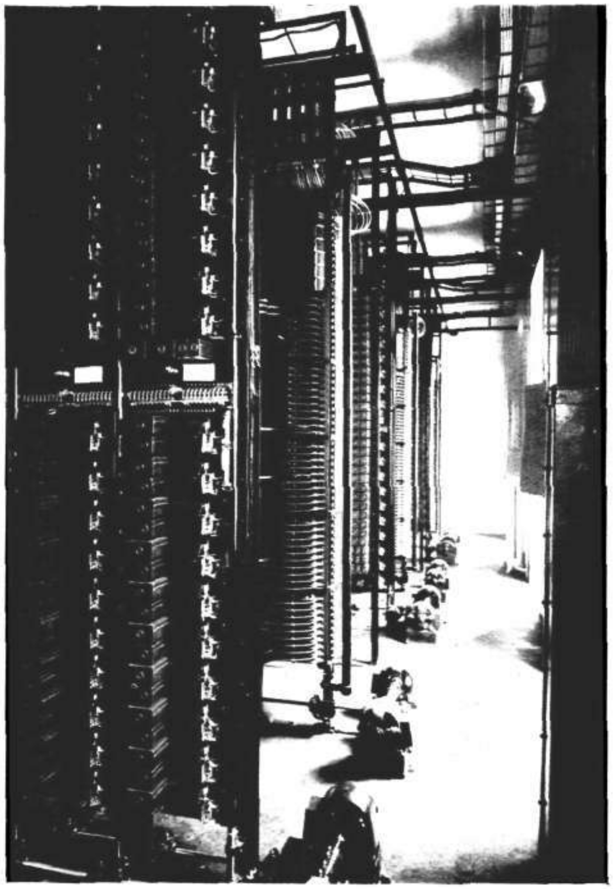
Switching process for toll calls and calls to manual provincial exchanges. Orders for such calls are placed over the connectors *C* of the *PBX* group at the municipal exchange, where a number of outgoing lines — numbered from 3000 to 3499 — from the multiple frames terminate in call-indicators and jacks in the toll board and in the provincial record board.

Toll calls. The diagram in fig. 3 shows schematically how the order wires to the right enter the toll board. The record lines from the jacks in the centre are connected to special switches *SOTG*.

The toll lines terminate in jacks to the left, under which are shown answering and ringing plugs with calling dials.

The operator answers the toll order call in the same way as an ordinary call. After the clearing of the toll line, the automatic subscriber is given a ringing signal by means of the calling dial after the ringing plug has been introduced into the record jack. Since the corresponding answering plug has already been introduced into the toll jack, the speaking connection is now completed.

Calls from automatic subscribers to the manual provincial exchanges. The calling subscriber is connected up with the provincial record board over the *PBX* group at the municipal exchange (see fig. 3). The depressing of the key restores the fallen indicator and connects up the receiver and transmitter of the operator. After the order has been



R 522 Fig. 4.

noted down, the operator can give the automatic subscriber necessary information over the line finder *LF* in the *PBX* group. It is only necessary for her to depress a key and call the

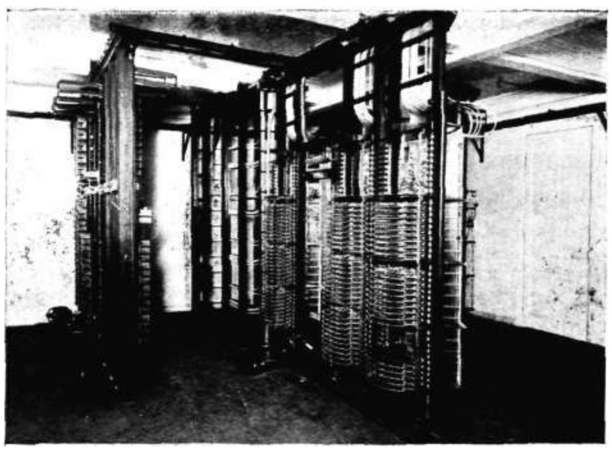
R 523 Fig. 5.

subscriber in the usual manner by means of a calling dial.

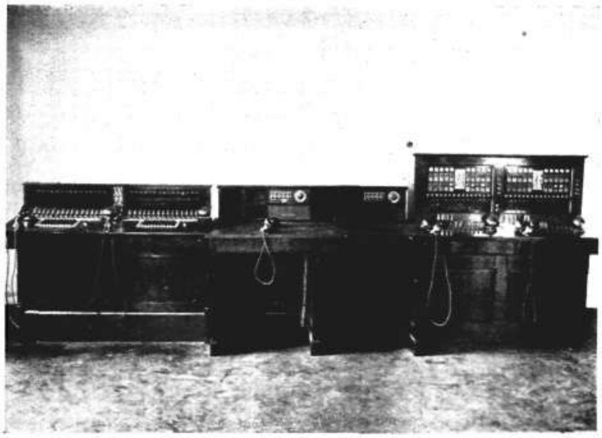
At the provincial exchange (fig. 2) the ordered calls are then promoted by means of a key board with impulse transmitter *IT*, the key set on this board enabling the operator to give quicker service than with calling dials. The lines to the manual rural exchanges are connected in parallel in the key and transfer boards, lamp signals being provided to indicate whether the line is occupied in one or the other of these boards.

The transfer board receives orders for calls to the manual provincial exchanges and handles the traffic between these exchanges.

By way of illustration, some views from the exchanges mentioned in this article are here reproduced.



R 524 Fig. 6.

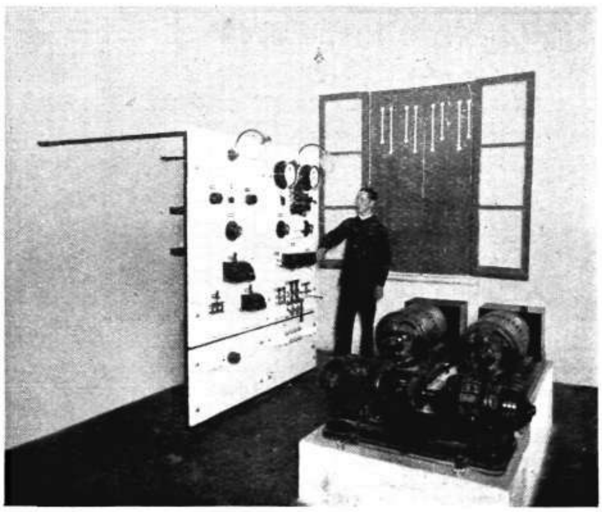


R 525 Fig. 7.

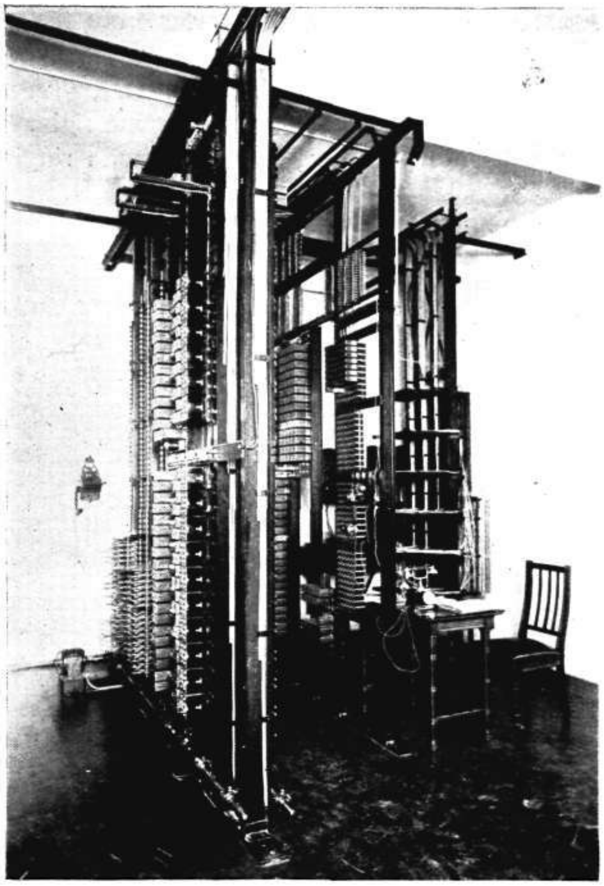
Fig. 4 shows the rows of racks with switching motors at the provincial exchange. In the foreground we see a sequence switch rack with register finders, the following ones containing selectors and line relays which, together with the registers (not visible in the illustr.), include all the necessary switching devices for 1500 subscribers. Local conditions have determined the size of the group, which is repeated until the required capacity has been reached.

Fig. 5 shows a general view of the power plant, containing ringing machines and machines for producing the dial tone (in the immediate foreground), and two motor-generators for charging the two storage batteries, these latter having a capacity of 2600 amp. hours each, with a tension of 24 volts. The charging current has a strength of 400 ampères. To the extreme right may be seen a part of the power distribution board.

In case of emergency, one of the ringing machines is equipped with a motor (for a 24-volt direct current) which is automatically connected up with the storage battery when the outside feed current is cut off. To guard against a like emergency, one of the charging generators is connected up directly to a 45 h. p. internal combustion motor.



R 527 Fig 9.



R 526 Fig. 8.

The central (provincial) exchange for the satellites is shown in fig. 6, the first row of racks containing the sequence switches for the group selectors *1 GS* — these latter being visible in the second row of racks. The register finders

RF for the registers are mounted in a third row of racks, not visible in the illustration.

The various switchboards for the provincial net are located in the room adjoining the main provincial exchange. These are shown in fig. 7, with the key board to the left, the record board in the center, and the transfer board for the manual provincial exchanges to the right.

Figs. 8 and 9 together give a complete general view of the equipment for a satellite exchange all mounted in one room with the exception of the storage batteries.

In fig. 8, the first row of racks from the left contains line finders and connectors, the next one line relays and subscribers' meters, with the cross-connecting frame to the extreme right.

Fig. 9 shows the power plant, with ringing and tone producing machines, battery charging machines and power board.

This is the first automatic plant built by L. M. Ericsson according to the satellite principle. We have already pointed out the advantages to be gained by adopting this principle in similar cases, one of the most important being a considerable reduction in the first cost as well as in the maintenance of the plant. Also, since the telephone administration in San Sebastián has declared the functioning of this system to be an unqualified success, we are amply justified in regarding the adaptation of this principle with satisfaction and do not hesitate to recommend the same for plants operating under similar conditions.

D. L.

R 60 The Ericsson handset suits all conditions and types of people.

See also page 4 of »General Notes» accompanying this number.

Stockholm 1926. Kurt Lindberg, Boktryckeriaktiebolag.

General Notes

Ericsson Automatic Exchanges. A contract has recently been signed between the Governmental Low Tension Electrotechnical Trust of the Soviet Union and the Commissariat of Posts and Telegraphs for the delivery of *four automatic telephone exchanges according to the Ericsson system for the city of Moscow*, capital of the Soviet Union. Each of these exchanges will have an ultimate capacity of 10,000 lines, making a total of 40,000 lines. The initial capacity will be 35,000 lines, distributed as follows: 10,000 each for two of the exchanges, with 7000 and 8000 respectively for the remaining two. The exchanges are to co-operate with the existing manual exchanges, delivered by L. M. Ericsson to The Swedish-Danish-Russian Telephone Co., owners — from 1902 to 1917 — of a concession for the operation of the Moscow telephone net. This manual exchange is built with automatic distribution of incoming calls and with a maximum capacity in its multiple of 60,000 subscribers' lines, about 40,000 of which are connected up at the present time. The junction traffic from the automatic exchanges to the manual exchange will be handled automatically by the aid of connectors, while the traffic in the opposite direction will pass over semi-automatic B positions equipped with key sets.

The realization of this program — together with the building of the Ericsson automatic exchange ordered for the city of Rostoff, mentioned in the previous issue of this journal — constitutes the neuclus of the vast program laid out by the Commissariat of Posts and Telegraphs for the modernization and expansion of telephone communications within the Soviet Union. The report of the Commissary of Posts and Telegraphs — an excerpt of which was published in the September number of »P. O. The Telegraph and Telephone Journal» — gives a fair idea of the extent of this program.

This excerpt reads in part as follows:

»There is a colossal demand for telephones. Telephonic communication is the most profitable branch of our work, but it is still in a very ruinous state. Telephones have not been renewed in the towns for ten years, and all the exchanges are of the old system. *Our new construction will be on the most modern automatic system.*»*

According to the cited report, on April 1, 1926 the U. S. S. R. had 171,000 telephones, and in the course of the next three years all the »volosts» or parishes of this vast country should be provided with telephonic communication.

—o—

During July, the *second thousand* lines with which the capacity of the *Verona automatic exchange* has been increased, were opened for traffic. Verona is situated in the second Italian concession zone in which the net is operated by a coalition consisting of a number of Italian operating companies, the automatic exchange in this city being delivered by L. M. Ericsson. As already mentioned in a previous issue [Vol. I., (1924), nos 1 & 2, page 23], L. M. Ericsson received an order in December 1923 for the delivery and erection of a new net as well as of an automatic exchange, with an ultimate capacity of 10,000 lines. The exchange was built for an initial capacity of 1,000 lines, to which extent it was opened for traffic in April 1925.

This initial capacity was based on the existing number of subscribers' lines at the time the order was placed, as well as on earlier experience with regard to the normal growth of the net, allowances being made for a certain additional increase which was expected to accompany the erection of a modern and up-to-date telephone plant. These expectations have been amply justified by the results obtained, since it has been found necessary to double the capacity of the exchange already during the course of the first year, giving ample proof that the plant is functioning in a most satisfactory manner.

—o—

The first automatic exchange in *Mexico* — Colonia Roma, in Mexico City — was opened for traffic in April of this year. The completion of this exchange constitutes the first step towards the automatization of the telephone net so successfully operated since 1904 by Empresa de Teléfonos Ericsson, S. A., with the L. M. Ericsson Telephone Company of Stockholm as main shareholder. Historical and statistical data concerning the operation as well as the present size of the net may be found on p. 28 of Nos. 3 & 4, Vol. III. (1926) of The L. M. E. Review.

The automatization is planned for an ultimate capacity of 60,000 lines (the subscribers at present numbering about 20,000) and the Colonia Roma exchange will form a complete unit within the projected system. This exchange has en ultimate capacity of 10,000 lines, its present capacity being 3000, with junction lines for traffic to and from the existing manual exchanges. More than 1000 lines are already connected up, and equipment is now being installed which will bring the capacity of the exchange up to 5000 lines. More detailed information as to the junction traffic may be found on p. 16 of Nos 1 & 2, Vol. I. (1924) of the L. M. Ericsson Review.

Private Automatic Exchanges. This number (see page 6) contains a table of the Ericsson types of private automatic exchanges, working and under construction. A single glance at this table will show how quickly the widespread popularity of these types of private exchanges has been attained. The system was completely worked out already in 1920, but was first adapted for domestic use while investigations were being carried on to ascertain what special requirements would have to be met for use in foreign countries. By the end of 1922, foreign deliveries also were an accomplished fact, and the table shows with what rapidity these deliveries increased, especially after the introduction of the intermediate types OL 20/40 (1925) and OL 100 (1923). The increasing demand for these types of exchanges has necessitated their manufacture being taken up by some of L. M. Ericsson's telephone factories abroad; in Colombes, near Paris, France, and in Vienna, for instance. In addition, L. M. Ericsson has come to an agreement with Hasler A. G. in Bern, Switzerland, for the assembly of private automatic exchanges of the Ericsson system,

* Italics by the Editor.

using parts of either their own or L. M. Ericsson's manufacture. Deliveries made by these factories — either of their own make or containing parts obtained from Stockholm — have not been included in the above-mentioned list. These figures will be published during the early part of next year together with a quarterly report covering deliveries made by the Stockholm works. Consequently, the Stockholm factory alone has delivered or received orders for 175 exchanges with a total of 7294 lines. Of this number 120 exchanges — with a total of 4645 lines — have been for export, these figures amounting to 70 % and 65 % respectively of the grand total.

Toll Exchanges. In conjunction with the approaching reorganization of European international telephone traffic, the Budapest toll exchange will be considerably enlarged and modernized by the middle of the coming year. This important work has been entrusted to two of the three existing telephone manufacturing concerns in Hungary, as practically all of the necessary equipment will be of Hungarian manufacture. As a result, the Ericsson works in Budapest have received an order for all of the new switchboard equipment with a total of 152 positions.

Wireless An exhibition of radio material — arranged by the Society of Swedish Radio Interests — was held in Stockholm between the 18th and 26th of September, L. M. Ericsson participating with an attractive stand.

The opening festivities began with a music number by the Radio Orchestra, after which Hemming Johansson, director in the Ericsson concern and president of the Society, held an introductory speech in which he extended greetings to those present as well as to all radio listeners throughout the land, also touching on the object and activities of the Society. The next number on the program was a discourse on the subject of »Wireless Telephony and its Possibilities as a Means of Communication», held by Secretary of Communications E. Lyberg, who thereafter proclaimed the exhibition officially opened.

R 515

The exhibition was very well attended, Ericsson's crystal receiver — the construction of which was demonstrated in detail — proving to be one of the most interesting exhibits.

A letter, received from Jakobstad in Finland and displayed at the exhibition, aroused an unusual amount of interest. According to the same, most remarkable results have been attained with the above mentioned crystal receiver, a listener in Jakobstad having been able to hear the Berlin broadcasting station — a distance of about 1300 kms. — without the use of any amplifying apparatus whatsoever.

In addition to the above receiving sets, wire, cables and various radio accessories, together with head receivers from the Ericsson works in Stockholm, valve sets and loud-speakers from the Ericsson branch concerns in London and Paris were featured.

—o—

Technical Communications from the Swedish Royal Telegraph Administration, 1926, number 3, contains a paper by Mr. Siffer Lemoine, engineer in chief for the Gov't Radio Bureau for land stations, on the *»Development of the Swedish Broadcasting Movement during 1925»*. The author mentions the fact that broadcasting in this country dates back to the early part of 1923, but was not definitely organized until January 1925. Consequently, this last mentioned year should be regarded as the first during which broadcasting was seriously taken up. Since then, the movement has developed rapidly, and we offer our readers some interesting facts borrowed from the above mentioned paper.

On January 1, 1925, there were three government broadcasting stations operating in Sweden — in Stockholm, Gothenburg and Malmoe. They had a common anode power of 1 kilowatt, the antenna input being 600 watts. Additional stations in Sundsvall, Boden and Karlsborg were put in operation during the year, and the Stockholm station moved to new and better quarters, its anod power being simultaneously increased to 1.8 kilowatts and its antenna input to 1.2 kilowatts. In a report to the government, however, the Telegraph Administration made it clear that these six stations did not meet the demands of the country. Consequently the Telegraph Administration arranged with various radio clubs and societies for the opening during this year of fifteen private stations with varying anode input — from 250 and 400 watts down to 25. Three more such stations are planned for, thus greatly increasing the serviceableness of the *crystal receiver.* The radio programs are distributed to these various stations over wires furnished free of cost by the Telegraph Administration.

The paper contains a diagram and detailed description illustrating the method of distributing the broadcasting programs, a map of Sweden indicating the location of the various stations and a number of illustrations showing views from the Stockholm and Gothenburg stations.

With regard to the number of radio licenses issued during 1925 the author states that for budget purposes an advance estimate of 60,000 was made, this number being actually more than doubled. On Dec. 31, 1925 the number of issued licenses amounted to 125,591. The article contains a graph indicating the number of licenses issued during 1924 and 1925, according to which the number at the end of 1924 was about 40,000. During both of these years we find a more marked increase during the first four months, the licenses sold up to the 1st of May constituting 75 % of the total for each year. During 1924 the remaining 25 % were pretty evenly distributed over the remainder of the year. During 1925, on the other hand, we find that after the 1st of September the increase is more marked than during the summer months.

Under such circumstances, it was but natural that the financial position of the Swedish broadcasting enterprise should be exceptionally good. Consequently the Telegraph Administration submitted a proposal to the Swedish Government requesting permission to erect a new broadcasting station with an antenna input of 20 to 30 kilowatts, permitting the use of crystal receivers at a distance of from 200 to 300 kilometres.

In »Technical Communications from the Swedish Royal Telegraph Administration», No. 5, 1926, Mr. Lemoine gives a detailed account of the principles of construction for this broadcasting station, which will be erected in Motala and have an antenna input of 30 kilowatts — as yet the most powerful station to be erected in Europe. If so desired, the effect can be increased to 45 kilowatts. This station is expected to be ready for use during 1927.

Railway Signal Equipment. On September 2nd of this year the electric interlocking plant at Haessleholm on the Swedish State Railways was completed and put in service.

This plant has been built by Signalbolaget, the interlocking machine, point setting machinery, etc. being furnished by L. M. Ericsson. Although the distance between the two most extreme switching points is about 1850 metres, there is but one interlocking machine, this latter being of a new type with electrical control only for its levers. This machine controls 58 signals, 52 points and 8 skotchblocks, all signals being arranged as day signals. The interlocking machine is connected up with track releasing apparatus mounted in a cabin on one of the platforms, from which the train dispatcher has complete control of all incoming and outgoing trains.

An illuminated track plan on which signals and insulated tracks are denoted, has been mounted in the signal cabin.

A detailed description of this plant will be published in a subsequent issue of the »Review».

Telephone Concessions. Already in 1910, the »General Telephone Company of Stockholm» — which operated extensive telephone nets in Stockholm and surrounding provinces as well as in a number of foreign countries — sought to obtain *a concession for operating a telephone net in Smyrna, Turkey.* Since the use of telephones was forbidden by the Turkish government at that time, however, these plans did not materialize.

In the beginning of 1924 a concession for the operation of a telephone net in Smyrna and adjoining cities and covering a period of thirty-five years was granted the municipal authorities in Smyrna by the Turkish government, after which a bid for tenders was sent out to all the larger telephone manufacturing concerns for the delivery of an automatic exchange, outdoor plant and telephone instruments.

In May of this year The L. M. Ericsson Telephone Company was successful in obtaining the contract in the face of very keen competition, Siemens & Halske, of Berlin, being one of the closest bidders. In addition to the order for the delivery and installation of complete equipment for the planned automatic exchange, as well as for the building of the net, this contract gave L. M. Ericsson executive as well as technical control of the Turkish company now being formed for the purpose of operating this net.

According to the agreement, a majority of the joint capital of this company — amounting to 400,000 Turkish pounds — will remain in the hands of the Municipality and The L. M. Ericsson Telephone Company during the entire term of validity of the concession. This agreement is signed by the prefect of Smyrna — on the part of the Municipality — and approved by the City Council through the Governor General of the District of Smyrna as well as by the Angora government.

The contract embraces a first stage of erection for 2000 subscribers' lines, including exchanges, underground conduit lines for the main cables, cables for aerial distribution lines, pole distribution cabinets and boxes, poles, line hardware and telephone instruments, figured at a total cost exceeding 1 million Swedish crowns.

According to the agreement, L. M. Ericsson has been assured deliveries for future extensions.

Literature. *»Los Sistemas Modernos de Telefonia Automática»* (Modern Automatic Telephone Systems) by Ignacio M:a Echaide 1926.

The contents of this fifty-two page illustrated booklet printed in Spanish constitute a lecture held by Ignacio M:a Echaide, engineer and manager of the provincial net of Guipúzcoa, Spain, before the Asociación de Ingenieros Industriales (Associacion of Industrial Engineers) of Bilbao on May 14 of this year, the large and interested audience consisting mainly of technical experts in various lines, chiefly within the field of telephony.

Mr. E. opens his discourse by going back to the origin and development of the automatic telephone, touching on the solution of various problems connected with the same. This is followed by a description of automatic devices and the principles according to which they function, illustrated by a number of simple diagrams.

Mr. E. then goes on to describe some typical systems now in use, such as Strowger's, ATEA's relay system, Western's and Ericsson's, their principles of construction and methods of functioning, illustrated by schematic diagrams for the various systems.

The automatic telephone exchange built for the Provincial Government of Guipúzcoa (La Diputación de Guipúzcoa) has been *constructed according to the Ericsson system.*

The author finishes with a discourse on the future possibilities of automatic telephony and on the lines which should be followed to insure its future development and success.

»La Telefonia Automática en Guipúzcoa. Al Alcance de Todos», (The Automatic Telephone Exchange in Guipúzcoa; a Popular Description), by Ignacio M:a Echaide, 1925. Published by La Diputación de Guipúzcoa.

This publication is a thirty-two page booklet printed in Spanish and illustrated with a number of interesting views and diagrams. The description covers the automatic exchanges erected by L. M. Ericsson for the Provincial government of Guipúzcoa and the Municipality of San Sebastián in Spain.

Both of the above publications by Mr. Echaide are most interesting and we take pleasure in recommending them to our readers.

—o—

— »Small and Medium-Sized Taxicab Telephone Exchanges» is the name of a paper to be found in No. 1, 1926, of »Technical Communications» issued by the Swedish Telegraph Administration. The author is Helge Ericsson, telephone engineer in the government service.

No. 10, 1923 of this same journal contained a technical description — also by Mr. Ericsson — of the various arrangements now in use in Stockholm for the ordering of taxicabs by telephone. By kind permission of the Telegraph Administration, a very interesting description of this exchange was printed in Nos. 11 & 12, Vol. I (1924) of »The L. M. Ericsson Review». This plant is of comparatively recent date, being specially adapted to existing conditions in Stockholm and consequently entirely up-to-date.

The above paper by Mr. Ericsson can be said to be a continuation of the first one and contains a description of what has been achieved by the Telegraph Administration with regard to the construction of taxicab telephone exchanges for small and medium sized towns, thus completing the subject. The author voices the opinion that in cities of metropolitan dimensions it may be necessary to resort to de-centralization by adopting a system with district exchanges. The article also states that the equipment has been designed for use with either a local battery or common battery system, the possibility of adapting the same to an automatic system also having been taken into consideration.

Taxicab Exchanges. An order for a *taxicab telephone exchange for Milano* has been received by L. M. Ericsson from the operating company in the first zone in Italy, »Societa Telefonica Interregionale Piemontese e Lombarda» (Stipel) through the good offices of our Italian subsidiary, Societá Ericsson Italiana in Genoa. This exchange will be built on practically the same principle as the Stockholm exchange. The first delivery will include three rows of switchboards with six positions in each row, making a total of eighteen positions. The number of order wires from the regular telephone exchanges will be sixty, this being also the number of cab ranks in the city. The ultimate capacity has been set at double this figure.

Another order for a similar exchange has been received through our representative in *New Zealand*, B. L. Donne. This exchange is to be erected in Wellington for a newly formed taxicab company which is to begin operations in this city.

»I can hear you perfectly well, my dear.
I can't think why you can't hear me.»

R 517 (With acknowledgements to »The Humorist».)

If Ericsson's handset were used such mistakes could not occur.

R 102

ELEVATED GENT TELEPHONING.

R 518

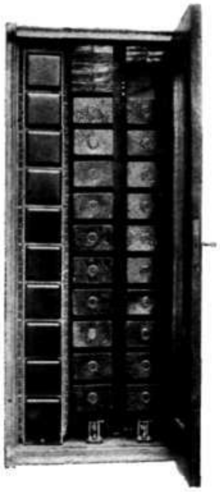
Elevated Gent: »Hullo!»
Voice from phone: »Hullo!»
Elevated Gent: »Hullo!»
Voice from phone: »Hullo!»
Elevated Gent (disgustedly): »*Curse* the echo!»

(By kind permission of »London Opinion»)

Table

of Ericsson Private Automatic Exchanges in Service and under Construction September 30, 1926.

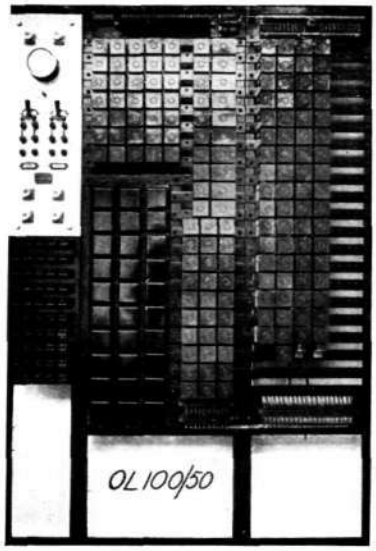
In service since	OL 20 and OL 20/40						OL 100						OL 500						Total number of			
	In Sweden		Abroad		Total		In Sweden		Abroad		Total		In Sweden		Abroad		Total					
	Number of		Number of		Number of		Number of		Number of		Number of		Number of		Number of		Number of		Exchanges		Lines	
	Exch's	Lines	Exch's	Lines	Exch's	Lines	Exch's	Lines	Exch's	Lines	Exch's	Lines	Exch's	Lines	Exch's	Lines	Exch's	Lines				
1920	1	24	—	—	1	24	—	—	—	—	—	—	2	120	1	50	3	170	4	—	194	—
1921	1	20	—	—	1	20	—	—	—	—	—	—	2	140	—	—	2	140	3	7	160	354
1922	—	—	5	100	5	100	—	—	—	—	—	—	2	100	2	60	4	160	9	16	260	614
1923	—	—	7	136	7	136	—	—	3	230	3	230	4	280	7	420	11	700	21	37	1066	1680
1924	3	60	10	200	13	260	3	150	4	225	7	375	5	370	7	430	12	800	32	69	1435	3115
1925	4	120	15	340	19	460	2	100	5	325	7	425	9	380	8	460	17	840	43	112	1725	4840
1926	7	200	22	504	29	704	3	175	4	175	7	350	2	200	3	240	5	440	41	153	1494	6334
Total	16	424	59	1280	75	1704	8	425	16	955	24	1380	26	1590	28	1660	54	3250	153	—	6334	—
Under constr'n	3	100	14	300	17	400		—	1	100	1	100	2	110	2	350	4	460	22	—	960	—



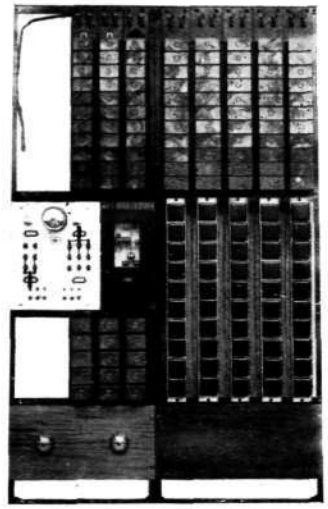
R 483 **OL 20.** Dim. 386×920 m/m

R 484 **DB 50**

R 491 **OL 20/40.** Dim. 500×2150 m/m



R 492 **OL 100/50.** Dim. 1241×1847 m/m
OL 100/100 Dim. 1797×1847 m/m



R 487
OL 500/50. Dim. 1330×2076 m/m
For each additional fifty lines, the width of the Switchboard is incr'd by 710 m/m.

R 485 a **DB 250**

R 486 a **DC 400**

Type DC 400 is used for lines over which a central exch'ge connection may be obtained.

R 490 a **Table Telephone Switch**

Table Telephone Switch for 12 central lines. Used when connections with the main exchange are desired.

R 488 **DE 100**

NOTE!

These switchboards may be connected up with main exchanges of any system. When requesting prices, etc., do not forget to state which inter-traffic facilities are desired.

R 489 a **DE 500**

Stockholm 1926. Kurt Lindberg, Boktryckeriaktiebolag.

Telefonaktiebolaget L. M. Ericsson

Döbelnsgatan 18
Stockholm

Please send me your offer for a private automatic exchange according to the following specifications:

1. Number of telephone instruments for first installation.
   Table sets:
   Wall sets:
   Total
2. Maximum number of telephones for which exchange is to be designed:
3. Required number of simultaneous calls:
4. The longest line will have a length of metres and will be of mms dia. {iron wire / bronze wire / cable}
5. Available current: Direct current volts
   Alternat. current: volts. phase, per's
6. Existing telephone system:
   number of lines:

19 .

Name:

Address:

Telefonaktiebolaget L. M. Ericsson

Döbelnsgatan 18
Stockholm

Please send me your offer for a private automatic exchange according to the following specifications:

1. Number of telephone instruments for first installation.
   Table sets:
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   Total
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3. Required number of simultaneous calls:
4. The longest line will have a length of metres and will be of mms dia. {iron wire / bronze wire / cable}
5. Available current: Direct current volts
   Alternating current volts phase per's
6. Existing telephone system:
   number of lines:

19 .

Name:

Address:

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Döbelnsgatan 18
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3. Required number of simultaneous calls:
4. The longest line will have a length of metres and will be of mms dia. {iron wire / bronze wire / cable}
5. Available current: Direct current volts
   Alternating current volts phase per's
6. Existirg tel phone system:
   number of lines:

19 .

Name:

Address:

The L. M. Ericsson Review

VOL. 3 SEPTEMBER—DECEMBER 1926 Nos. 9 to 12

Lars Magnus Ericsson
In Memoriam.

R 557 NORRTOMTA, VERMSKOG, IN VÄRMLAND. BIRTHPLACE OF L. M. ERICSSON.

ENGLISH EDITION

L. M. Ericsson

THE L. M. ERICSSON REVIEW

ENGLISH EDITION.

JOURNAL OF
TELEFONAKTIEBOLAGET L. M. ERICSSON, STOCKHOLM.

HEMMING JOHANSSON, Director.

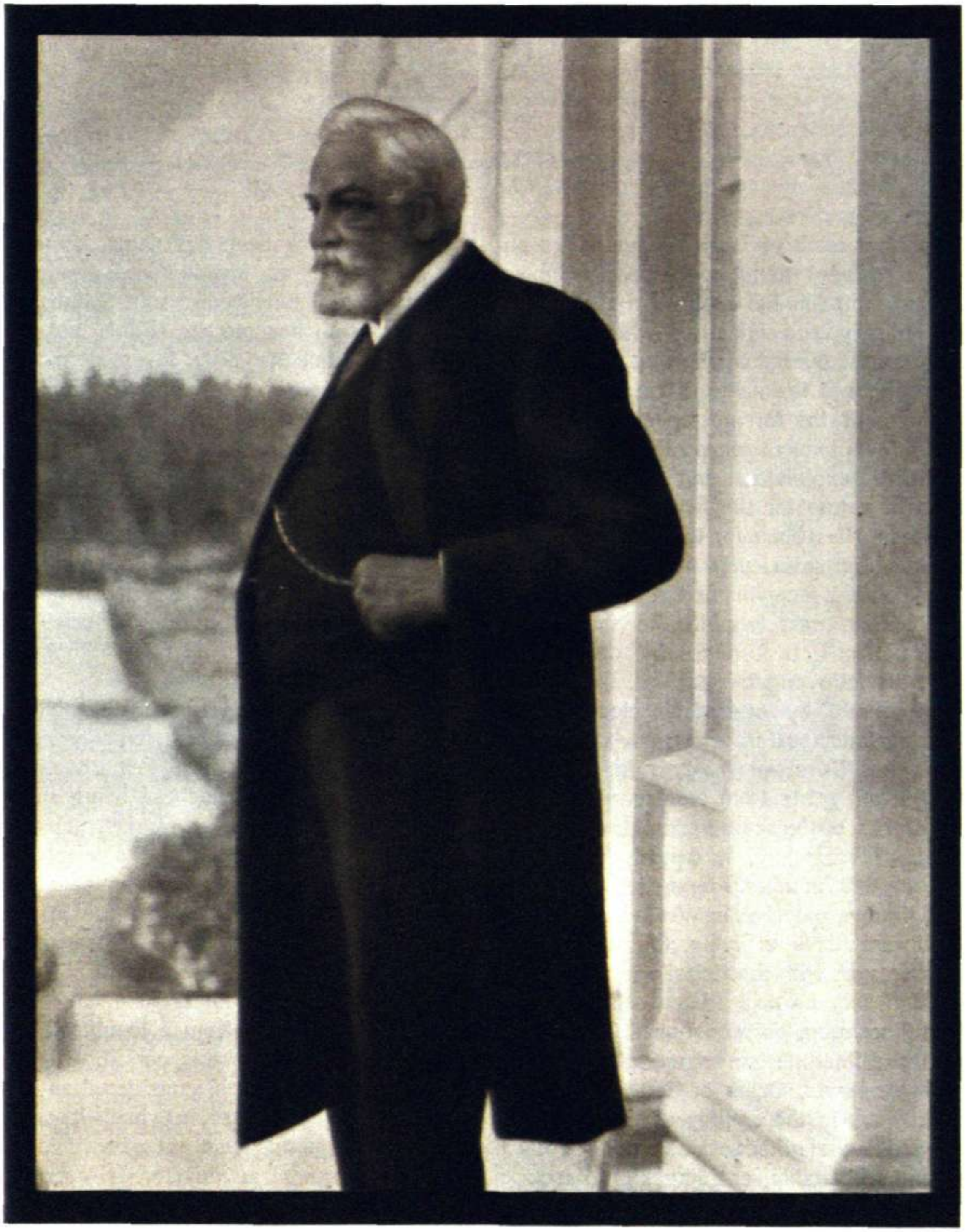
Issued monthly. Yearly subscription rate: 7/–
All communications and subscriptions to be forwarded to the Editor.

During 1926 — the same year in which this Company passed the half-century mark of its activities — we have sustained a very serious loss in the decease of Lars Magnus Ericsson, founder of this organization and head of the same for a great number of years. Although he retired from actual participation in the activities of the firm some years back, his dominating personality has stood forth as an inspiring example for every member of our concern. We cannot better honour his memory than by carrying on his work to still higher development by maintaining and perfecting that high standard of production which, in his opinion, constituted the only solid basis for the success of our business.

With the firm conviction that all members of this company will devote their best energies towards this end, I beg to extend to them my sincere good wishes for

A Prosperous New Year

Stockholm, January 1:st, 1927.



R 558 LARS MAGNUS ERICSSON. Born May 5, 1846 — Died Dec. 17, 1926.

Lars Magnus Ericsson.

In Memoriam.

The loss by death of Lars Magnus Ericsson on December 17th has withdrawn from us a prominent figure in the promotion of Swedish science, industry and initiative, which he has helped to spread over the whole world. In the field of telephony, the name of L. M. Ericsson occupies one of the foremost positions among that group of pioneers whose lives have been devoted to the exploitation and development of the forces of nature for the benefit of mankind. What Ericsson has been for the development of the telephone is sufficiently well known to require any detailed recapitulation at this occasion. We will confine ourselves to the mention of a few interesting facts from the life of this notable man, the following biographical sketch having been penned by one of his closest associates during latter years.

Lars Magnus Ericsson was born in Vermland, Sweden, on May 5th 1846 under very humble conditions. His birthplace »Norrtomta», lying in the parish of Vermskog, is reproduced on the title-page of this number. Being left fatherless already at the age of twelve, he was forced to leave home and earn his own living, thus making an early acquaintance with the vicissitudes of life. At the age of twenty he decided to seek fame and fortune in Stockholm, his pronounced taste for instruments and finer mechanical work leading him to his first employer, Oeller & Co. After having spent six years in the employ of this firm, his diligence and natural giftedness obtained for him a government scholarship, enabling him to acquire practical training and experience in foreign countries. He remained away for four years, spent chiefly in Germany and Switzerland. On his return to Stockholm in 1876 he laid the foundation for the enormous world-encompassing concern which now bears his name, launching out on his career as inventor and designer. The starting capital consisted of 1000 Swedish crowns which was to become the source and origin of the many millions now invested in the widespread Ericsson organization. Ericsson's genius and foresight led the activities of his enterprise during the following year into the field which had been opened up at about this time by the invention of the telephone in America. Thus it is his initiative and creative spirit that are directly responsible for the remarkable development which this enterprise was to experience and which, with his ideas as a guiding principle, was to steadily continue even after his retirement from the firm.

This small enterprise, whose activities were first housed in a kitchen, experienced a rapid growth. Already after a few months larger quarters were procured, these being situated on a courtyard near the Ox Market. Here experiments with the newly invented telephone were carried on, and here also it was that plans were laid for the manufacture of these instruments. Three years later — in 1879 — it again became necessary to find larger quarters. These were located at No. 5 Biblioteksgatan, and the transition of the business from a handicraft to an industry dates back to this period. At this time the telephone was still considered an article of luxury for private use in small local installations only, but this was not of vital importance since the material manufactured by Ericsson included telegraph receivers, fire alarm equipment and measuring and metering instruments as well.

An event which strongly influenced Ericsson's production of telephone material was the building in 1880 of the Stockholm telephone net, soon to be followed by similar nets in Gothenburg, Malmœ, Sundsvall och Soederhamn. These projects were backed by the American Bell organization which, quite naturally, imported American-made material for their construction. Ericsson was not long in taking up competition, however, for which purpose he designed a telephone instrument which telephone experts proclaimed superior to the American ones, giving the same their unqualified approval. The Bell company did not expand in Sweden beyond the above mentioned five cities. The telephone nets in Gevle and Nykoeping, which were built later on, came into existance through the initiative of mutual telephone societies, Ericsson telephones and switchboards being used exclusively.

Another important event which gave the development of the Ericsson enterprise a still stronger impetus was the organization, three years later, of »Stockholms Allmänna Telefonaktiebolag» (The General Telephone Co. of Stockholm) by H. T. Cedergren, engineer and well-known Swedish pioneer in the field of telephone communications. The ensuing competition soon resulted in the withdrawal of the Bell interests, thus putting a stop to the importation of American telephone material.

These developments in Swedish telephone communications marked the beginning of a steady and rapid growth in the production of Ericsson telephones and kindred appliances required to meet the increased demand resulting from Cedergren's masterly and genial administrative qualities. The many and constant improvements in both design and construction — among which Ericsson's world-famous transmitter occupies a prominent position — were also an important contributing factor to the increased output. The field of telephony — with respect to the strenous work devoted to the development of this means of communication over the whole world — found in Ericsson an active participant with an abundance of initiative and contributions of his own distinguished by his constructive genius. Applications of many of his designs are still in use, while many new designs unquestionably bear the stamp of his methods, his ideas and his principles.

In 1884 the factory building at No. 5 Thulegatan was erected. This was added to in 1890 by erecting a new building on the adjoining lot on Rådmansgatan. In 1886, finally, the extensive factory buildings at nos. 19—21 on Thulegatan were erected, at the present time occupying the entire block bounded by Thulegatan, Kungstensgatan, Döbelnsgatan and Rensgatan, the shops at 5 Thulegetan and 18 Döbelnsgatan being retained.

In 1896 the enterprise was reorganized to Aktiebolaget L. M. Ericsson & Co. (L. M. Ericsson & Co., Ltd.). Already some years previously — during the early nineties — Ericsson had directed his attention towards exportation, chiefly to Russia, Holland, England, Finland and other nearby countries. To this very day we will find that in the majority of these countries most of the telephone equipment is of Ericsson's manufacture. Encouraging results led to the forming, later on, of the Russian and English subsidiaries with factories of their own, the Russian factory being completed already in 1897. Thus did Ericsson lay the foundation for the expansion of his organization beyond the boundaries of his native land, an expansion which was to reach far out across the earth and which is responsible, among other things, for the existance of the factories in Vienna, Budapest, Paris, etc.

Exportation entered into a new era of expansion — which has persisted until the present day — at the same time as Swedish initiative, under the leadership of H. T. Cedergren, directed its activities towards the construction and operation of telephone nets in foreign countries.

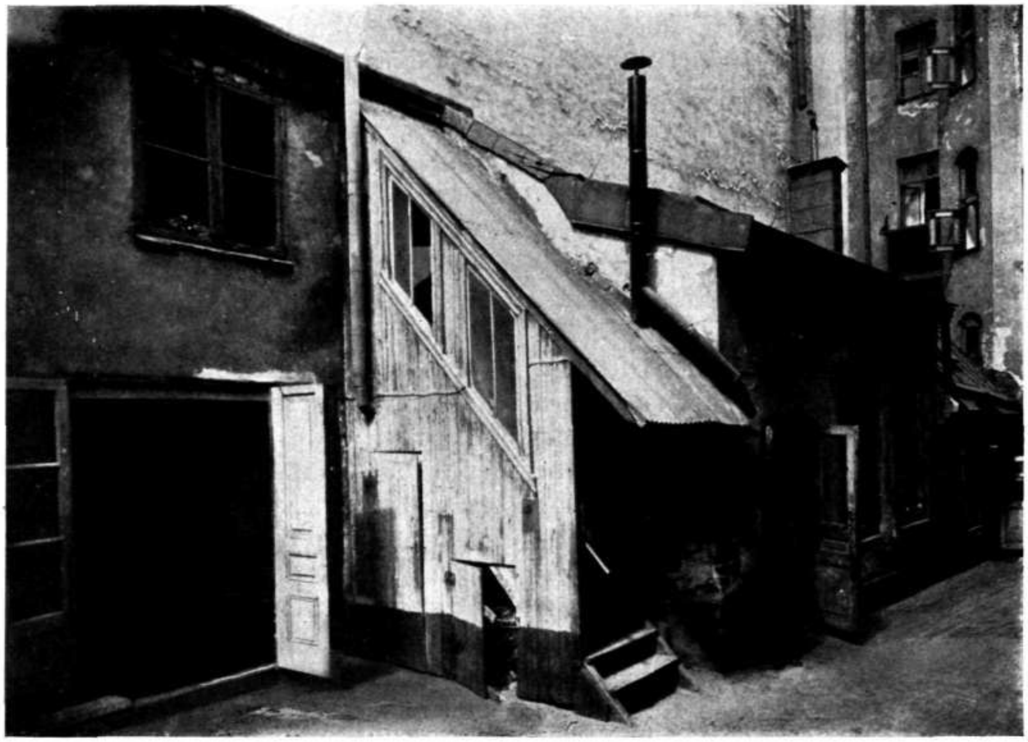
In 1903 Ericsson resigned the leadership of the company he created and to which he had devoted almost thirty years of incessant and fruitful labour, and retired to his country estate Ahlby, later on moving to the nearby Hågelby. During the next twenty-three years he had the pleasure and satisfaction of following the extraordinary growth and expansion of the concern which reflected his unparalleld genius and foresight, and expired at the age of eighty, in the year on which this company passed the half-century mark of its existance.

W. B.

Lars Magnus Ericsson.

(A few personal impressions.)

L. M. Ericsson was still in the height of vigour when he decided to shift to other shoulders the burden of responsibility for the care and leadership of the handiwork which his genius and energy had created. It is very likely that his highly developed sense of duty was a contributing factor to this decision. The enterprise had reached a point in its development where its founder — in spite of his unusual capacity for work — found himself no longer able, as heretofore, to give every detail of this complicated machine his personal attention. Ericsson was no doubt very keenly aware of this deficiency — as he himself regarded it. On the other hand, he could feel assured that his lifework was built on a firm and solid foundation and that it possessed all necessary qualifications to endure even after his withdrawal. Consequently, he left the company — this was in 1903 — and devoted his still unbroken energies to farming, an occupation for which he had always evinced a lively interest.



House near Ox Market, Stockholm, in which Ericsson's Shop was Located from 1876 to 1880.

Thus, many years have passed since »L. M.» left us, but those who have worked under his leadership still retain a clear and vivid recollection of him.

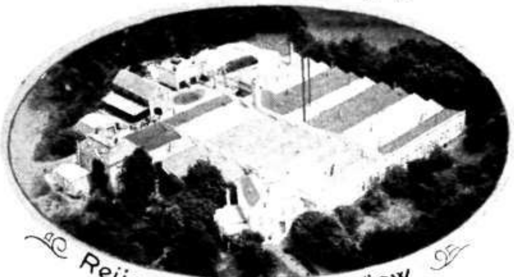
The prevailing impression after a first meeting with Ericsson was a feeling of respect and inferiority. He was of a powerful and imposing build, his manner was modest and at the same time filled with a certain natural dignity, and it did not take long to discover thas his intelectual powers were of no less imposing dimensions than his physical ones. It is true that the first impression of unimportance and inferiority could seem depressing or even put a restraint on the

FACTORIES OF THE *Ericsson* CONCERN. JAN. 1. 1927.

Leningrad

Beeston Notts England, Air-View

Air-View of the Stockholm Works



Reijen Holland, Air-View

Air-View of Works at Colombes near Paris

Madrid

Älvsjö Cable Works near Stockholm

Rome

Vienna

Budapest

R 561e

assiduous application of ones own best efforts. The warmheartedness and sterling qualities which lay hidden beneath the dignity and apparent aloofness, however, soon caused the feeling of discomfort — which perchance may have existed — to be replaced by one of increasing devotion as one came to know and understand this solid and upright character better and better.

Ericsson's manner towards his many subordinates might be considered peculiar. He was, without doubt, a most excellent leader and organizer, even though these qualities may have been kept in the background by the self-restraint which dominated his personality. His orders were often softened by being given the form of a wish or request, without losing a whit in forcefulness or efficacy on this account. He had a very equable disposition, and the writer cannot recollect one single instance — even under extremely trying circumstances — where Ericsson forgot himself or offended any one. If he had cause to be displeased with someone or something, he never voiced his feelings in angry words or reprimands. He had the gift of making such an impression on the delinquent by means of biting sarcasms and justified comment — although unaccompanied by any immoderation — that the reprimand was felt more keenly than if it had been couched in harsh and angry terms.

Ericsson's statements were often tinged with a feeling of pessimism, and the impression that he was a pessimist may have been prevalent to a certain degree among those who knew him. Even while still fully occupied in the sphere of his activities, with success increasing almost from day to day, it could happen that he would make a remark somewhat as follows: »Yes, it's all well enough that we have plenty to do, but it can't be so very long until the world's needs in the telephone line are filled, and what are we to do then? It would undoubtedly be wiser to switch over to the manufacture of some article of consumption such as matches, for instance». There is no doubt whatever but that the views which lay back of such a statement constituted a beacon in Ericsson's business policy from whose course he never deviated; he steadfastly refused to countenance any manner of speculation even in its most innocent forms. However, this principle did not deter him from pledging a large stake when determined to achieve a certain purpose; as, for instance, when of vital importance for the development of his company, he promptly decided to make a large personal investment in a new and promising telephone concern so as to be sure of securing their orders for telephone material.

For my own part, I am of the opinion that at bottom Ericsson's nature was optimistic. What made him appear a pessimist was in fact his deeply rooted cautiousness and prudence. His energy and capacity for work together with his conduct in everyday life were not characteristic of a pessimist.

Energy and capacity for work — here we have the secret of the success so eminently experienced by Ericsson. At the time the writer entered into the service of this company, Ericsson was at the height of his vigour, fifty-two years of age. The amount of work which he could accomplish was fenomenal. Often, when coming to work, he would have with him a sketch or drawing of some new design, prepared during the previous evening or night, or roughly put down on paper during the boat trip in to town from his country estate. His whole day was occupied with inspecting and directing the work in the factory — with interest for even the most minute details — with interruptions for discussing business problems with the office force or for inspecting the drafting room and taking part in the work there. Closing time for factory or office often meant to him only an oppurtunity to devote himself with undisturbed attention to some absorbing problem of design to be worked out at his beloved drawing board during the still hours of the night. Or else a large number of those hours which others devote to rest or recreation were used for the testing of new instruments and apparatus. Frankly, I do not believe there is any exageration in the statement that the drawing board and T-square were Ericsson's best friends outside of the family circle. It was in their company that he found a large amount of the rest and recreation of which he was in need. He remained true to them for a long time after having retired from his chosen field of activity, and when, in his declining years, a failing eyesight together with other infirmities necessitated his giving them up, he must have felt as if he had lost a part of his own self.

But Ericsson had a great number of other friends — his books — which he valued highly and with which he spent many happy hours. Through private studies he had acquired extensive knowledge, not only in subjects directly related to his own field of activity, but also in a wide range of other subjects. Not even the old philosophers were unknown to him. At one occasion some years ago I saw him seated with Plato before him, lost in meditation over Socrates' discourse in his own defense before his judges. When, during latter years, it became more and more difficult and finally impossible for him to read, it gave him great pleasure when others were instrumental in imparting to him the contents of books and newspapers.

»After Working Hours». Ericsson's Wife Assisting with Experiments in the Home.

The quality possessed by Ericsson which has become best known through his works and to which the greater part of his success and fame is generally ascribed, was his gift for designing. In this respect, as well as in others, he was a self-made man. However, this expression hardly seems adequate; he was more a genius than anything else, and genius is not acquired by self-study. Those who were able to observe Ericsson obtained the impression that a certain design or construction was already worked out and practically complete in his brain before he attempted to put it down on paper, with such precision and speed did he accomplish this latter process. Ericsson's great skill and craftsmanship were naturally of great help in his work over the drawing board. He was a prominent instrument maker, well acqainted with all the intricacies of his trade. Thus, he knew intuitively how the instrument with which his brain was momentarily occupied should be designed so as to make its manufacture as simple as possible. He also had an exact knowledge of what demands might be put on a construction designed for a certain purpose; also, how best to meet these demands in a practical way. In his opinion, the outward appearance of an instrument was of the most vital importance; consequently, he always made his constructions as attractive and pleasing to the eye as possible. And last but not least, his requirements as to quality in workmanship were set very high, equally applicable to every little detail, from the primary operations in the presses and lathes to the application of the final outer finish. The high standard of Ericsson products together with their elegant and attractive appearance have given the name »Ericsson» its character of guarantee for an article reflecting both care and skill in its manufacture. In one of the English colonies — in which Ericsson products have found an excellent market — it has been said that the Ericsson instrument is the Rolls-Royce among telephones.

A typical example of how a well-made piece of work could influence Ericsson is cited here. While travelling in the United States in the early nineteen-hundreds for purposes of study, he had acquired an automatic Colt pistol. This beautiful piece of workmanship gave his trained sense of perception immense satisfaction and it is said that when, during the trip home on board the liner, he sometimes felt despondent or heavy hearted, he would take out and examine his newly acquired treasure. This never failed to disperse his depression and clear his countenance.

R 560 L. M. Ericsson's Grave in Botkyrka Cemetery.

It has already been said that Ericsson did not spend much time in recreation. In fact, he led a rather secluded life as far as social intercourse was concerned, that is, he never wasted time on visits or in pleasure establishments of any kind. In his home, however, he did not live in seclusion. Especially at Ahlby, of which he was very fond, he was the most delightful and hospitable host and the pleasure he evinced when receiving and welcoming his friends was deep and unfeigned.

In the same way that Ericsson's life flowed on dispassionately and in complete harmony, so also did he build up his great handiwork without dissension or crises. He was an upright man who tried to be fair in all his dealings with his fellow men. I do not think it possible for any honest and straightforward mind to retain his memory tainted with the slightest grudge for unfair treatment; no higher eulogy can be given the leader of an enterprise which has given work to thousands.

Lars Magnus Ericsson was one of industry's great men, and, what is more, a gentleman in the deepest sense of the word.

R 562

The Toll Traffic Problem in Europe with Special Reference to the Organization of the Service

by A. Lignell, Director of Telephones, Stockholm, Sweden.

(Conclusion.)

The importance of having an exceptionally well trained personnel for handling the traffic over the expensive international telephone lines has already been pointed out, for there certainely is no doubt but that efficient service can considerably increase the profits derived from a line. As a rule, the intervals between calls over international lines are altogether too long, but we must not overlook the fact that it is far more difficult to obtain good co-operation between operators in such cases than when dealing with domestic traffic only. In the latter case, the operators have uniform instructions to follow, stand under the same executive authorities — thus facilitating the adoption of necessary reforms —, and are much better qualified to come to a perfect mutual understanding in their common work than can reasonably be expected of the operators handling the comparatively new international telephone traffic which, as yet, lacks all common, detailed instructions and service regulations.

The C. C. I. has undoubtedly an important mission to fulfil in this respect. Also, detailed service regulations covering the method of handling the preparation of calls, the handling of personal calls subject to advance-ordering, i. e. calls to a certain person or a certain subscriber's station (préavis) and for calls to a certain person called by message to a public telephone station (avis d'appel) have already been worked out. Further, rules have been issued covering the method of handling transit calls, i. e. calls between two countries, passing over a third country which directs the service between the other two, and for service with telegraphic ordering of calls. In addition, it is the intention to proceed at the earliest possible date with the compilation of complete, international service regulations.

At the present time, the employment and training of toll telephone operators is very differently managed in different countries.

In the employment of such personnel, it naturally is a great advantage if there is a large number of employees to choose from, already tried out and tested in many respects related to toll service. It is for this reason that Swedish toll operators are always recruited from among the ranks of the local telephone operators.

In Sweden local operators are engaged when between seventeen and twenty years of age only, at which occasion — besides schooling and other important factors — the physical condition of the aspirant is given very special attention, a careful examination being made by physicians in the employ of the Telegraph Administration.

Of the 652 applicants during 1925 to the preparatory course for local operators, 367 were preliminarily admitted as being apparently suitable. At the subsequent physical examination, however, 95 of these 367 — or 26 % — were rejected.

Among other things, the physicians must take into consideration the general constitution of the applicant, the condition of the pulmonary organs and of the blood circulation, eyesight, hearing, the pitch and quality of the voice, the condition of the hands, and if there is *occasion to suspect epilepsy,* hysterics or neurasthenia.

During the time of training in the above mentioned preparatory course, additional pupils, which have proved themselves unsuitable in one way or another, are rejected, the number of such

L.M.Ericsson

N:r 1.

REPORT

covering service on line number 6050 between STOCKHOLM and HELSINGBORG, March 18, 1926. *Operator on duty: Bme*
Service under observation from 1.29 to 2.29 o'clock. *Report by: Bs.*

Total number of observation minutes = 60.

Remarks concerning service at home exchange	Calls: Kind: P M Series	Calls: from	Calls: to	Seconds required for promoting call at: home exchange	Seconds required for promoting call at: other exchange	Total time for promoting call	Actual speaking time: min.	Actual speaking time: sec.	Number of periods charged	Line idle for lack of calls: min.	Line idle for lack of calls: sec.	Line idle wasted time: min.	Line idle wasted time: sec.	Time used for promoting other personal, message or series calls.	Remarks concerning service at other exchange
			Call going on				5	18	II						
1 period		S.	1731	23	23	23	3	23	I						
	P.	S.	462 Jacobsson	22	31	31	6	02	II						
		S.	3081	38	c. 5 18	c. 5 38	5	24	II					42	2 pers. calls
	P.	S.	Thelin Rein	14	14	14	5	35	II						
S busy ordering Ordering party busy with toll call.	P.	S.	1205 Vedlin	c. 22 —	n. l. 11 —	33 —	—	—	—						
		S.	411	19	25	25	3	36	II						checked 1 per.
		S.	1205 Vedlin	29	c. 26 43	26 43	4	18	II						
	P.	S.	2305 Carlsten	—	—	—	—	—	—						party not reached
		S.	450	29	29	29	3	14	I						
		S.	Rubber	9	14	14	1	55	I						
	Ser.	S.	62	14	50	50	2	12	I					47	2 pers. calls
		S.	462	21	20	21	2	49	I						
		S.	3640	21	25	25	1	32	I					30	P.
	P.	S.	Electr.	22	c. 12 14	12 22	6	12	II						
		S.	883											20	P.
Number of calls			Total	283	360	411	51	30	20					139	
/12			Average	24 s.	30 s.	34 s.									

P. = personal call, c. = delay in checking, n. l. = not on line.

rejections during the year in question amounting to an additional 5 %. Later on, and according to necessity, the best local operators from among the staff created in the above described manner are picked out for training in the toll division, and here, also, those operators which do not fill the requirements for toll service are removed.

The pupils work under the supervision of women instructors and are examined by specially trained women supervisors. As soon as the pupil is sufficiently proficient to work independently, she is entrusted with such work over shorter toll lines to start with, the service being checked up by supervisors who — by means of listening arrangements — are able to follow all the manipulations of the pupil, over the toll line as well as in her intercourse with the subscribers.

The results are noted down on a checking sheet and show the time used by each of the two operators at the communicating exchanges for promoting a call, the nature of the charges for call periods, all irregularities in the service at the home exchange and to what extent the line has been utilized for actual speaking time. The checking takes place without the knowledge of the operator, and when it is finished she is notified of any shortcomings for future betterment. The operator is not accepted for handling toll traffic independently until the checking reports — after the completion of the training course — show absolutely satisfactory results. After that, constantly recurring checkings insure the maintenance of satisfactory service over the toll lines.

As it may be of interest to see the results of two such checkings, each one of sixty minutes duration, with full traffic load and under exactly similar service conditions but with different operators, two reports are here shown. Report No 1. shows good results and Report No. 2 poor results.

A comparison of these reports will show the following:

	Report No. 1	Report No. 2
Lapse of time at home exchange from clearing signal until next subscriber is ready to start speaking	0'24"	0'43"
Lapse of time at other exchange from clearing signal until next subscriber is ready to start speaking	0'30"	0'49"
Lapse of time from call to call	0'34"	0'69"
Actual speaking time	51'30"	46'20"
Periods charged for	20	17
Speaking time per call	3.9'	4.2'
Time for advance ordering of coming calls	2'19"	0'52"
Number of calls with service	12	11

The average lapse of time from the foregoing clearing signal until the subscribers for the next call start speaking is 34 seconds in the first case and 69 seconds in the second case, making an average difference of 35 seconds per call in the time required for promoting calls.

Even if one figures with as low a number as ten calls per hour, this means a loss of 350 seconds or five minutes and fifty seconds, corresponding to five lost toll minutes per hour. Since a considerable charge — 3 Swed. Crowns and more — is often made for toll minutes in international traffic, we have a loss of 15 Swed. crowns per circuit-hour, which loss, with a large number of circuits, can mount up to considerable sums.

A reduction of only ten seconds per call in the time required for promoting calls means more than one toll minute per hour. Thus, it is quite plain that efficient service is desirable not only from the point of view of system and order, but also from a purely economical point of view.

The training of good operators is a tedious undertaking, as all those who have anything to do with toll service are well aware. To give excellent service requires an unusual degree of accuracy, good judgement and quick perception, but, as already stated, the work is well worth the trouble.

In this connection, it may be of interest to know that in Sweden the toll operators are permanently appointed government employees, enjoying as such not only better salaries than the local operators, but also a number of other

N:r 2.

REPORT

covering service on line number 6050 between STOCKHOLM and HELSINGBORG, June 3, 1926. *Operator on duty: Sn.*
Service under observation from 7 to 8 o'clock. *Report by: Bs.*

Total number of observation minutes = 60.

Remarks concerning service at home exchange.	Calls: Kind: P M Series	Calls: from	Calls: to	Seconds required for promoting call at: home exchange	Seconds required for promoting call at: other exchange	Total time for promoting call	Actual speaking time: min.	Actual speaking time: sec.	Number of periods charged	Line idle: for lack of calls: min.	Line idle: for lack of calls: sec.	Line idle: wasted time: min.	Line idle: wasted time: sec.	Time used for promoting other personal, message or series calls	Remarks concerning service at other exchange
			Call going on				1	09	I						
		S.	2935	13	130 65	130 65	—	—	—						S. calls 2935 no answer
		S.	2230	35	40	40	2	50	I						
	P.	S.	1666 Malmstr.	17	14	17	5	18	II						
S breaks connection without warning		S.	1258	14	c. 19 11	19 14	6	25	II						
		S.	2993	40	14	40	2	25	I						
		S.	4670	44	38	44	6	03	II						
		S.	Mölle 12	16	33	33	2	35	I					30	P.
	P.	S.	518 Mrs Tyring	c. 7 n. l. 24	c. 18 —	18 24	—	—	—						Mrs T. cannot be reached over 518
	P.	S.	1110 Hedenbl.	45	35	45	4	03	II					22	P.
	P.	S.	518 Tyra Johnson	24	58	58	6	29	II						
		Ösmo	4550	n.l. 122 56	35	122 56	6	08	II						
Calls poorly prepared		S.	1247	15	c. 9 25	9 25	2	55	I	Call going on					
Number of calls			Total	472	544	759	46	20	17					52	
/11			Average	43 s.	49 s.	69 s.									

P. = personal call, c. = delay in checking, n. l. = not on line.

advantages such as a pension (at the age of 55 years), vacation and salary during illness, while the local operators, on the other hand, are engaged on terms permitting dismissal after a certain length of notice, consequently without pension priveleges and enjoying other benefits only to a restricted degree. Naturally, the possibility of obtaining a permament post as toll operator acts as a strong stimulus on the local operators, thus contributing to an increased efficiency.

In the selection of toll operators a good knowledge of languages is a decided advantage, in addition to which special courses in German, French and English are arranged for the toll service employees. These courses are planned with the definite purpose of teaching the operators special service phrases and expressions in the various foreign languages, as well as everything that has any bearing on the work in which they are engaged.

The best toll operators are selected for international service and are kept at work — as far as possible — on the same routes as previously, since the chances for obtaining satisfactory service over a certain line are considerably increased if the operator is accustomed to the traffic and has a good knowledge of the same.

Special features for stimulating the traffic.

In the same manner as it is of importance that the tariff rates are set so as to stimulate traffic and permit a satisfactory utilization of the lines, so also is it just as important for the telephone administration as well as for the general public that all possible measures be adopted that can in any way increase the value of the service for the public.

To this group of desirable measures may be assigned, in the first place, the furnishing of personal and subscription calls; also, of calls to a certain designated subscriber's station, special express calls (in favour of which regular and express toll connections may be broken), and the possibility of calling a non-subscriber to a public telephone instrument.

All these varieties of calls are permitted according to the instructions contained in the international telephone regulations (Révision de Paris 1925) but are all made dependent on the special agreements existing between the affected telephone administrations. Since these facilities without doubt are an important factor in the development of telephone communications, it is to be hoped that the respective administrations will sanction the use of all these various forms of calls.

Since we here in Sweden have many years' experience of these same call forms — in domestic traffic as well as with Denmark and Norway — I will describe them a little more thoroughly.

Personal calls (Préavis).

The frequency of personal calls in Sweden is in constant ascendancy. During 1924 the number of such calls constituted twenty-nine percent of the total number of calls, the corresponding figure for distances under 180 km being twenty-one percent, for distances between 180 and 540 km forty-three percent and for distances exceeding 540 km fifty-five percent of the total number.

At present the total percentage is forty and for the above distances thirty-two, fifty-four and ninety-two respectively.

The frequency rises with higher rates, which is but natural since the importance of getting in touch with the right person increases with the cost of the call, a subscriber often taking the chance of having to make a new call over the shorter and cheaper distances. The importance of this fact with reference to the international traffic with comparatively high rates is apparent.

The international tariff rate for the advance ordering of a personal call seems to be rather high, however, being set at one third of the basic rate or equal to the rate for one minute (the basic rate is the charge for one three-minute period), consequently amounting to 4 Swed. crowns for a basic rate of say 12 Swed. crowns per period. This comparatively high charge does not correspond to the time required for the promotion of the advance order, which can most certainely be limited to thirty seconds; also, we must keep in mind the fact that the possibility of obtaining personal calls at a reasonable extra charge means an added stimulus to the frequency of the calls and consequently is to advantage for the telephone administration.

The rates in Sweden for advance ordering of personal calls are unusually reasonable, amounting to

0.20 crowns	for distances up to 180 km and with a period rate of max. 0.50 crowns.
0.30 »	for distances up to 540 km and with a period rate of max. 1.10 crowns.
0.50 »	for distances exceeding 540 km and with a period rate of max. 2.50 crowns.

In case of a future reduction of international rates, a lowering of the extra charge for personal calls to say twenty percent of the period rate is undoubtedly called for.

The international extra charge for calling a certain person to a public telephone instrument (avis d'appel) is the same as for personal calls (préavis). However, this charge can be deemed reasonable, since such a call always includes the sending of a message while the information concerning a personal call is simply imparted over the phone to the designated instrument.

Subscription calls satisfy the need for service at definite recurrent times, especially during the busy hour when the lines are often more or less clogged with express calls, and are used in Sweden principally by the press and financial institutions. At the present time subscription calls in Stockholm amount to 600 call periods per day.

The value of *special express calls* lies in the possibility — in very urgent cases — of obtaining right of precedence over other forms of private calls. Conditions may arise calling for some very urgent communication and it would be a serious dificiency in the traffic regulations if no means had been provided for just such cases. However, calls of this description should have such high rates as to discourage their use except in emergency cases. For this reason the charges in Sweden for special express calls are set so high as to be prohibitive, only twelve such calls having been promoted in the whole country during 1925. The international rate adopted for such calls — ten times the period rate — is too low from the Swedish point of view. Thus, in the traffic agreements already signed between Sweden and foreign administrations the rate for special express calls has been set at twenty times the period rate.

In conclusion, I wish to touch upon a condition which is of the greatest importance for the development of the telephone traffic, and that is the chances for obtaining quick connections over the lines or, in other words, the nature of the waiting times for calls. In America, where the importance of obtaining quick connections is fully appreciated, each telephone line — as already mentioned in a previous number — consists of such a large number of circuits that the average waiting time for all calls over distances corresponding to those of the European international traffic does not exceed from ten to twelve minutes. Such a large number of circuits must necessarily mean very high period rates, however, and this has led to the adoption in Europe of a system with express calls which, if correctly handled, gives quick connections for express calls and reasonable waiting times for the balance of the traffic.

In order to dispatch the traffic regularly and satisfactorily with this system, it is important that the growth of the traffic be carefully noted, so as to prevent the express calls from becoming predominant over a certain line, in which case they lose their character of calls with short waiting time.

For this reason, it is advisable to investigate lines over which the traffic is very heavy as soon as it is observed that the waiting times begin to be too long, especially for express calls.

As it may be of general interest to see how such investigations are carried on in Sweden since many years back, a description is given in the following of the forms used for this purpose

REPORT I a. *Minutes During each Hour that Circuit is Idle for Lack of Calls.*

Date	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9
20		17	19	0	0	0	0	20	6	32	25	55	39	22	
21		54	14	0	0	0	0	0	22	37	43	38	43	58	
22		41	17	0	0	0	0	0	0	0	52	42	35	18	
23		31	18	0	0	0	0	38	28	0	33	35	42	20	
24		32	18	0	0	0	0	0	0	0	0	0	7	31	
25		24	—	0	0	0	0	23	60	60	36	43	60	55	
Total		199	86	0	0	0	0	81	116	129	189	213	226	204	
Average time idle		33	14	0	0	0	0	14	19	22	32	36	38	34	

REPORT I b. *Mean Loading Time per Hour During the Above Days.*

R 541

REPORT II. *Waiting Times.**

Date	Number of Calls											Number of cancelled orders
	Immediate connections obtained		Promoted within							Over 90 min.	Total	
	Series and time orders	Other calls	10 min.	20 min.	30 min.	40 min.	50 min.	60 min.	90 min.			
20	—	1/	7/4	12/4	18/4	19/4	20/	20/	22/	—/	22/4	—
21	—	1/	17/2	21/5	23/5	25/5	26/	27/	31/	1/	32/5	—
22	—	—/	8/7	15/11	15/13	15/14	17/	18/	19/	4/	23/14	—
23	—	—/	20/3	26/6	28/6	32/6	34/	37/	37/	—/	37/6	—
24	—	—/	18/8	32/12	35/13	39/13	24/	45/	47/	—/	47/13	1
25	4	—/	9/7	14/12	20/12	23/13	24/	28/	30/	1/	31/13	—
Total	4	2/	79/31	120/50	139/53	153/55	160/	175/	186/	6/	192/55	—
%	2.1	1/	41.1/56.4	62.5/90.9	72.4/96.4	80/100	83.3/	91.1/	96.9/	3.1/	——	—

* The numbers in the divided spaces denote ordinary / express calls.

2.

REPORT III.

Number of Charged Speaking Minutes. *

Date	7–8	8–9	9–10	10–11	11–12	12–1	1–2	2–3	3–4	4–5	5–6	6–7	7–8	8–9	9–10	10–11	11–12	Total charged speaking minutes
20	18/—	33/	27/15	30/15	33/21	39/9	51/	24/	39/6	18/	15/6	3/	15/	12/	27/	39/	42/	465/72
21	24/	3/	36/3	12/21	24/21	51/3	45/3	27/6	27/6	15/6	12/	18/	15/	—/	33/	45/	45/	432/69
22	18/	18/	36/3	27/18	6/30	18/36	45/3	42/	18/12	45/	—/	6/	6/	18/	30/	39/	63/	435/102
23	24/	18/	33/	21/21	60/6	36/18	36/	15/	24/9	24/15	30/	18/	18/	33/	18/	27/	54/	489/69
24	15/	18/	24/12	3/39	39/15	48/9	48/3	36/6	33/15	24/6	45/	30/	21/	15/	27/	33/	78/	537/105
25	15/	15/	30/	39/21	42/9	30/18	54/9	6/	—/	—/	18/9	18/	—/	3/	24/	27/	48/	369/66
Total	114/—	105/—	186/33	132/135	204/102	222/93	279/18	150/12	141/48	126/27	120/15	93/—	75/—	81/—	159/—	210/—	330/—	2727/483
Average	19/	18/	31/6	22/23	34/17	37/16	47/3	25/2	24/8	21/5	20/3	16/	13/	14/	27/	35/	55/	455/81

REPORT IV.

Number of Non-Promoted Ordered Calls at Beginning of Hour and Conversation Respectively. *

Date	7–8	8–9	9–10	10–11	11–12	12–1	1–2	2–3	3–4	4–5	5–6	6–7	7–8	8–9	9–10
20	—/	—/	—/	3/	1/	1/	0/	0/	1/	1/	4/	2/	1/	4/	—/
21	—/	—/	1/	2/	7/	3/	0/	4/	0/	1/	1/	0/	0/	0/	—/
22	—/	—/	0/	3/2	3/4	5/	3/1	1/	3/	3/	2/	1/	0/	0/	—/
23	—/	—/	1/	1/	6/	2/	0/	2/	1/	2/	1/	2/	1/	2/	—/
24	—/	1/	0/	3/3	1/	3/	5/1	1/	2/	4/	4/	5/	3/	0/	—/
25	—/	—/	3/	3/	2/	7/2	5/	2/	1/	2/	4/	3/	1/	2/	—/
Total	—/	1/	5/	15/5	20/4	21/2	13/2	10/—	8/	13/	16/	13/	6/	8/	—/
Average	—/	0/	1/—	3/1	3/1	4/	2/	2/	1/	2/	3/	2/	1/	1/	—/

Ordered series calls or calls for certain time ordered for the following hour are classified as non-promoted calls

* The numbers in the divided spaces denote ordinary / express calls.

and of how the statistical information is collected and prepared, with the observance of the changes in rates resulting from the application of the international regulations. The appearance of the forms may be seen in the accompanying illustrations, the figures from such an investigation being inserted in the respective columns for the sake of lucidity.

Report I a. This report gives the time in minutes — for each hour — during which the circuit is idle for lack of calls. The figures are obtained from the operator on duty, who makes a note of between which minutes the circuit is idle. Since this operator is not engaged with the handling of any traffic at such moments, these annotations do not give much trouble.

Report I b. The load curve is obtained from the complement minutes to the mean idle time during each hour (bottom row of figures in report I a). This curve gives a clear idea of the circuit traffic load, from which one is able to judge the possibilites for increased traffic during the different hours of the day. This curve also gives information as to whether lower rates can suitably be applied during certain times of the day.

Report II. The data in this report — as well as in reports III and IV — are obtained from the annotations of the operator on the call slips as to the exact time for the ordering and promotion of a call, and on a special list as to the number of unpromoted ordered calls at the beginning of each hour and the number of incoming speaking minutes during each hour (with exchange service). The collocation of these data is taken care of by a person specially assigned to this work.

The report is arranged so as to give direct information as to the percentage of calls promoted within certain waiting times, so as to ascertain to what degree the rulings of the C. C. I. as regards waiting times on lines of varying lengths are observed (1/2, 1, 1 1/2 hrs).

If one wishes to see how large a percentage of the calls are promoted with waiting times between ten and twenty minutes, twenty and thirty minutes, etc., these figures are easily obtained by subtracting the percentage of calls for both adjoining minute figures.

By providing separate spaces for express calls and ordinary calls (express calls under and ordinary calls over the diagonal), it is possible to judge the nature of the promoting facilities for both categories and to see their maximum waiting times for the various days. The relation between express calls and ordinary calls is also obtainable here.

The number of cancelled call orders is also denoted. It is to be observed that this report covers outgoing calls only.

Report III. This report gives the number of charged speaking minutes per circuit and shows to what degree the circuit is occupied by express speaking minutes and ordinary speaking minutes as well as the speed of promotion for express calls during each traffic hour. As already stated, this information is of importance for judging the value of express calls to the public.

By comparing this report with report II it is possible to tell the number of express calls in various directions. The average number of speaking minutes during each hour compared with the traffic curve in report I b show how much the time for promoting calls exceeds the time charged for. Consequently, this report is of great value when making a close study of traffic conditions.

Report IV. A good estimate of the nature of the waiting times during the various hours of the day as well as of the even or uneven distribution of call orders over the traffic time is obtained from the number of waiting calls at the beginning of each hour.

The collecting of statistical information on traffic loading is naturally associated with a certain amount of work and should not be undertaken oftener than is necessary for gaining a thorough knowledge of the traffic conditions on the various circuits. This work is amply repaid, however, by a knowledge of whether an increased number of circuits is necessary and desirable from an economical point of view. A thorough knowledge of the nature and development of the traffic is one of the corner stones of efficient toll traffic.

The New Rotterdam Toll Exchange.

By J. H. Warning, chief engineer of the telephone exchange section of the Royal Dutch Telegraph Department.

On the night preceding Sunday August 1:st of this year the Rotterdam toll traffic was cut over to the new toll exchange housed in the Post Office, Telegraph and Telephone building at Coolsingel, Rotterdam. This event was successful in every way, so that on Sunday morning the entire toll traffic could be handled by the new exchange without the least difficulty.

Likewise, when, on the Monday following, the exchange had to bear up under its first full, week-day traffic load, the service gave perfect satisfaction and has continued to do so ever since.

The auspicious opening of this very large exchange — built according to the most modern principles with regard to technical features as well as to service — is due first of all to the excellent co-operation between the government authorities and the manufacturers, the excellent quality of the material having endoubtedly also contributed to this result in no small degree.

It is not my intention to devote this article to a detailed description of the circuits and switching operations; for the present, I will merely attempt to give my readers an idea of the scope of this plant and of the principles according to which it is designed.

In June 1920 it was decided to entrust The L. M. Ericsson Telephone Co. with the delivery of the entire plant, consisting of a toll exchange and a telegram telephone service bureau.

The preparation and approval of the final plans and the manufacture of all the material together with the installation and erection of the same have, quite naturally, taken a great deal of time, so that the delivery of the completed plant could not take place until July 28, 1926.

The fundamental idea which permeated the planning of this exchange was the obtainment of the highest possible degree of uniformity in all its component parts — thus increasing the adaptability of the service —, at the same time striving towards the automatic handling of the traffic to the greatest possible extent. This last mentioned feature, however, cannot be very extensively used for toll service. The system »automatic selection of a disengaged operator» has been applied to those classes of service which need not necessarily be handled at a certain definite place. In this connection I will mention the following groups of traffic:

1. Ordinary order traffic of the local subscribers.
2. Incoming information traffic.
3. Incoming telegram telephone traffic.
4. Order traffic of the direct toll subscribers.
5. Order-wire traffic.

All these various categories are handled according to the preselector principle.

The outgoing telegram telephone traffic as well as the outgoing information traffic is handled in the reverse order according to the principle with line finders, while the traffic with the automatic local exchange is handled according to the principle with line finders for the jacks and preselectors for the selection of an idle junction line.

The toll exchange.

Fig. 1 shows the respective positions of the various exchange units.

The main and intermediate distributing frames are located in the same room, together with relay racks and racks for the resistance coils, the automatic switching devices, a test board with three positions and two supervisors' desks, each one with two positions.

The operating room contains the toll boards with 198 positions for handling the regular toll traffic, 36 positions for handling the subscribers' call orders, twelve double positions for preparing the distribution of order slips, one desk with four positions for the pneumatic dispatch system, two positions for concentrated night service, eight »B» positions for direct toll and suburban traffic, one commutation switchboard with two positions, two chief operators' desks with two positions each, and one exchange manager's desk.

The adjoining room contains switchboards with ten positions for handling the information service, together with sorting tables and filing cabinets for the used order slips.

The number of toll lines can be increased to 1000 without increasing the present switchboard equipment. The line relay equipment is sufficient for only eight hundred lines, however, so that an increase in toll lines exceeding this number will necessitate the installation of additional relays. At present, the toll lines number about four hundred.

As already intimated, the ordinary toll positions are all exactly alike. They are equipped for handling five direct and ten concentrated lines, being mounted with eight pairs of cords with their respective ringing, isolating, speaking and listening keys.

The keys for two pairs of cords are mounted on a common removable block, a feature which greatly simplifies the making of necessary repairs. The blocks are equipped with contact plugs which fit into sockets in the key board, permitting the removal and immediate replacement of a faulty block, which can then be repaired at leisure in the repair shop without causing the operator the least inconvenience.

Each board has two positions, between which are mounted a calculagraph with electrically controlled clockworks and an electric metering clock which is advanced every six seconds. Further, there are receiving and sending devices for the pneumatic dispatch system together with a receptacle for used order slips. Each position is equipped with a calling dial for the automatic traffic to the local city exchanges. Also, every position has arrangements for telegraphic ordering of calls.

The multiple field is always multiplied over two positions and contains the following equipment:

a. 300 junction lines to the local »Centrum» exchange which is still arranged for manual service,
b. 400 lines for transit »B» traffic,
   120 lines for transit service traffic,
c. 80 lines for direct toll »B» traffic,
   20 lines for suburban »B» traffic,
   20 lines for internal »B» traffic,
d. 40 lines for public telephone booths at the board of trade and at the telegraph station,
e. 10 junction lines for traffic with the automatic local exchanges »West» and »Noord».

Both commutation switching positions are equipped with a common jack field for toll lines, containing

1000 line jacks,
1500 service jacks,
3000 concentration jacks

and a jack field for transit »B» lines and transit service lines.

The positions for night concentration service are equipped with jacks and indicator lamps for the concentration of two hundred lines.

The thirty-six ordering positions are arranged so that each operator has two order lines at her disposal, only one of which can be busy at the time, however.

The boards for the direct toll subscribers' lines are equipped for two hundred and forty lines.

The transportation of the order slips between the order positions and the preparatory positions is handled by means of a belt conveyor. The sorted slips are then carried on to the pneumatic dispatch central by means of four small cars running on an aerial track system, the further distribution from here to the toll positions being accomplished by means of a pneumatic dispatch system. The return transportation of the used slips to the filing department is also handled by a track system with eleven cars, mounted under the switchboards.

The telegram telephone service bureau.

In conjunction with the toll exchange, a telegram telephone service bureau has been installed in the same building. The placing of the various units is shown in fig. 5.

Telegrams are sent out and received through this bureau by telephone to and from telegraph substations as well as city telephone subscribers.

The equipment consists of fifteen switchboards with thirty positions, together with a four-position exchange for the internal traffic. This last-mentioned exchange handles the traffic from the various departments within the building — mutual as well as with the local and toll nets, simultaneously serving as concentration boards for the telegram telephone traffic during those hours of the day when the internal traffic load is slight.

The incoming telegram telephone traffic from the local subscribers is automatically distributed to disengaged operators, each position being equipped with two lines in the same manner as the order positions for the toll traffic.

For outgoing traffic to the subscribers, a connection with the desired local exchange is automatically obtained over an idle telegram line by simply plugging up in the corresponding jack.

The outgoing traffic to the substations takes place over jacks in the vertical panels of the boards while the incoming traffic is automatically distributed to disengaged operators in the same manner as the incoming telegram telephone traffic. Since a large number of the lines to these stations are used also as toll lines, they must naturally be connected to the toll positions as well. A ringing signal to the toll exchange is sent over the metallic circuit, while a signal to the telegram service bureau is sent over one bridged wire with earth as a return.

Blank telegram forms are distributed to the operators and filled in forms collected and sent on to the telegraph station by means of an aerial track system and six small cars specially constructed for this twofold function.

The power plant.

The power plant consists of the following equipment:

Two charging machines for the storage batteries, each consisting of one motor, supplied with current from the 2×220-volt city net, and one 24 to 36-volt generator for 700 amperes and with a capacity of 25 kilowatts.

One machine for furnishing current for the Haller aerial track system, consisting of a 220-volt motor and a 50-volt generator.

Three ringing machines which deliver a 75-volt, 24-period alternating current. Two of these machines are fed from the city net, the third one obtaining necessary current from the storage battery. They supply both positive and negative current at the same time for telegraph purposes, each one of them being connected up with an impulse machine which supplies the necessary tone signals.

One vacuum and compressed air machine for the pneumatic dispatch system.

Each one of the two storage batteries consists of twelve cells and has a capacity of 4000 ampere-hours.

The 163 electric clocks and the 105 calculagraphs are actuated by means of a rotating cylindrical switch making one revolution every six minutes, the clockworks being successively connected up in groups. This motor-driven switching device is controlled by means of a main clock.

The service.

A short description of the manner in which the traffic is handled will now be given.

A subscriber desiring a toll call places his order for the same over an order wire, the calling signal being automatically directed to a disengaged operator. If no operator is disengaged at the moment, the call is held until an idle line has been found. In order to be able see how many subscribers are waiting at any desired moment, one of the chief operators' desks is equipped with a specially graded ammeter, on which direct readings will give the desired information. In this way it is possible to make necessary changes in the number of operators as the need may arise.

The filled in order slips are transported to the sorting positions by means of a belt conveyor. Here, the operator on duty removes them from the conveyor, completes the information where necessary and distributes the slips in four different directions. The aerial track system carries the sorted slips to the respective positions of the pneumatic distribution board, from where they are sent on to the correct toll positions. When the call has been dispatched, the slip is placed in the receptacle for used slips, after having been stamped in the calculagraph. The next car that passes by collects these slips and carries them on to the filing department where they are sorted according to their respective numbers.

An incoming call for a subscriber on the Rotterdam telephone net is dispatched directly by the operator on duty. At present, the traffic with the local exchanges — either automatic or manual — is handled over an order wire by the local »B» operator. The order wire connection is so arranged that a disengaged local »B» operator is automatically reached when the push button for the desired exchange is depressed; or else the connection is held up until an operator becomes disengaged.

The intention is to permit the connecting up of the desired subscriber's line directly by means of the toll operator's calling dial as soon as the local exchanges are equipped for this purpose. Consequently, the switching at the toll exchange is arranged so that an idle junction line to the desired local exchange is automatically obtained by plugging up in a junction jack for the exchange in question.

An incoming call for direct toll traffic is handled in exactly the same way, with the exception that a button for the direct toll »B» board is depressed instead of an order wire button for a local exchange.

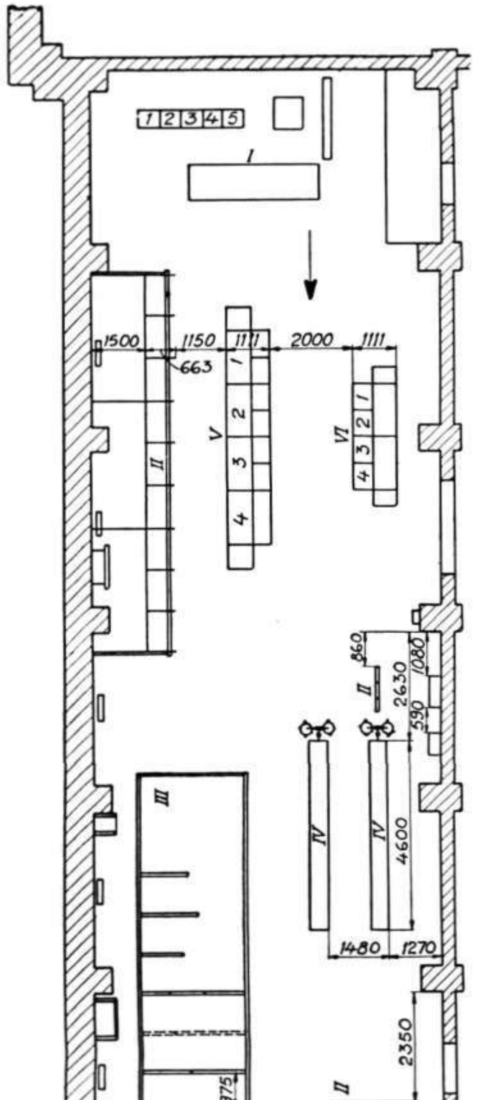
An incoming call requiring a transit connection to another position is handled in either of two different ways.

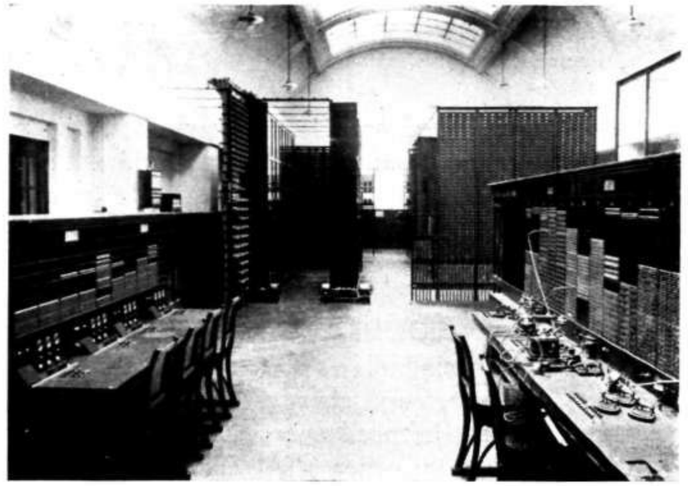
If the call is to a so-called leading position, i. e. the line over which the call is made has right of precedence over the line with which a connection is desired, the operator receiving the call completes the connection herself. To this end, she connects herself up over a service line to the operator handling the desired line and inquires if this line is disengaged. If this is the case the last mentioned operator makes the desired connection by the aid of one of the two numbered single cords at her disposal — this cord being directly connected to the correspondingly numbered jack in the transit »B» multiple — and gives this number to the first operator, who then takes the local cord of the previously used cord pair and plugs it up in the jack with the given number, thus completing the transit connection. If the desired line is busy, a preliminary connection is made by introducing the transit »B» plug in the preliminary jack of this line. As soon as the line becomes disengaged, the inquiring operator receives a clearing lamp signal, after which the connection is established.

If the desired connection is to a line which has the right of precedence over the line on which the call is made, the operator on duty makes out a transit order slip which is carried through a pneumatic tube to the distributing central, where it is sorted together with the slips from the regular ordering positions.

In this manner the operator obtains the transit order slip from the leading position and establishes the connection as soon as its turn has come, as already described.

Finally, I wish to mention that there is a regular training school for operators as well as for repair men and erectors. Fig. 7 shows the placing of the school equipment.





R 547 Fig. 2. Main, Intermediate and Automatic Distributing Facilities, to the left on Floor Plan. Seen in Direction of Arrow.

R 546 Fig. 3. Operating Room, Entire Lower Part of Floor Plan. Seen in Direction of Arrow.

R 545 Fig. 4. Information Section. Right Hand Part of Floor Plan. Seen in Direction of Arrow.

Key to Floor P…r, Fig. 1.

To Left on Floor Plan:
- I Main Distributing Frame
- II Intermediate Distributing Frame
- III Relay Rack
- IV Selector Rack
- V Test Board
- VI Supervisors' Desks

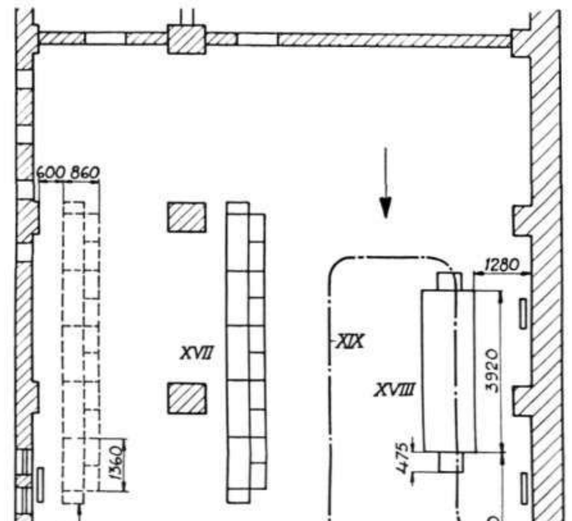
In Operating Room Below on Floor Plan:
- VII Toll Boards
- VIII Toll Ordering Boards
- IX Preparation Desks
- X Pneumatic Distributing Desks
- XI Night Concentration Board

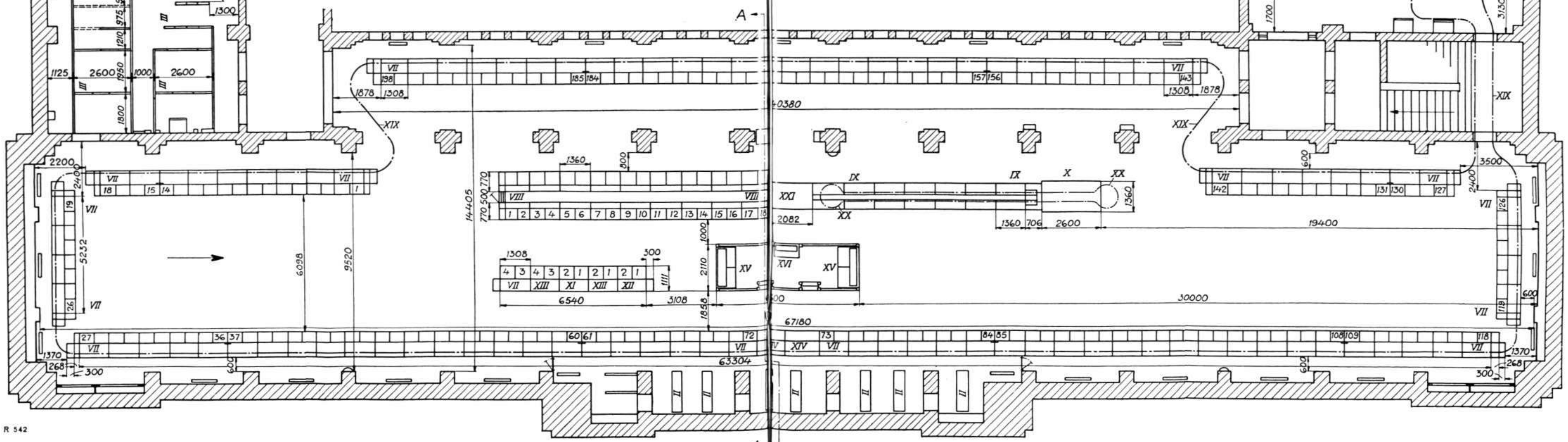
In Operating Room Below on Floor Plan:
- …II »B« Positions for Direct Toll Traffic
- …II »B« Positions for Suburban Traffic
- …V Commutation Switchboard
- …V Chief Operators' Desks

In Information Section to Right on Floor Plan:
- …I Exchange Manager's Desk
- …I Information Boards
- …II Card Index Files

…X Aerial Tr. Syst. I, passing through operat. room and informat. sect.

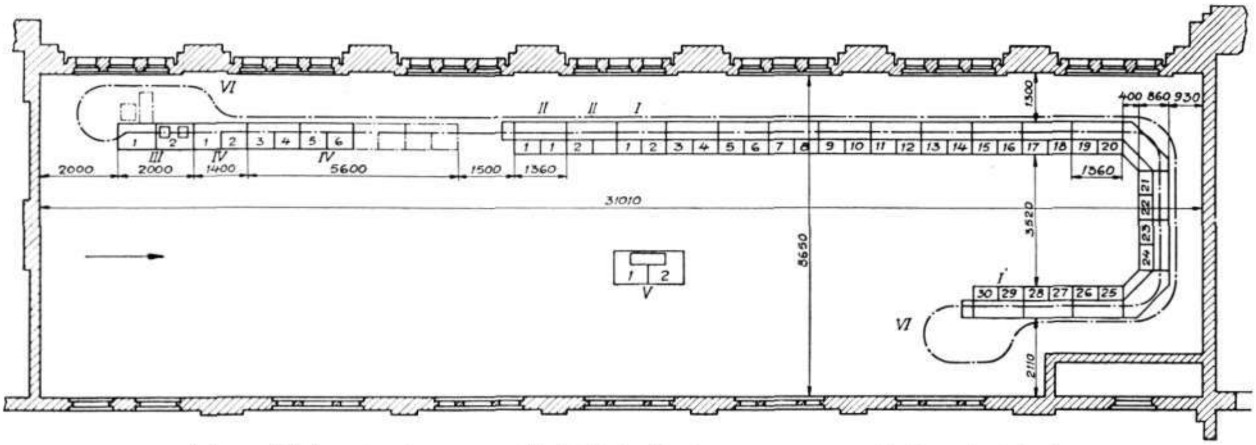
In Operating Room Below on Floor Plan:
- …X Aerial Track System II
- …I Receiving Device for Pneumatic Dispatch System





R 542

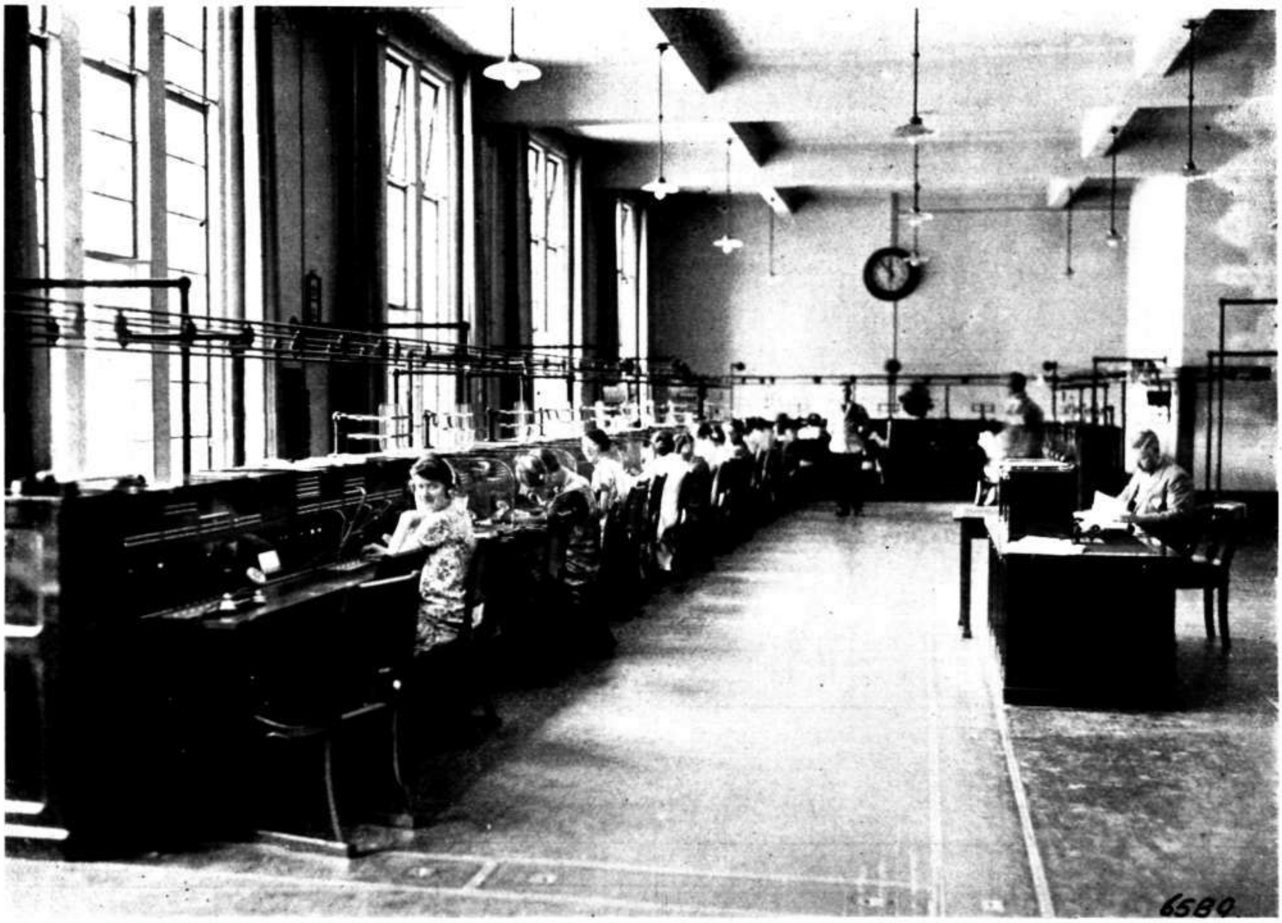
Fig. 1.



R 543

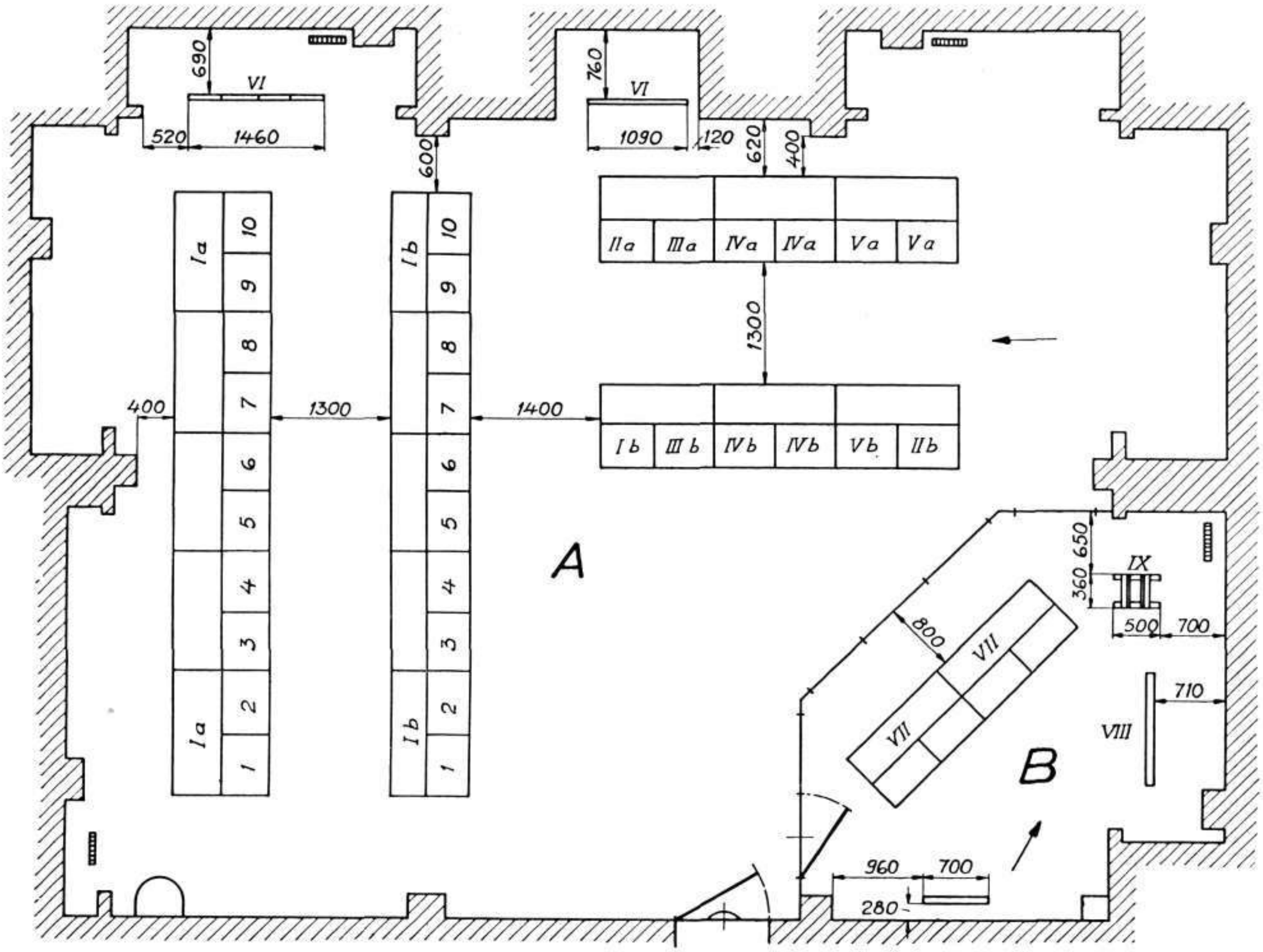
I Telegram Telephone Board
II Board for Internal Traffic
III Distributing Board
IV Administration Desk
V Supervisor's Desk
VI Aerial Track System

Fig. 5.



R 548

Fig. 6. Telegram Telephone Bureau, seen in Direction Indicated by Arrow on Floor Plan Above (Fig. 5).

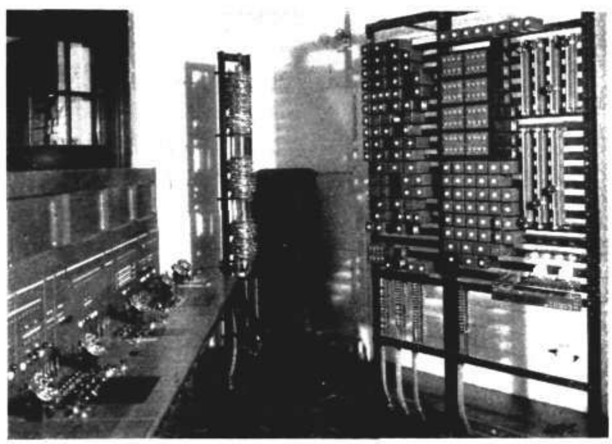


R 544

Fig. 7.

A	Training School For Operators	
Ia	Pupils' Toll Positions	
Ib	Instructors' Positions for same	
IIa	Pupils' »B« Position	
IIb	Instructor's Position for same	
IIIa	Pupil's Information Position	
IIIb	Instructor's Position for same	
IVa	Pupil's Order Position	
IVb	Instructor's Position for same	
Va	Pupil's Telegr. Teleph. Position	
Vb	Instructor's Position for same	
VI	Intermediate Distributing Frame	
B	Training School for Repair Men	
VII	Board for Imitating all Actual Circuits	
VIII	Relay Rack.	
IX	Selector Rack.	

R 549 Fig. 8. Training School for Operators, *A*, seen in Direction Indicated by Arrow on Floor Plan Above (Fig. 7).



R 550 Fig. 9. Training School for Repair Men, *B*, seen in Direction Indicated by Arrow on Floor Plan Above (Fig. 7).

There are som ten boards — outwardly exact duplicates of the toll boards — for imitating the regular toll positions and at which the pupils are seated. For each of these positions there is a corresponding instuctor's board equipped with keys whereby the woman instructor can imitate — on the pupil's board — all the various ordinary toll connections and signals. Thus, it is possible to give the pupil the necessary training and practice before putting her in actual service. Pupils' and instructors' boards are installed also for the instruction of operators for »B» traffic, information, telegram telephone service and ordering service.

In the repair men's school, all the existing circuits are reproduced exactly as they occur in the exchange.

As already mentioned in the beginning of this article, its purpose is merely to give a short general description of the exchange. An opportunity for giving a more detailed description — by means of circuit diagrams — of the manner in which the entire system functions will probably present itself at some future date.

Martin Löfgren. In Memoriam.

R 554

On November 7th, 1926 Martin Löfgren was carried away by death, only forty-six years old. This able engineer and designer entered his career in the field of telephony in 1898, starting in as a student with Aktiebolaget Telefonfabriken in Stockholm, which firm later on was absorbed by Aktiebolaget L. M. Ericsson & Co. After having completed his studies in 1902, Mr. Löfgren spent ten years with various foreign companies, returning to Sweden in 1912, at which time he entered the service of Telefonaktiebolaget L. M. Ericsson. The Ericsson automatic system, which had entered the first stages of its development at about this time, found in him an interested and inventive worker. Towards his associates he was retired, unobtrusive and considerate, always intensly absorbed in his work. On account of his quiet manner, there were not many who knew him intimately, but those among his comrades who became better acquainted with him will always retain his personality in grateful and valued memory.

Eric Vallin, 50 Years.

R 555

On December 6th Eric Vallin — one of this company's most valued engineers — celebrated his 50th anniversary, in honour of which the Ericsson office force had the pleasure of extending to him their most hearty congratulations.

Mr. Vallin entered the service of Aktiebolaget L. M. Ericsson & Co. in 1903, immediately after having graduated from the Royal Institute of Technology in Stockholm, and has consequently been associated with this company for twenty-three years.

It is not our intention now to enter in detail upon Mr. Vallin's work in the capacity of one of our most able men. What he has accomplished is all too well known by the company, by his fellow workers and by the members of our foreign branches. His engaging personality and sterling qualities have made him highly esteemed and respected by all those who have come in contact with him.

These sentiments were accurately portrayed in a versified address written by one of the office »poets» and read on this occasion.

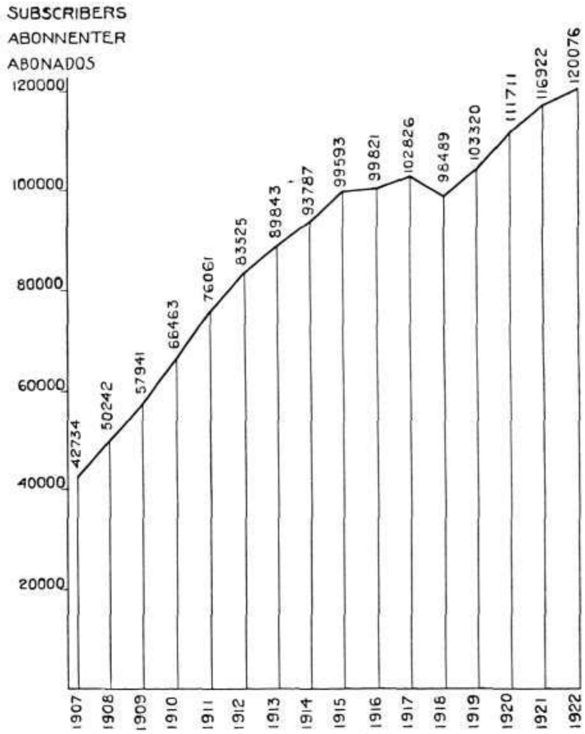
Telephone Communications in Italy.

The development of telephone communications in Italy advanced rapidly during the years immediately preceding the Great War, and it was generally hoped that conditions in this field would soon reach the same standard as in other countries. During 1913 and following years, however, there occured a marked slowing up in this work of development, caused in part by the unfavourable economical conditions which were a result of the war with Turkey. The real cause was not mainly of an economical nature, however; on the contrary, it could far more be found to lie in the manner of handling the service which — owing to various motives not always easily indentified — had not been maintained on as high a level as could be desired.

The popularity of the telephone had increased with considerably greater speed than the purely material development, the demand being much in excess of the supply. This made itself felt in the lack of toll lines — which made communication between the cities both tedious and troublesome — as well as in the lack of modern telephone exchanges and sufficiently large local nets, making it difficult and — in some cities — actually impossible to connect up new subscribers.

The operation of the nets in the larger cities lay for the greater part in the hands of the Italian government, while in a large number of smaller towns and communities the nets were operated by private companies who had been granted concessions by the Government for longer or shorter terms. It is to these private operating companies that a large part of the blame for the retardation of this development must be attributed, in many cases caused by the manner in which they preferred to exploit their nets and exchanges to the utmost merely for private gain, instead of developing and bettering the service by extending the nets and modernizing the exchanges.

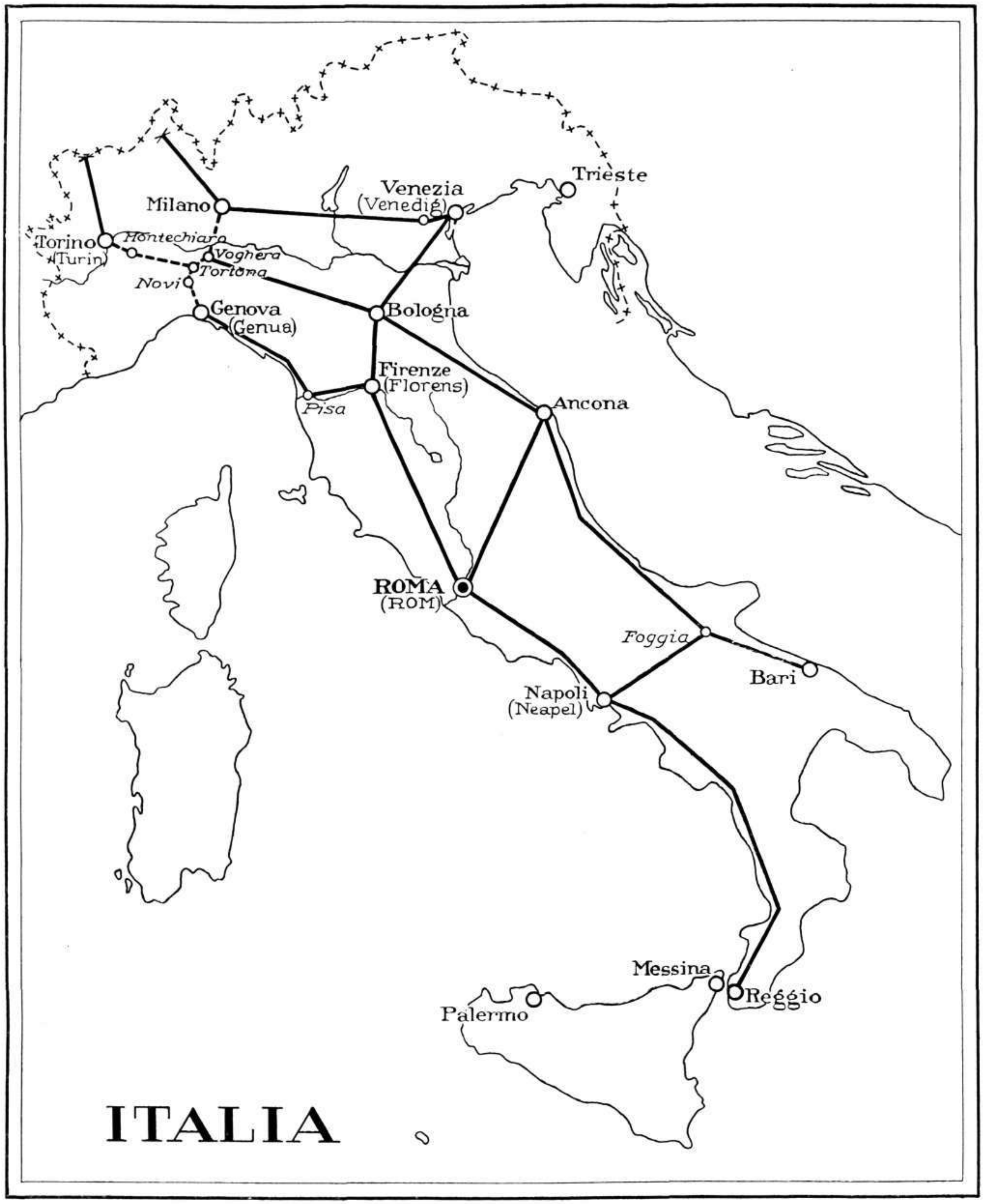
Conditions became still worse during the war. The marked decrease in the number of subscribers during 1917 and 1918 — the most severe years of the war — is shown in the accompanying diagram.



R 532 Fig. 1. Increase in Number of Subscribers in Italy from 1907 to 1922.

Immediately following the war, a tendency toward the better could be observed, this improvement being due to the increased need for telephones in the fields of both commerce and industry.

Such were the conditions at the time Fascism came to power in Italy. The new Fascist government decided to completely reorganize the telephone service so as to bring about an improve-



R 533

Fig. 2. Toll Lines to be Built by the Italian Government before 1933.

ment in the none too satisfactory existing conditions. According to the new plans, the government was to be relieved of the cares of operating the telephone nets, this work to be taken over by a restricted number of companies whose financial and technical resources would enable them to make those improvements in telephone conditions deemed necessary to insure the proper progress of this means of communication.

These plans have now been realized as far as the local service and the shorter toll lines are concerned. Only the operation of the longer and more important toll lines still remains directly in the hands of the government Plans have been afoot for letting private interests handle the operation of these lines as well, but it has met with serious difficulties to raise the capital of one billion lires required for this purpose.

Now that the government has only the longer toll lines to take care of, the funds that formerly had to suffice for the needs of the local nets also can be utilized solely for the improvement and extension of the toll service. Thus the government has adopted a program which has been inaugurated by the construction of the toll cable line Milano-Totona-Turin and Totona-Genoa. This program is to be completely carried out before the end of 1933, at which time Italy will be covered by a widespread toll telephone net, whereby quick and easy telephone communication between all parts of the country, as well as with the international lines, will be possible.

The following table together with the map in fig. 2 show the extent of the work which is to be accomplished within the next seven years.

Cable line	Number of circuits	Distance in kms.	Total lenght of circuits
Milan—Sempione	30	160	4.800
Voghera—Bologna	80	230	18.400
Bologna—Florence	100	140	14.400
Florence—Rome	100	320	32.000
Rome—Naples	80	260	20.800
Naples—Reggio di Calabria	50	520	26.000
Bologna—Venice	50	170	8.500
Milan—Padova—Venice	50	230	11.500
Rome—Ancona	50	330	16.500
Ancona—Bologna	50	250	12.500
Florence—Pisa	50	90	4.500
Naples—Foggia	50	210	10.500
Foggia—Bari	50	140	7.000
Genoa—Pisa	50	190	9.500
Foggia—Ancona	50	330	16.500
Turin—Conf. Francia	120	20	2.400

Division of the country into zones.

In connection with the surrendering of the local nets to private concerns, the government decided to divide the country into telephone zones or districts, the concession for each zone to be assigned to an operating company.

At one time certain influences strove to bring about only one concession for the telephone service of the entire country, to be granted to one single operating company, which attempt — had it been realized — would have resulted in a sort of telephone monopoly. The plan to provide Italy with really excellent telephone service with the aid of private capital, private initiative and wholesome competition would undoubtedly never have been realized through any such monopolization. Also, the government had enough foresight to perceive this, deciding, as already mentioned, to grant concessions to five different concerns. Although the results of this decision have been apparent for only a very short time, it has already proved to be the correct solution of the problem. This statement is amply corroborated by the lively activity developed by the various concerns between which competition is keen when it comes to a show-down as to what can be accomplished in the way of extensions and improvements for both nets and exchanges. This happy circumstance speaks well for the future of the telephone in Italy and proves the advantages — in this case, at least — of free competition as against a monopoly.

The government has set up a program for each zone, stipulating a certain minimum extension for exchanges and nets, which program

R 534

Fig. 3. Map Showing Boundaries of the Five Zones.

the concessionaire must follow on peril of being deprived of his concession.

All concessions have been granted for a minimum term of twenty years, subject to renewal. The geographical boundaries of the different zones are indicated on the map in fig. 3.

guaranty of 9 million lires being given for the same. According to the stipulations for this zone, the paid-up joint capital was to amount to at least one hundred million lires at the time the concession was taken over.

Milan and Turin are the two largest cities

R 535 Fig. 4. View of Naples from the Grave of Vergil.

in this zone. According to the minimum requirements stipulated in the program, the Milan net is to be extended to a capacity of 38,000 lines, distributed among eight exchanges. The corresponding figure for Turin is 22,500 lines, distributed among five exchanges.

First Zone.

The first zone includes the provinces of Alessandria, Cuneo, Novara, Turin, Bergamo, Brescia, Como, Cremona, Mantua, Milan, Pavia and Sondrio, i. e. all the provinces within Piedmont and Lombardy, and has been handed over to »Societá Telefónica Interregionale Piemontese e Lombarda» (STIPEL) with headquarters in Turin. STIPEL has taken over the local nets within this zone previously owned by the government, a

Second Zone.

The concession for the second zone has been awarded to »Società Telefonica delle Venezia», and covers — in addition to the city of Venice — the provinces of Venetia Julia and Venetia Tridentina. The guaranty given by this company to the government amounted to $2^1/_2$ million lires, the paid-up joint capital at the time the concession was taken over amounting to 30 million lires.

stipulated paid-up joint capital at the beginning of operations amounting to 20 million lires.

The program for this zone stipulates — among other things — that an automatic exchange for 9000 lines shall be built in Bologna.

R 536

Fig. 5. The Messina Cathedral.

The reconstruction program calls for a minimum of 8600 lines for Venice and 10,000 lines for Trieste.

Third Zone.

The third zone is operated by »Società Telefonica Italiano Medio Orientale» (TIMO) and embraces the provinces of Emilia, Romagna, the Marches, Abruzzi and Molise. The guaranty amounts to 1 million fifty thousand lires, the

Fourth Zone.

The fourth zone embraces the provinces of Liguria, Tuscany, Latium and Sardinia. The concession for this zone is owned by »Società Telefonica Tirrena» (TIRRENA) with seat of operations in Florence. The sum deposited with the government as guaranty amounts to 1 million lires, the paid-up joint capital at the time of purchase amounting to 70 million lires.

The reconstruction program for the largest cities in the fourth zone includes the following minimum requirements:

The Florence telephone plant shall have a capacity of 12,000 lines, distributed among three exchanges.

The Rome plant shall have a capacity of 36,000 lines, distributed among seven exchanges.

The telephone plant in Genoa shall have a capacity of 23,500 lines, distributed among six exchanges.

Fifth Zone.

This zone embraces the provinces of Campania, Basilicata, Apulia, Calabria and Sicily, the concession for the same having been awarded to »Società Esercizi Telefonici» (SET) with head office in Naples. The guaranty required by the government amounted to 2.7 million lires, the paid-up joint capital at the beginning of operations amounting to 50 million lires.

The owners of the concession for this zone probably have the most difficult task of all, depending on the fact that the existing systems at the time the concession was obtained were in a more ruinous state than in other parts of the country. Besides the restoration and extension of existing plants, quite a number of new plants had to be constructed within this zone.

As already mentioned in Nos. 1 & 2, Vol. II of »The L. M. Ericsson Review», Telefonaktiebolaget L. M. Ericsson is one of the main shareholders in »SET».

The building program for SET covering the immediate future is very comprehensive. The following full automatic exchanges — to be delivered by L. M. Ericsson — shall be completed within the next one and a half years, viz:

for Naples, Borsa, main exchange for	10,000	lines
Amedeo	2,500	»
P. Nolana	2,000	»
for Messina, one autom. exchange for	2,000	»
» Catania » » » »	4,000	»
» Palermo » » » »	6,000	»
Total	24,500	lines

The automatic telephone plant for Naples is designed for an ultimate capacity of 80,000 lines, distributed among the above mentioned three exchanges with 40,000 lines for Borsa and 20,000 lines for each of the remaining two. At present Naples has a manual local battery exchange with abt. 6000 subscribers' lines and a Western Electric automatic exchange housed in the »Amedeo»

R 537 Fig. 6. The City Hall in Brescia.

exchange building and giving service to abt. 1800 subscribers. These two exchanges will be done away with as soon as the new Ericsson automatic exchanges are put in service and all the subscribers' lines cut over to the same. During the period of transition, inter-traffic between the old and new exchanges will be arranged.

SET's business and executive offices, as well as the subscription office, will be located in the new building — just completed — erected for the P. Nolana exchange. A new building is under erection also for the Borsa exchange. The Amedeo automatic exchange will be installed in the building which now contains the Western exchange. This building, which was originally designed for an automatic exchange with a capacity of 10,000 lines, will now — thanks to the much smaller floor space required by the Ericsson system — be sufficient for equipment for 20,000 lines, giving ample proof of one of the many advantages of the Ericsson system.

In addition to the above mentioned large automatic exchanges, some thirty or more manual exchanges with capacities of 200 to 300 lines each will be built within the near future.

The erection and building of the extensive outside plants required in the fifth zone will be handled by a company specially formed for this purpose, »Compagnia Istallazioni Reti Telefoniche» (CIRT), with head office in Naples. The first jobs to be handled by this company are the building of entirely new telephone nets for Naples, Messina, Catania and Palermo, these being already partly under way. CIRT is building these nets according to the Ericsson system of line distribution, the line material used being of Ericsson's manufacture.

R 539 Fig. 7. The Ericsson-Fatme Telephone Factory in Rome.

»Società Ericsson Italiana».

Since 1917 the Ericsson telephone company has been represented in Italy by the sales company »Società Industriale Italo-Svedese». On January 1:st 1926 this firm entered into the newly formed Ericsson branch, »Società Ericsson Italiana» (SEI), with head office in Genoa and branch offices in Rome and Naples.

Naturally, SEI's main object is to look after the Ericsson interests in Italy. Quite a number of large deals have been handled by this company during the current year. The following orders for telephone exchanges — among others — having been received through them, viz:

Brescia, automatic exchange for 3000 lines together with toll exchange for forty toll lines and six positions,

Cremona, automatic exchange for 2000 lines,

Alessandria, automatic exchange for 2000 lines,

Mantua, automatic exchange for 1000 lines,

Vercelli, automatic exchange for 1000 lines,

Milan, taxicab telephone exchange for eighteen positions and sixty cab ranks, of the same system as the Stockholm taxicab exchange.

Besides its purely commercial activities, Società Ericsson Italiana has established itself as a contracting firm for the erection of outside plant. The first Ericsson net in Italy was built in Verona (second zone), being put in operation when the new automatic exchange was opened for traffic in April 1925 (A description of the Verona net may be found in Nos. 7 & 8, Vol. II of this journal). This net proved to be an excellent advertizing proposition, judged by the large amount of interest it aroused in various quarters. A breach was thus made and new orders were received in rapid succession, Società Ericsson Italiana at the present moment being occupied with the erection of nets in the cities of Brescia, Como, Cremona, Mantua and Novara.

In addition, SEI is occupied with the extension of the Milan net in certain parts of the city. Even in such cases where no direct order for a complete net has been received, the lively demand for Ericsson line material shows how highly the Ericsson system is appreciated.

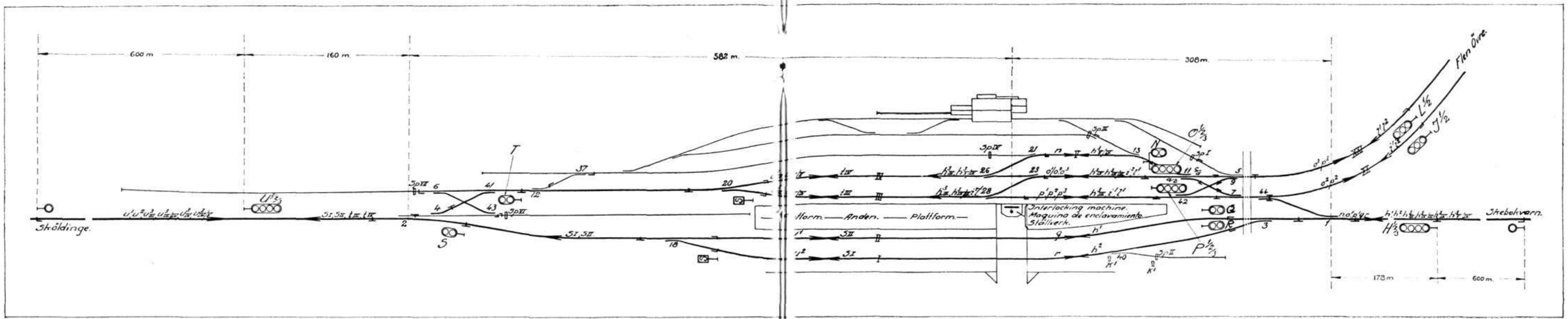
L. M. Ericsson obtains own factory in Italy.

In order to satisfy the enormous demands of the Italian market for Ericsson telephone material, plans to establish an own factory in Italy were rather near at hand — a solution which would simultaneously satisfy Ericsson's own interests as well as the national interests of Italy. Therefore, when — at the beginning of this year — an opportunity to realize this plan presented itself, L. M. E. was not slow to grasp it, this action resulting in the taking over by L. M. E. of the majority of the stock in »Società Fabbrica Apparati Telefonici e Materiali Elettrici» (FATME), whose works are situated just outside of Rome. After the reorganization of this factory — now known under the name of »Ericsson-Fatme» — under Swedish leadership, the manufacture of the Ericsson types of instruments and line material has been able to start. The manufacture and delivery of 19,000 telephone instruments as well as for appreciable quantities of line material for the outside plant building company CIRT and Società Ericsson Italiana have already been contracted for. Some of the equipment for the new automatic exchanges in Italy, such as main distributing frames, line relay racks, cable troughs and power switchboards, will also be manufactured at the Ericsson-Fatme works.

The Rome factory, which now has about 300 workers on its pay-roll, is built on modern principles and offers excellent possibilities for future extension.

The above account shows what an extensive market L. M. E. has found in Italy. The building of all the automatic exchanges as well as the delivery of most of the equipment has been entrusted to the Stockholm factory, which has secured the services of a staff of Italian electricians for the work of erection, these men having been given the opportunity of spending some time in the Stockholm factory. Through the complaisance of the two operating companies STIPEL and SET, three engineers and thirteen fitters were sent to Stockholm during April of this year, where they went through a six months' training course in the Ericsson telephone works and in the construction of an Ericsson automatic exchange for 20,000 lines now being built in Stockholm for the Swedish Telegraph Administration.

G. G.



R 540 Fig. 1. Track Plan of Flen Railway Station.

The Electric Interlocking Plant at Flen, Sweden.

By H. Holmqvist, Signal Engineer for District I of the Swedish Govt. Railways.

The new interlocking plant for the Flen railway station — a typical example of what can well be considered a modern and economical plant for medium sized railway stations — was put in operation in May 1925. The following pages will be devoted to a description of the same, especially with regard to newer devices and arrangements.

R 528 Fig. 2. Signal Cabin.

The first project for the modernization of this station included a mechanical interlocking plant with a lever interlocking machine, placed in the vicinity of the station building and under the direct control of the station master. However, it was discovered that such an arrangement would not permit any reduction in the number of hands required, since the withdrawal of the train admitter and the track inspector was counterbalanced by the personnel required to handle the interlocking machine. A new project was then drawn up, calling for an electric interlocking machine located in a signal cabin (see fig. 2) on the station platform, this machine to be taken care of and manipulated by the station master himself. This project was based on the assumption that the station master should clear the tracks and manoeuvre the signals, the clearance at points for the respective tracks to be electrically controlled. All switching operations, on the other hand, were to be taken care of locally, i. e. by means of devices located at the various points in the

L. M. Ericsson

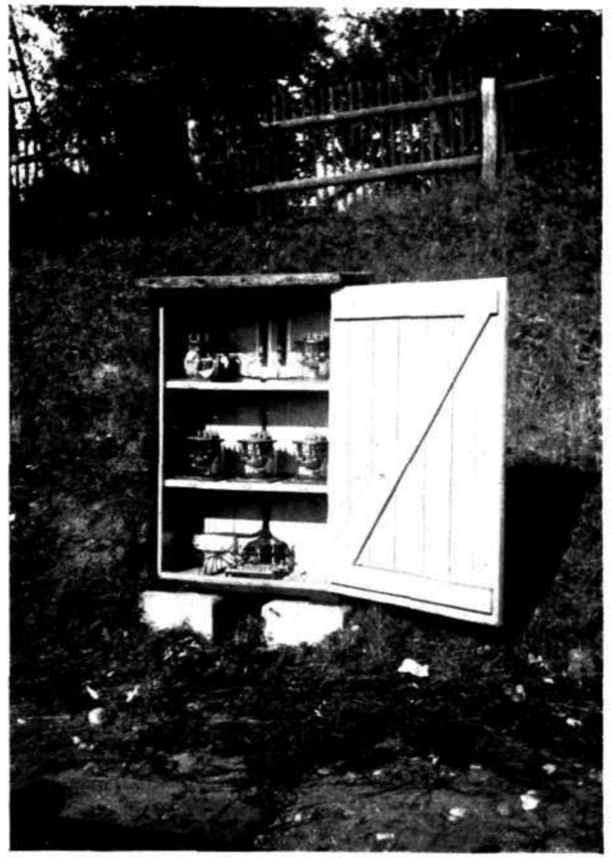
track yard. It was figured that the installation of such a plant would permit a saving of two men, an assumption which has proved itself correct.

The functioning of the plant is based on the system with insulated track sections, the rails serving as conductors for a current which keeps a track relay energized as long as the track section is free from rolling stock. On account of electrification of the railway, it was necessary in this case to leave one rail unbroken for the passage of the traction current.

An alternating current with a frequency of fifty periods is used for the track circuits, the tension being comparatively low — about twelve volts, transformed down from a 220-volt current. The relays will not function for a current of any other frequency than fifty periods, this being necessary to protect them from the influence of the traction current which has a frequency of about sixteen periods. Track relays and transformers are located in wooden cabinets (see fig. 3) out in the track yard, at the ends of the track sections.

The positions of the track relays are repeated by direct current relays mounted in a relay cabinet in the signal cabin.

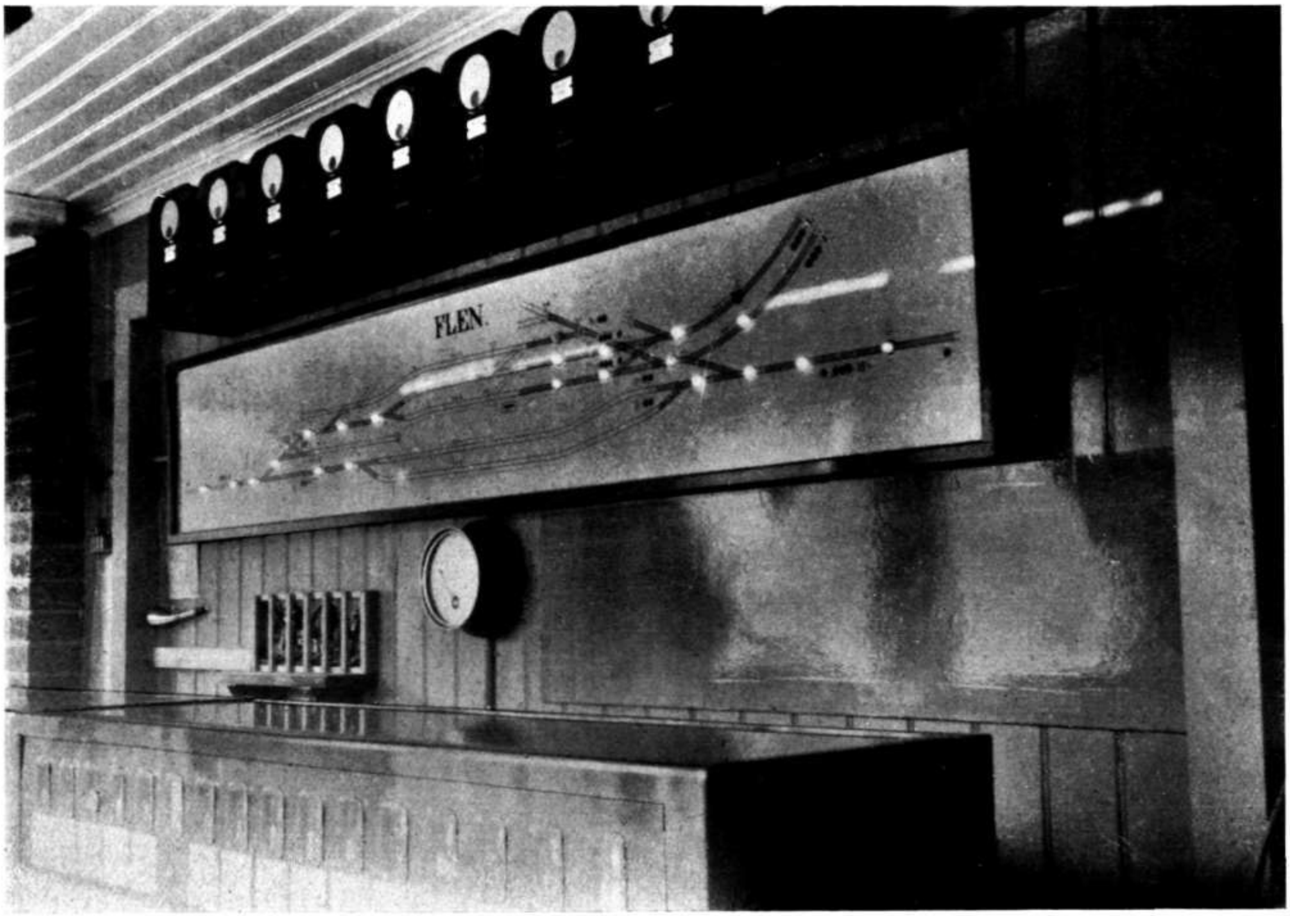
The interlocking machine is of the standard L. M. Ericsson electrical type. It is this firm — represented by Signalbolaget — that has delivered the material and built the plant.



R 529 Fig. 3. Relay Cabinet Mounted in Station Yard.

The interlocking machine contains point levers for the central control of those points which require setting for the clearance of the various tracks. All of these point levers are equipped with point locking magnets, making it impossible to move the lever as long as a car is on the track which passes over this point. Further, the interlocking machine contains signal levers for incoming and outgoing signals; with regard to the clearing of freight tracks, the same signal combinations are used for several tracks.

The signal levers are so constructed that it is impossible to place any one of them in »clear» position unless all the track sections forming a part of the track in question are free from rolling stock. This condition is obtained by leading the switching current for the signal levers over contacts in the above mentioned repeating relays. By the aid of an illuminated, transparent track plan placed over the interlocking machine (see fig. 4) it is possible for the station master to ascertain by a single glance which track sections are clear. Behind every track section on the plan there is a little lamp which glows as long as the section is not occupied by one or more cars. As soon as a car enters this track section, the lamp ceases to glow. The lighting and extinguishing of these lamps is controlled by means of the repeating relays in the interlocking machine.



R 530

Fig. 4. Illuminated Track Plan.

We have already mentioned that the centrally controlled points can also be set locally by hand. For this purpose, the interlocking machine is equipped with a number of relays controlled by means of special levers located beside the various points out in the track yard. The yard man carries a key which fits into the local point setting device and is turned to the one side or the other, depending on the direction in which the point is to be set. This causes the corresponding relay in the interlocking machine to energize, closing a motor circuit and setting the point. If the point in question forms a part of a previously cleared track, the current to the relays is cut off by means of contacts on the signal levers, any attempt to set the point locally being thus frustrated.

All of the signals in this plant are so-called light signals, visible at a distance of about one kilometre even in strong sunlight. At Flen, the incoming signals and a couple of the outgoing signals are mounted on concrete posts, the remaining outgoing signals being mounted on contact-line poles or suspended from the gantries which support the overhead traction wires (see fig. 5).

The Flen plant is the first in Sweden in which a consistent use has been made of light signals, with which excellent results have been obtained. Light signals have the decided advantage of being almost more clearly discernible in foggy or misty than in clear weather, the opposite being the case with semaphores. Furthermore, the absence of moving parts makes them less liable to get out of order than mechanical signals.

R 531

Fig. 5. Outgoing Signals at North End of Station Yard.

Light signals are especially suitable for electrified railways, as they stand out clearly in the confusion of poles, trusses and traction wires.

The light signals are manoeuvered by the aid of direct current relays which are energized by the setting of the signal levers. The signal current itself is a. c., being transformed in small cabinets placed near the signals.

It can well be said of this plant that it satisfies very exacting demands as to efficiency and convenience, and it is very probable that this type of interlocking plant will be chosen for other stations on the Swedish Govt. Railways. At the present time Signalbolaget is occupied with the installation of similar plants at Herrljunga and Skövde.

Signal arrangements based on the same principle have also been adopted for Tumba and Huddinge. In these cases the previous mechanical interlocking machines have been retained for the setting and locking of the points, but the mechanical signals have been replaced with light signals, controlled from the station platform by the station master. Also, the entire track yard has been divided up into track sections. As long as the two through tracks only are used, no special man is required at the interlocking machine, this being necessary only when the side-tracks are being used or if there is any switching to be done.

Vol. III. 1926.

CONTENTS.

I. Biographical data.

II. Articles.

III. General Notes.

Stockholm 1927. Kurt Lindberg, Boktryckeriaktiebolag.