

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.

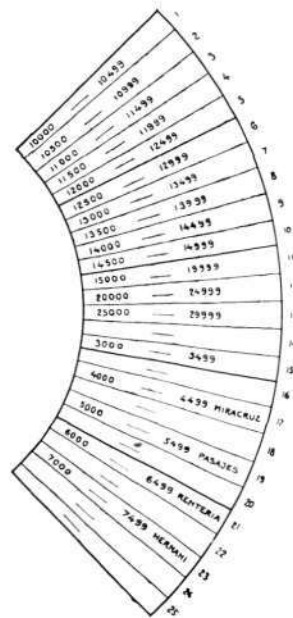
For »La Red Urbana», or the municipal net, the initial capacity is 5000 lines, while for the provincial net it is 2000, i. e. 500 lines for each of the above mentioned four exchanges.

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.



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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 accommodate 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.

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 *I 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 *I 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.

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, Rentería 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

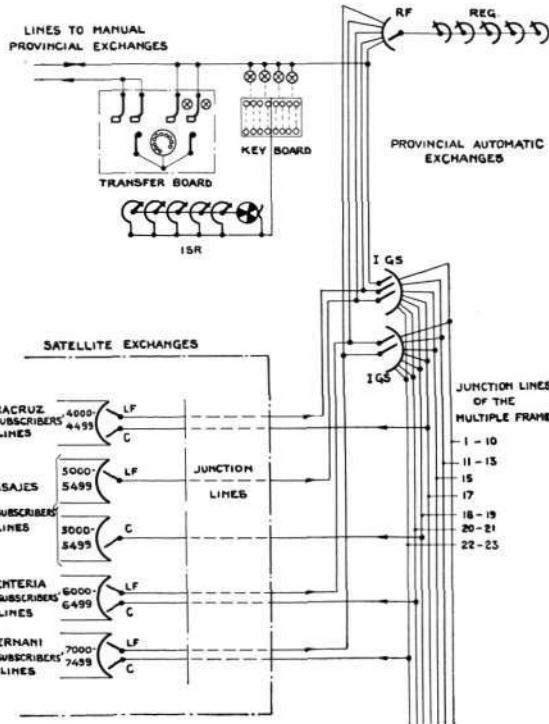


Fig. 2.

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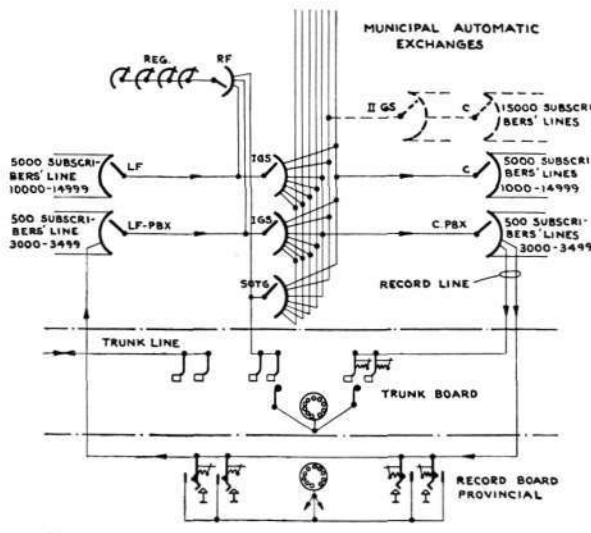


Fig. 3.

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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 installation 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 place 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 *I 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 *I 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 *I 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 described, with the exception that here the group selector *I 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 *I 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 has 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 *I 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.

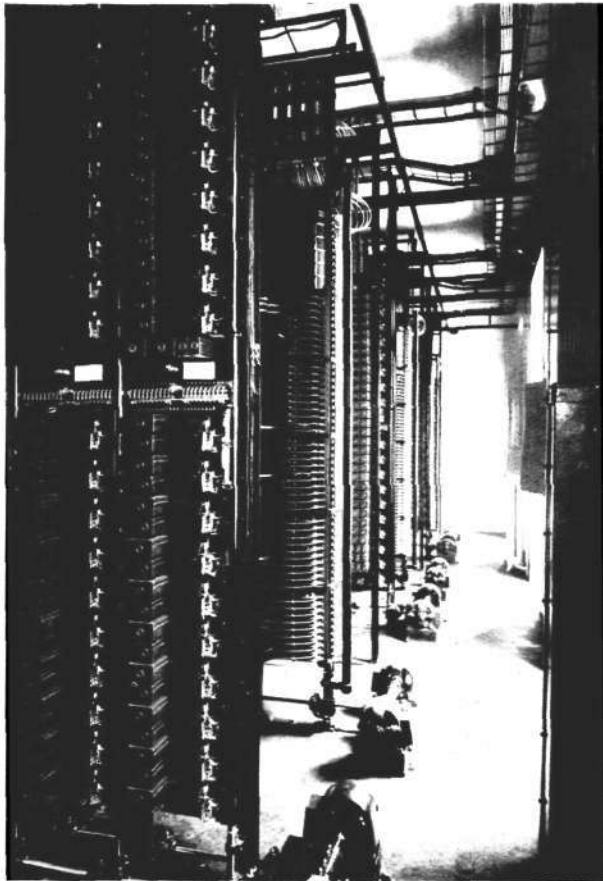
Toll calls. The diagram in fig. 3 shows schematically how the order wires to the right enter the toll board. The record lines from the jacks in the centre are connected to special switches *SOTG*.

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.



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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



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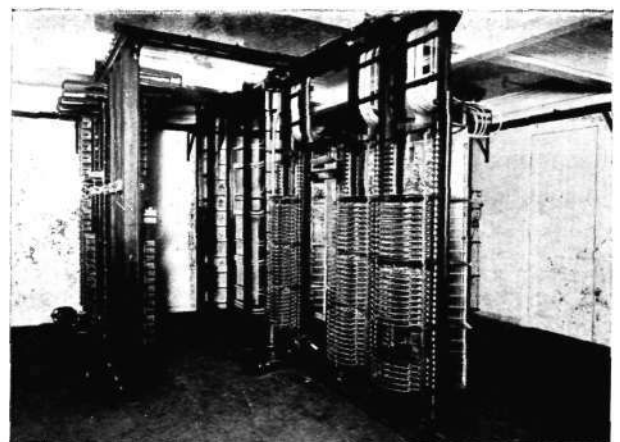
Fig. 5.

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.

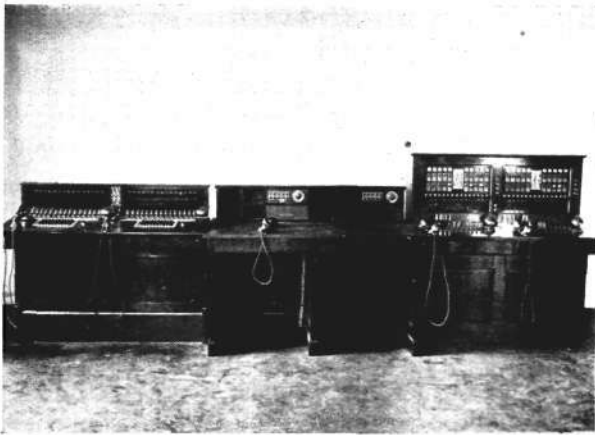
The transfer board receives orders for calls to the manual provincial exchanges and handles the traffic between these exchanges.

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



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Fig. 6.

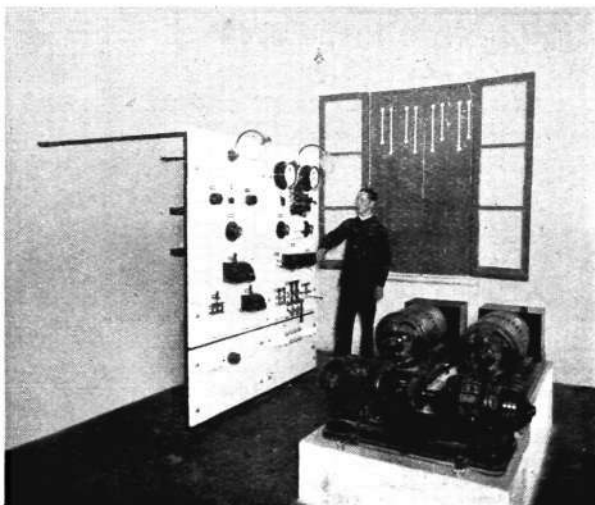


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Fig. 7.

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

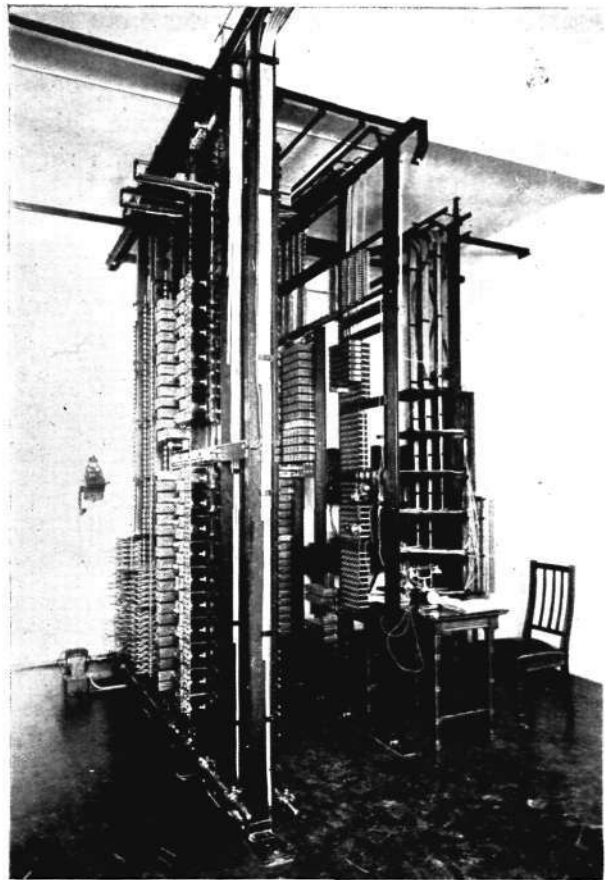


R 527

Fig. 9.

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



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Fig. 8.

connected up directly to a 45 h. p. internal combustion motor.

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 *IGS* — these latter being visible in the second row of racks. The register finders

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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.



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The Ericsson handset suits all conditions and types of people.

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

CONTENTS OF THIS NUMBER: Anton Ryberg †. — The Toll Traffic Problem in Europe with Special Reference to the Organization of the Service. — On Various Principles of Receiver and Loud-speaker Design. — Description of the Ericsson Automatic Exchanges in San Sebastián and Vicinity.

Stockholm 1926. Kurt Lindberg, Boktryckeriaktiebolag.