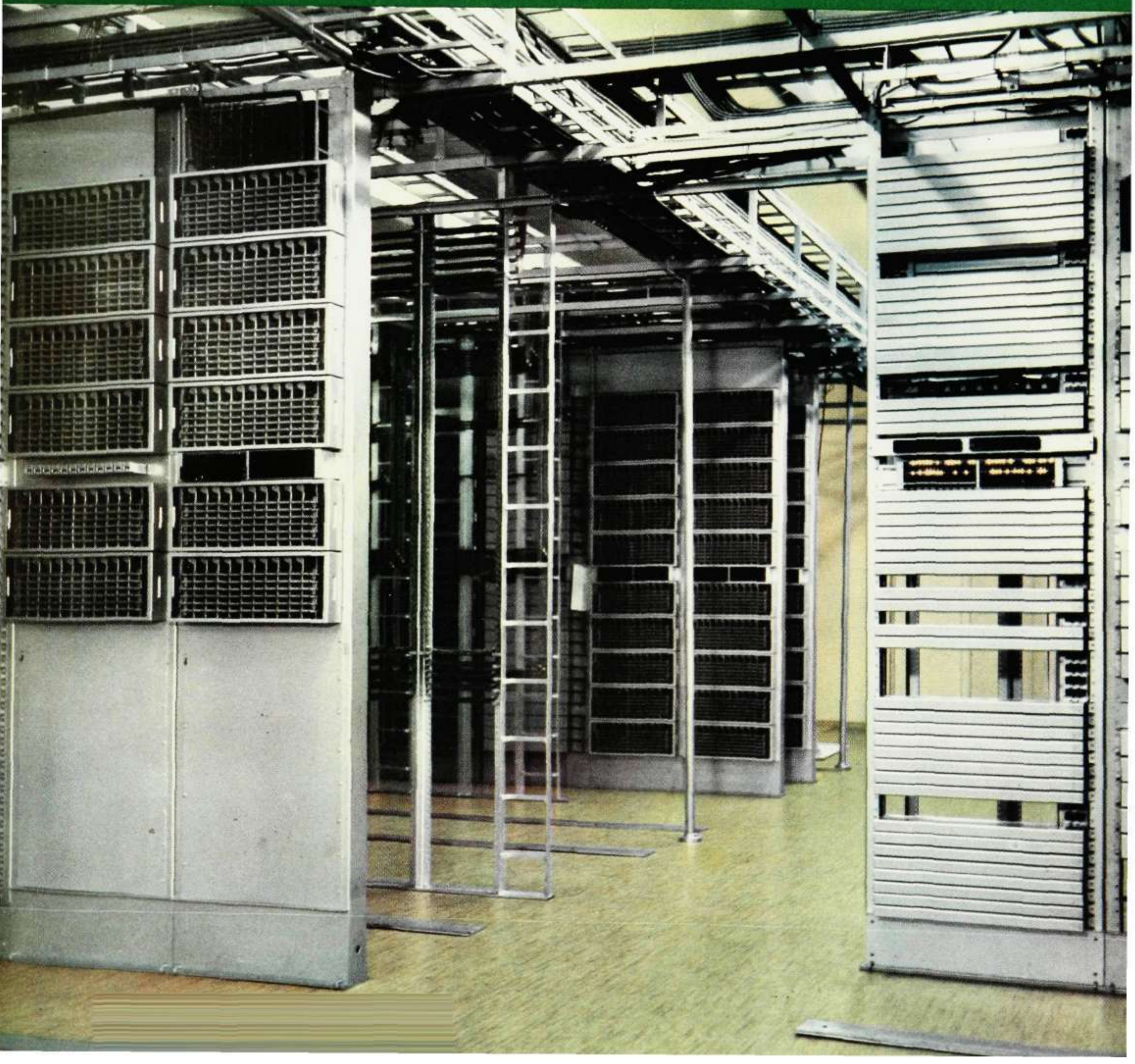
Ericsson Review

No 4
1950



ERICSSON REVIEW

Responsible Publisher: HEMMING JOHANSSON
Editor: SIGVARD EKLUND, DHS
Editor's Office: Stockholm 32
Subscriptions: one year $ 1.50; one copy $ 0.50

CONTENTS

On cover: Interior of the automatic telephone exchange Sörnäs in Helsinki carried out in accordance with the L M Ericsson by-path system with crossbar switches.

Printed in Sweden, Esselte AB, Stockholm 1950

The LM Ericsson Crossbar Switch System in Helsinki

DR S A KARLSSON, THE HELSINKI TELEPHONE SOCIETY, HELSINKI

U. D. C. 621.395.344

At the end of the war the Helsinki network group was exclusively composed of automatic exchanges, based on the step by step system, with a capacity of approximately 65 000 numbers. In spite of this it was decided to carry out the required extensions in accordance with the LM Ericsson by-path system with crossbar switches. The author attributes this decision to the superior essential features of the new system, describes the principles of the system and gives an account of operating results obtained so far and the extension schemes which have later been decided upon.

All telephone calls in and around Helsinki are carried out over automatic exchanges. In the centre of the town there are exchanges at Centrum, Tölö and Sörnäs with 31 000, 15 200 and 6 800 numbers. To these exchanges are connected 9 end exchanges containing a total of 7 300 numbers, see Fig. 1. The Helsinki network group covers in addition some 40 automatic rural exchanges for approximately 5 000 numbers.

The exchanges, all according to the Siemens and Halske step by step system, were practically without number reserves already during the later phases of the war. Material for this system could, however, not be obtained at that time and it was necessary to decide on some other system, which was readily available.

The new system should, as a primary condition, operate efficiently and economically with the existing Siemens exchanges. In the first place it seemed as if another step by step system would best meet this condition. In spite of this such a system was not ordered for the extensions of the Siemens exchanges in Helsinki, but the crossbar switch system according to the by path principle offered by L M Ericsson. The reasons for this were in the main:

1) *The superior contact performance in the crossbar switch.* Experience has shown, that non-precious sliding contacts are not quite satisfactory, and that selectors with such contacts are subject to rattle and require expensive main-

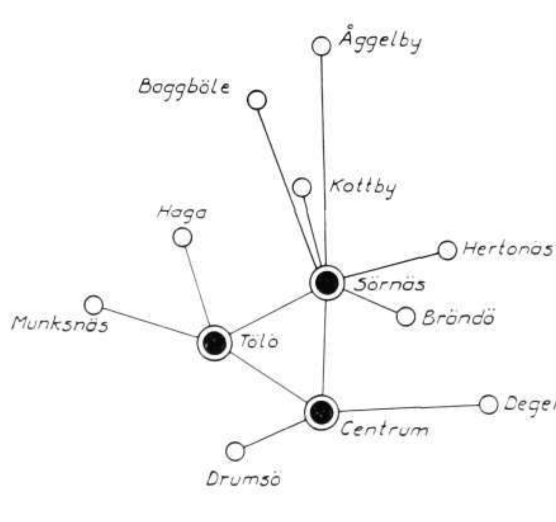


Fig. 1 X 6536
The telephone exchanges in Helsinki

tenance. In the crossbar switch twin silver contacts are used, the contact is equal to that in relay spring sets, which according to experience are free from rattle and do not require appreciable maintenance.

2) *Absence of selector cords.* The selector cords require expensive maintenance and give rise to rattle and faults difficult to trace.

3) *Small magnet load.* The high power and current required to operate the selector magnets in the step by step system causes substantial contact wear and expensive maintenance.

4) *Reduced selector maintenance.* The operating forces and movements in the crossbar switch are small. This results in reduced wear and adjustment work as compared with the intricate mechanismus in the step by step and power-driven systems.

5) *Extremely fast operation.* The slow operation of the step by step selector limits the number of rotary steps to 10, which means an inefficient utilization of the connecting elements, as the availability of the gradings is limited to 10. The fast operation of the crossbar switch makes it possible to form large well utilized element groups. The fast operation of the crossbar switch enables the use of registers and partial registers for direct operation, combining the advantages of the register systems and the direct operation systems.

The crossbar switch appears, therefore, to meet the principal conditions on selectors for fully automatic long distance telephony, whereas the step by step selector can fulfil these requirements only to a very limited extent.

The crossbar switch exchange Sörnäs in Helsinki will be described below. The Sörnäs exchange is the first stage in an extensive scheme of exchanges for Helsinki and is the first crossbar switch exchange put into service based on the L M Ericsson by-path system.

Circuit Lay-out

The system in Helsinki has been devised so as to co-operate efficiently with the Siemens exchanges. This means that calls from and to the Siemens exchanges do not require matching repeaters. The operation voltage 60 V is, therefore, maintained also on the new system.

The subscribers are divided into 1 000-groups for finders and final selectors (*SL*, Fig. 2). The selectors form two link systems, one for outgoing and one for incoming traffic. The outgoing link system consists of selector stages A and B and the incoming link system of stages A, B, C and D. The A-stage is consequently common for incoming and outgoing traffic. The subscriber group has in addition a common marker *M*, 10 registers *R*, 60 incoming »connector» circuits *LKR* and 60 outgoing finder circuits *SR*. Six incoming connector circuits are connected to one register. One connector circuit only can be connected to the register at one time, and the remaining free connecting circuits belonging to the register are blocked during the engaged period of the register. The marker selects and marks the connection routes for incoming and outgoing traffic. The subscriber's number in the 1 000 group is marked in the marker by 10 relays for the unit, 10 for the ten digit and 10 for the hundred digit. For outgoing calls the subscriber's line relay *LR* identifies the subscriber's number. By means of a translator (identifier) in the marker the unit, tens and hundreds relays are operated corresponding to the subscriber's number. The marker is then selecting a free connection route from the marked subscriber's line to a free outgoing junction over a by-path circuit in the marker, whereupon the marked actual connection is established.

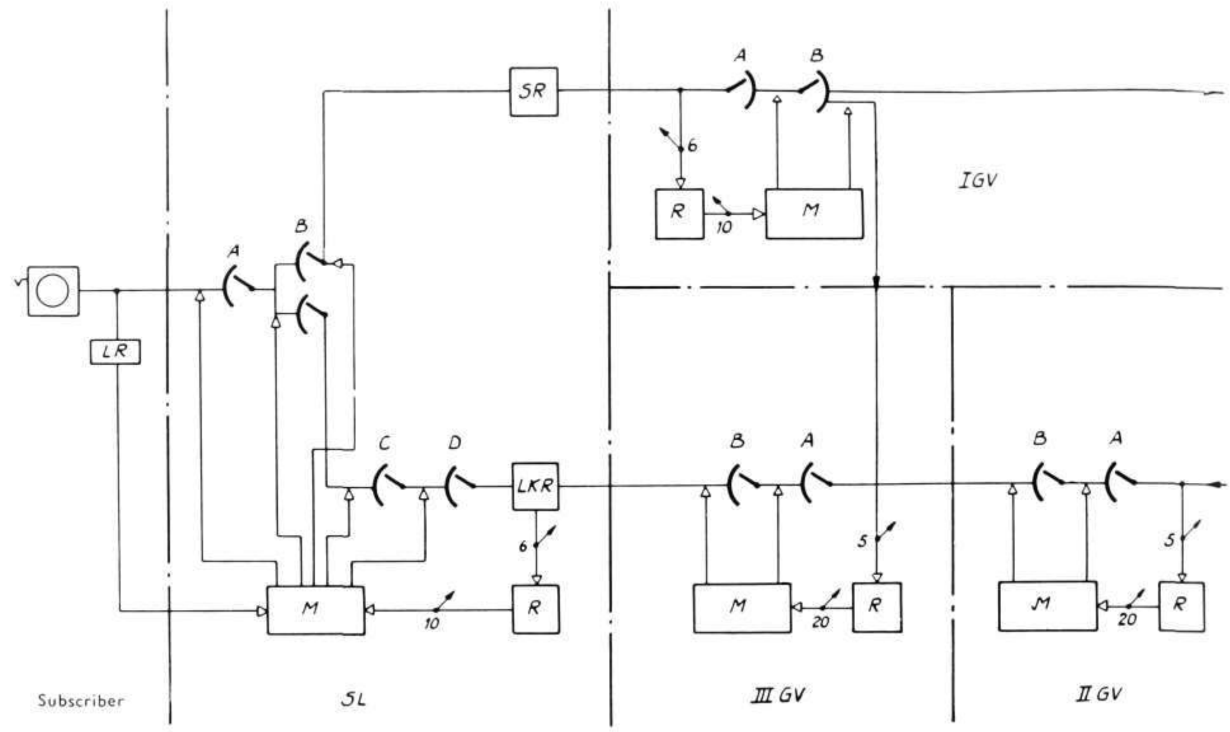


Fig. 2 X 7575

Skeleton diagram of finders and final selectors (SL) and group selectors (GV)

When the actual connection is established the marker is released and connection is obtained by means of the vertical unit magnets in the A- and B-stages. For an incoming call a connector circuit *LKR* and corresponding register *R* is engaged. The register receives the three last digits in the dialled number, which are transferred to the unit, tens and hundreds relays in the marker. The marker then marks, through a by-path circuit, a free connection between the connector circuit engaged and the subscriber corresponding to the number dialled. The marked route is established and the marker and the register are released. The connection is held by the vertical unit magnets in the A-, B-, C- and D-stages. The total operating time for the marker is 350 ms approximately.

The outgoing junction is connected over an outgoing finder circuit *SR* to a first group selector *I GV*. Six outgoing finder circuits *SR* are connected to one register *R* in *I GV*. Ten registers are combined with one marker *M* which, therefore, is common to 60 *I GV*. The group selector consists of two stages A and B. The outgoing finder circuit feeds the microphone of the A-subscriber, serves as impulse repeater, checks the call metering etc. *I GV* is operated with one or two digits in 10 decades or traffic channels. The 10 two-digit codes all start with the same figure, at Sörnäs figure 7. The 9 one-digit codes are made up of the remaining first figures. The register *R* for *I GV* receives the code and sets the marker, which connects the call to a free outlet in the required direction. If one of the one digit routes is dialled, connection takes place immediately on receipt of the impulse train. If a two-digit route is dialled, the register receives both figures. When the second dial train is completed, connection takes place in the required direction. At Sörnäs exchange the two-digit routes are internal. In this way one group selector stage is eliminated for these routes.

For internal calls in Sörnäs a third group selector *III GV* is thus directly taken from the *I GV*. The *III GV* is fundamentally similar to *I GV* and as *I GV* it may be operated by one or two digits. At Sörnäs exchange, however, one digit operation only is used and the *III GV* works in the same way as a Siemens *III GV* which it may replace. Five incoming lines have a common register *R*, and 20 registers are connected to a common marker *M*, which consequently serves 100 lines or group selectors.

The incoming traffic from other exchanges is received by a second group selector *II GV* which is identical with *III GV*.

Incoming lines from other exchanges and outgoing lines to other exchanges end up in either Siemens exchanges or crossbar switch exchanges. The two systems are thus co-operating without matching repeater equipment.

The Marker Principle

As follows from the plan, the system consists of *GV*-units and *SL*-units with markers and registers. To give an idea of the function of the marker and the by-path principle employed, the fundamentals of a group selector marker will be outlined by means of simplified general diagrams.

Fig. 3 shows a grouping plan for one *II GV* unit. The A- and B-stages each consist of 10 crossbar switches, referred to as *1 A—10 A* and *1 B—10 B* respectively. The switch consists of 10 vertical units with 2 groups of 10 outlets designated *I, 1—10* and *II, 1—10*. In the A-stage the outlets are multipled over two switches. There are consequently $5 \times 20 = 100$ connecting links between the A- and the B-stage. In the B-stage the outlets from each vertical unit are multipled over 5 switches resulting in $20 \times 20 = 400$ outlets. These 400 outlets may be grouped to vias in different ways. In the Sörnäs *II GV* and *III GV*, the outlets are grouped in 10 vias with 40 outlets per via. Each via will contain 2 of the decades 1—20 shown in the plan. The 20 outlets in

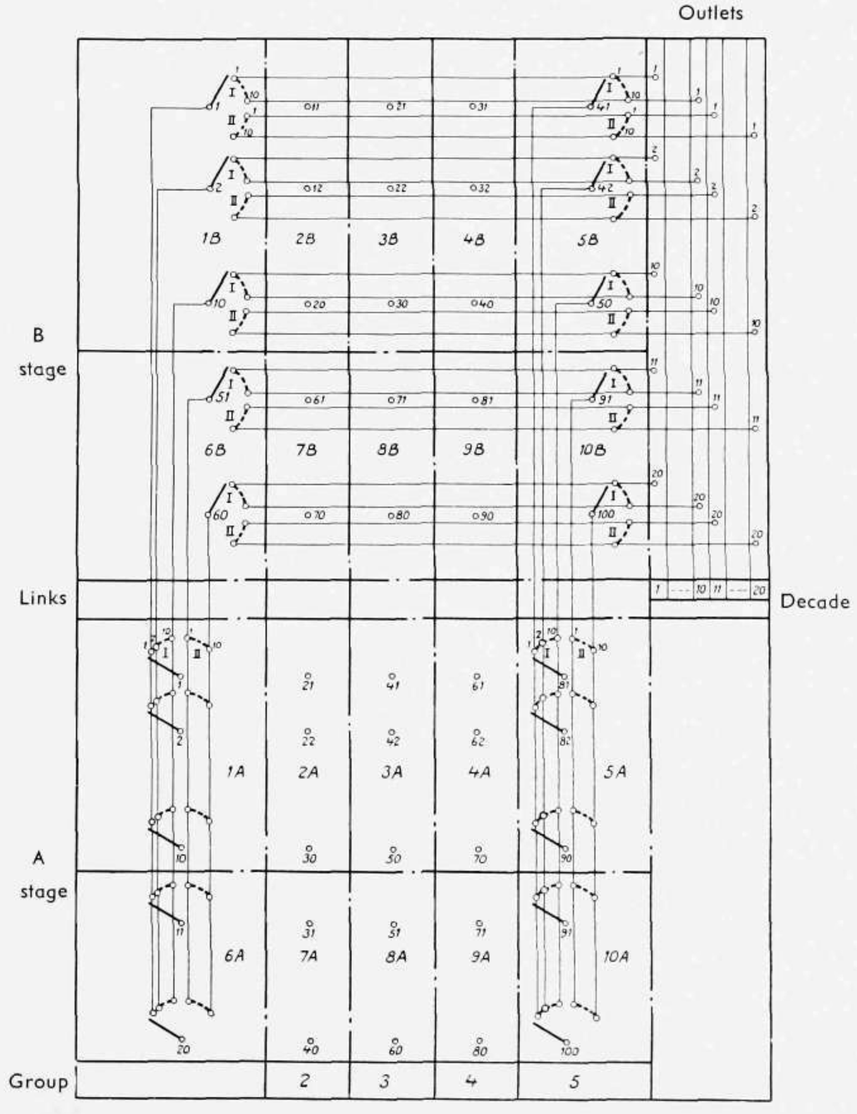


Fig. 3
Grouping plan for II GV-unit

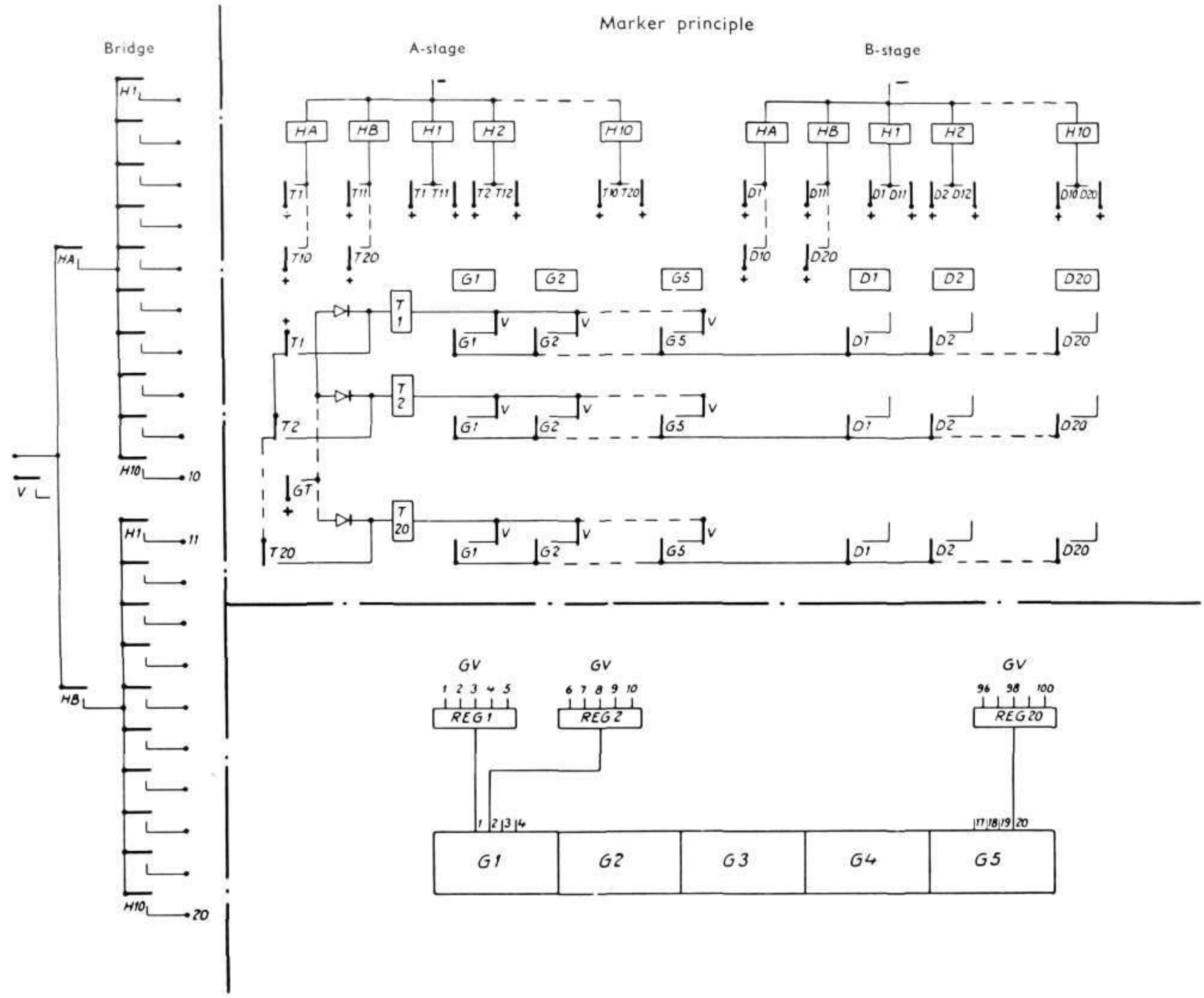


Fig. 4 X 7577

Marker principle for group selector

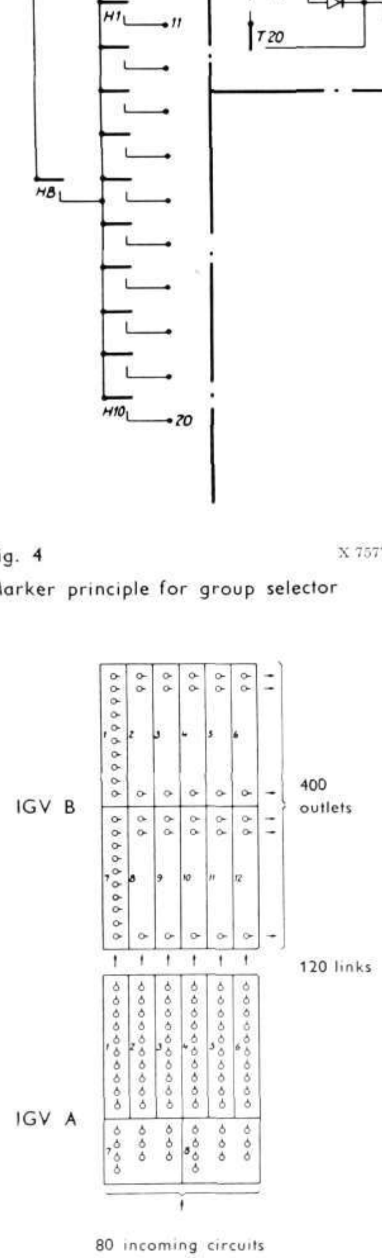


Fig. 5 X 4695

Simplified grouping plan for I GV-unit

each decade are distributed over the 20 multiples in the B-stage. In Fig. 3 each decade is represented by a column stating the numbers of the outlets. The incoming lines are connected to A-vertical units and are numbered in 1—100. To increase the reliability the switches, registers and the marker are devided into 5 groups. The grouping of the switches follows from Fig. 3 which illustrates that a call will only engage elements in the same group.

Fig. 4 shows a vertical unit with 20 outlets, as well as the grouping and the marker principle. The unit contains 12 contact groups. Ten of these groups are duplicated, indicated in the figure as two groups of 10 contacts designated *H 1—H 10*. Two of the groups are single groups referred to as *HA* and *HB*. The 10 duplicated groups are selected by bar magnets *H 1—H 10* and the single groups by bar magnets *HA* and *HB*. From the figure it will be seen, that the vertical unit selects a certain outlet through operation of *HA* or *HB* and one of magnets *H 1—H 10*. The outlets in the unit is consequently marked by the bar magnets which are, therefore, also termed selecting magnets. Each vertical unit has in addition a contact group *V*, which is operated by the unit magnet.

Five group selectors have a common register and four registers belong to the same group. Each of the 5 groups designated *G 1—G 5*, therefore, contain 4 registers and 20 *GV*.

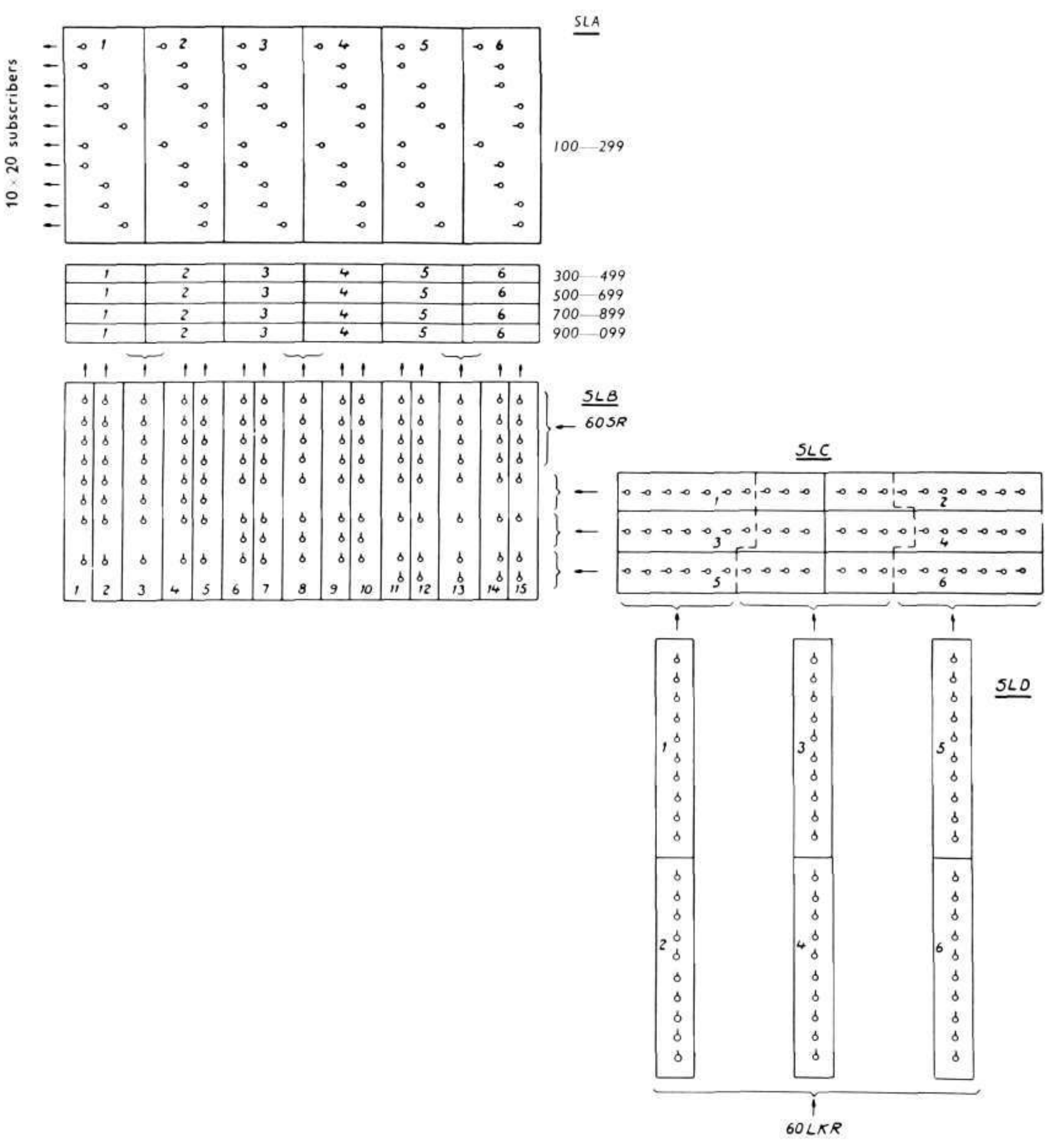
A group selector may be operated only if the corresponding register is disengaged and one *GV* only may be connected to the register. We assume that

GV 2 has been engaged, and with this register 1 belonging to group 2. The subscriber dials figure 1. The dial impulses are stored in the register, engaging the marker and operating decade relay *D 1* and group relay *G 1*. As each via is consisting of two decades, via 1 contains decades I and II. Decade relay *D 1* connects, in group 1, selectors *1 B* and *6 B*, bar magnets *H 1* and *HA* (Figs. 3 and 4) and connects the 20 outlets to test relays *T 1*—*T 20* over contacts on relay *G 1* and the 20 vertical unit contacts *V* in selectors *1 B* and *6 B*. Disengaged outlets are connected to negative whereas engaged and blocked outlets are connected to positive and open potential respectively. Only those outlets meeting a disengaged vertical unit in selectors *1 B* and *6 B* are connected to the test relays. The test takes place during a limited period during which all test relays are connected to positive over contact *GT*. All test relays corresponding to disengaged vertical units and outlets are connected during the test period and are operated instantaneously. Only one relay will remain operated viz. the one nearest *T*, which is the origin of the positive.

We assume that relay *T 2* remains operated after test. Contacts on *T 2* connect bar magnets *H 2* and *HA* in selectors *1 A* and *6 A*, marking outlet 2 in the A-stage of group 1 corresponding to link 2 and the second vertical unit in selector *1 B*. In the B-stage, *HA* and *H 1* in group 1 will mark decade 1 and in the A-stage, *HA* and *H 2* outlet 2. When the marking has been completed, the connection is established by operation of unit magnets in vertical units *A 2*

Fig. 6 X 7576

Grouping plan for finders and final selectors



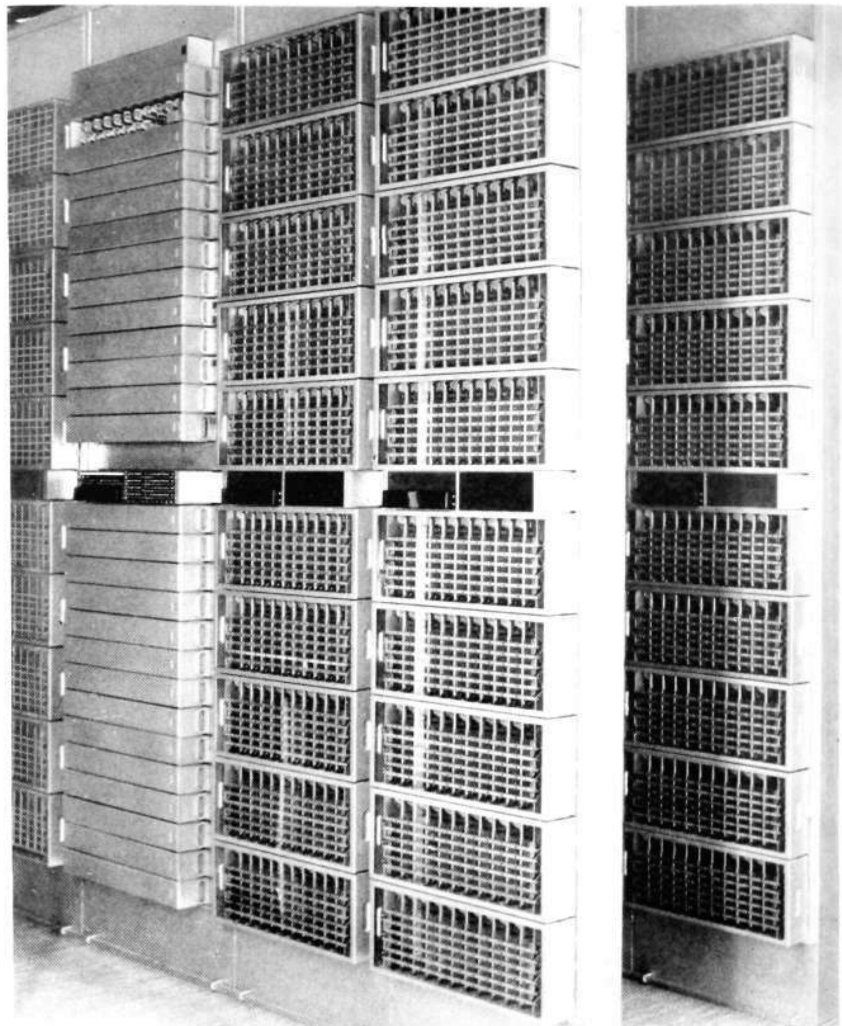


Fig. 7 X 6545
The front row contains all GV-unit covering 100 II GV

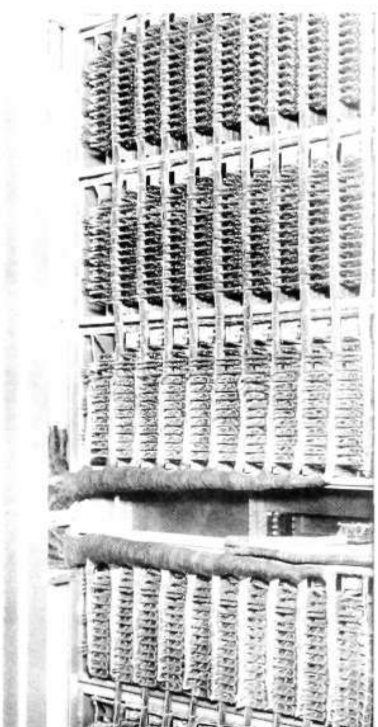


Fig. 8 X 4700
Rear of the selector rack cover removed

and *B 2*. The marker and the bar magnets are then released. The total operation time for the marker is 100 ms approximately. If no T-relay operates during the test period, decade relay *D 1* is released and *D 11* is operated followed by retest of outlets in decade II.

Relays *T 1*—*T 20* are connected in a lockout circuit. Such circuits constitute a very important part in crossbar switch systems. The safe performance of the circuit is depending on the series connected contacts on the chain relays. If one of the contacts is faulty the T-relays farther away in the circuit are disconnected. To increase the safety of the relay circuit, parallel contacts are used. Another method of increasing the reliability is to move the starting point for the circuit one step on each operation of the marker. With this method a more even distribution of the load on the outlets is also obtained.

Expansion or Contraction

The group selector units are characterized by the grouping plan which may be varied within wide limits. The *II GV* described above has the same number of selectors in the A- and the B-stages. If the number of selectors in the B-stage is increased, resulting in a link connection with expansion, the internal blocking is reduced and the outlets may take a heavier traffic. A simplified grouping plan for such a link connection is shown in Fig. 5, which is the grouping plan for *I GV* of the Sörnäs exchange. The small circles indicate vertical units and the arrows the multiple direction. Each arrow thus represents 20 outlets. The A-stage contains 80 vertical units and the B-stage 120 units. The expansion is, therefore, 1 : 1.5.

If the vertical units in the A-stage carry a light load it is economical to employ contraction i. e. a smaller number of B-selectors than A-selectors. This is the case for the A- and B-stages in *SL*. Fig. 6 shows the grouping plan for *SL* in the Sörnäs exchange. The A-stage contains 300 vertical units, whereas the B-stage has 120 units. There is, consequently, a contraction of 1 : 0.4. The D- and C-stages have the same number of vertical units and thus no contraction or expansion. The same applies for the C- and the B-stages. The vertical units in the A-stage reach 20 subscribers. There are 6 vertical units for 20 subscribers. In order to balance of the traffic the vertical units are divided in two groups, 3 of the units are accessible from the same 20-group and the remaining 3 from another 20-group. The unit and ten digit figures in the first group are reversed in the second group. A subscriber's multiple of this kind is termed a transposed multiple.

Mechanical Lay-out

Fig. 7 shows part of the *II GV*-group. To the right in the nearest rack row are two selector racks each fitted with 10 crossbar switches and to the left of these a relay rack. This part constitutes one *II GV*-unit containing 100 *II GV*. The front of the selectors and the relays are protected by a cover. The selector covers are provided with glass fronts to enable supervision of the selector positions from the outside. The rear of each rack is enclosed by a protection cover.

Fig. 8 shows the rear of a selector rack with protection cover removed. It will be seen that the selector multiple is a wire multiple.

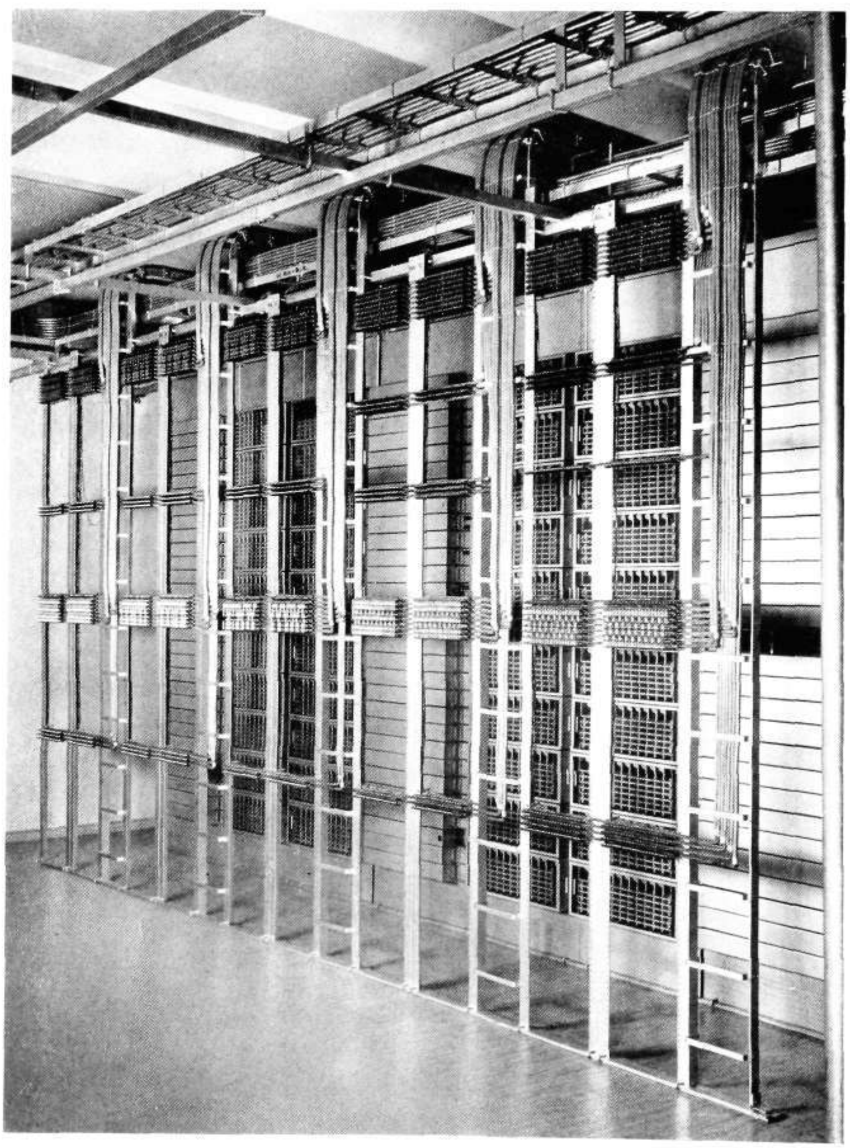
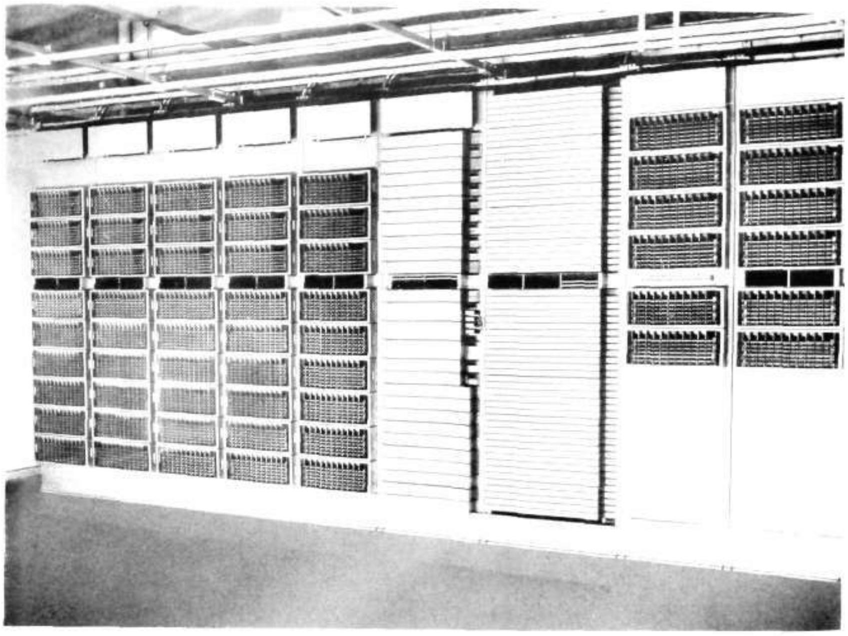


Fig. 9 X 6546

In the foreground grading rack (IDF) for II GV



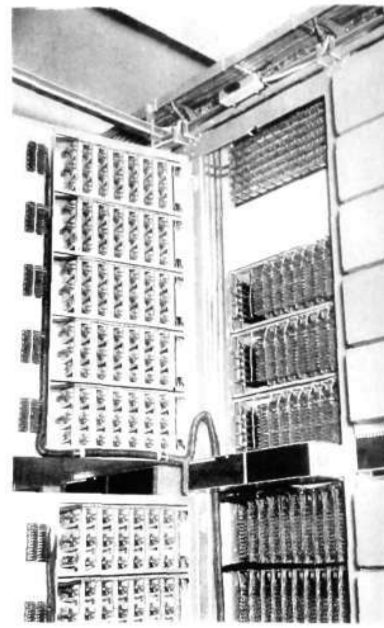


Fig. 10 X 6547

Rack containing a finder and final selector group for 1000 numbers

Fig. 11 X 4701

Rear of the finder and final selector rack for the A-stage

showing line relay gate opened

Fig. 9 shows in the foreground the grading rack, *IDF*, for the *II GV*. The grading is carried out with bare wire but insulated wire may be used when required. The grading frame is designed by the Helsinki Telephone Society.

Fig. 10 shows the *SL*-group. To the extreme left are 5 selector racks. Each rack contains selectors and line relays for a subscriber group of 200 numbers. On the front are 3 B-selectors and below these 6 A-selectors. The line relays are mounted on gates at the back of the racks as shown in Fig. 11. Relays for 20 subscribers are assembled in exchangeable units. The selector racks are

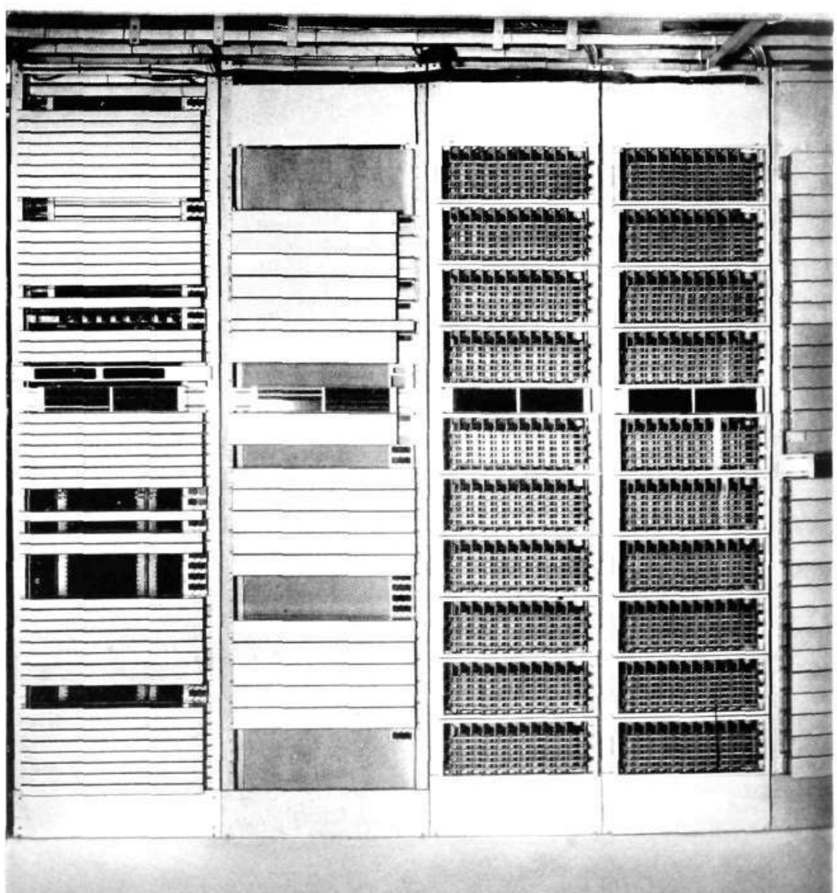


Fig. 12 X 6548

Row of I GV-units containing 80 I GV

In the rack for finder circuits, shown to the left, a number of finder circuits have been removed.

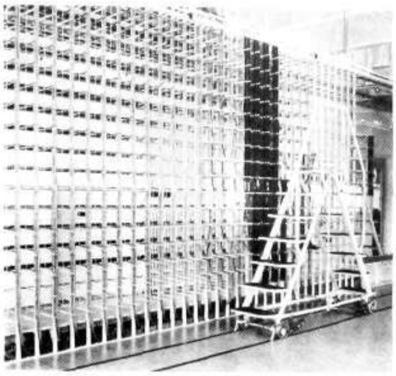


Fig. 13 X 4702
Main distribution frame

followed by the marker rack, which also contains 10 registers for incoming traffic. Then follows 60 incoming connector circuits *LKR* and finally the selector racks for 6 C- and 6 D-selectors.

Fig. 12 shows one *IGV*-unit containing 80 *IGV* and 60 outgoing finder circuits *SR*. The finder circuit rack will be found to the extreme left, followed by a relay rack with the *IGV*-marker mounted at the top and 10 *IGV*-registers below. At the end of the row two selector racks will be seen, each containing 4 A-selectors and 6 B-selectors.

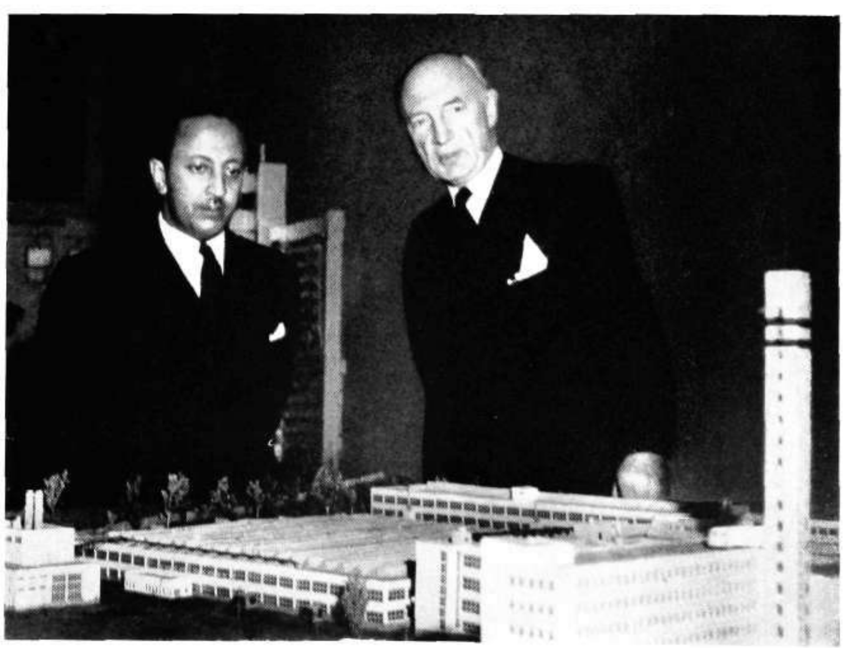
Fig. 13 shows the main distribution frame for the Sörnäs exchange. This frame is of a new design developed by the Helsinki Telephone Society. Test jack strips without fuses are arranged on the line side as well as on the exchange side. The line and the exchange cables in the frame consist of 100-pairs cables distributed on 5 20-pairs strips. The cable and the branches are lead sheathed right up to the strip. The frame is a tube construction. The jumper wires are insulated by two layers of rayon and one layer of PVC.

Operating Results and Extension Schemes

A trial group consisting of 100 *IIGV* was put into operation in February 1948. Extensive tests were carried out with this group both as regards the performance of the system and its traffic carrying properties. The anticipated results were verified in both these respects. Certain minor modifications were then made in the system and in March and April 1950 800 *IIGV* were put into service and after that complete equipment for 1 000 subscribers in Sörnäs.

The installation have as yet been in operation too short a time to establish the *most efficient procedure for the supervision and maintenance of the new system*, nor has the training of the staff been completed. The faults, which usually appear when a new exchange is put into service, have been few. Although the circuit and the lay-out of the system differs from that, which the staff has been used to, the maintenance has not caused appreciable difficulties. As long as the maintenance has not been definitely organized, detailed figures cannot be published regarding reliability and maintenance cost, but the results so far obtained have entirely come up to expectations and indicate that the system enables very reliable and inexpensive operation. The confidence of the Telephone Society in the system has just recently resulted in further orders being placed for extensions of 11 000 numbers in addition to the 15 200 numbers ordered previously.

The Crown Prince of Ethiopia visiting L M Ericsson



Early November the Crown Prince of Ethiopia visited the L M Ericsson works at Midsommarkransen, Stockholm, and made a tour round the premises studying the production with interest. The photograph shows the distinguished visitor in front of a scale model of the works which was demonstrated by the Managing Director of the Company, Mr. Helge Ericson.

A Midget Telephone Relay

E. WIBERG, TELEFONAKTIEBOLAGET L M ERICSSON, STOCKHOLM

U. D. C. 621.318.5:621.395

The majority of connection elements in a telephone exchange consists of the ordinary telephone relay. In the lay-out of a telephone system it frequently happens that full advantage cannot be taken of the technical possibilities of the telephone relay and the use of this relay will in certain cases require unnecessary space at excessive cost. For this reason there has been an increasing demand for a small and cheap relay of simple design. A description will be made below of a new relay RAG 500 developed by Telefonaktiebolaget L M Ericsson with a fewer number of contact combinations than the ordinary telephone relay and requiring considerably less space.

The new relay, type *RAG 500*, Fig. 1, which has only one spring set, resembles with regard to shape, size and build-up the spring sets used on the L M Ericsson normal telephone relay.

A maximum of four contact springs may be used and the contact combinations may be varied as far as the number of contact springs will permit. The outside dimensions of the relay with four contact springs are, width $^5/_{16}$", height $^7/_8$" and length $3^{21}/_{32}$" ($8 \times 22 \times 93$ mm).

Mechanical Lay-out

The components of the relay are shown in Fig. 2.

The flat type magnet system consist of a straight square core (1) with a bakelite moulded *flange* at one end (*2*). The purpose of the latter is to support the winding and guide and support a paper bakelite comb (3) serving as buffer for the stationary contact springs (4). The opposite end of the core is provided with a moulded bakelite flange (5) shaped to support the winding and to carry two soldering tags (6) for connection of the winding (7).

The soldering tags, which must have small dimensions, are made of wire. One end of the wire is flattened and has a hole for the external wiring. The opposite end is provided with a notch for the terminations of the winding.

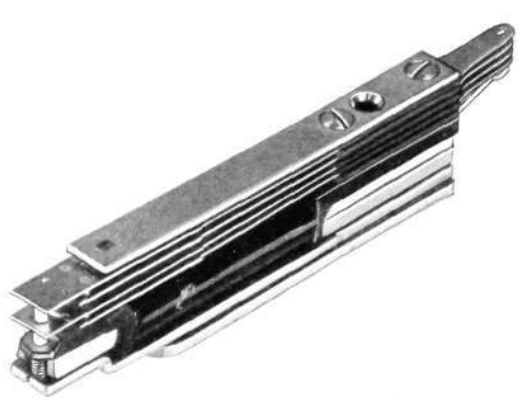


Fig. 1

Telephone relay RAG 500

X 6543

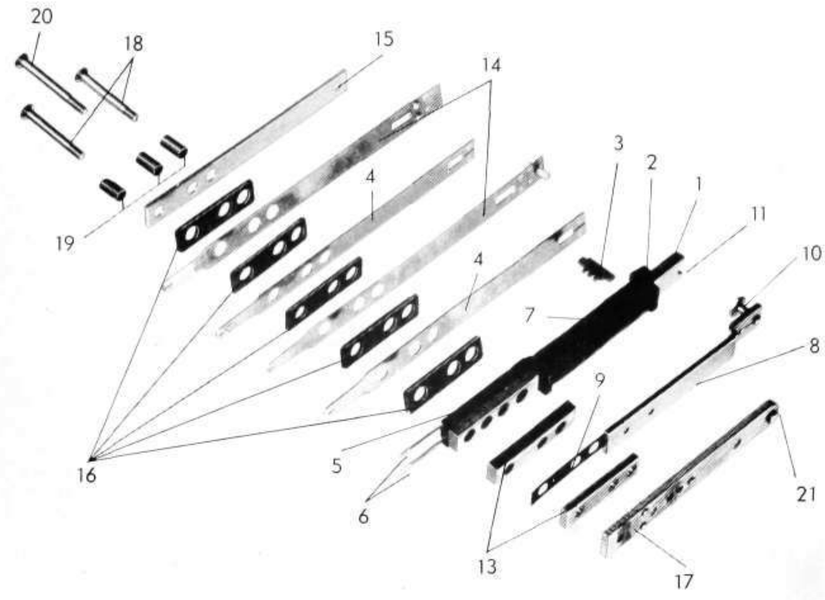


Fig. 2 X 6560

Telephone relay RAG 500 dismantled

Figures refer to the description in the article.

The centre of a tag has a parallel knurl locking the spring in longitudinal direction when placed in the bakelite flange. The tags are secured by list pressing the bakelite.

On the armature (8) is rivetted a thin flat spring (9) serving as hinge for the armature. The armature may be pre-tensioned by bending this spring.

The front end of the armature carries a setting screw (10) entering the forked slot (11) in the core. This screw is used for the adjustment of the armature gap. The same screw also transmits the movement from the armature to the spring set the head of the screw operating the lifting stud (12) on one of the contact springs. The iron circuit also includes spacing plates (13) clamping the armature spring on both sides when the relay is assembled.

The contact springs are of conventional type and do not require further description.

The moving contact springs (14) are provided with lifting studs for the armature movement whereas the stationary springs (4) are resting on the prongs of the buffer comb (3) as mentioned above.

The buffer comb is secured between the top guard plate (15) and the slot in the front bakelite flange on the core. This plate provides mechanical protection and serves as clamping plate for the fixing screws in the assembly.

The contact springs are insulated by means of conventional insulating bakelite plates (16).

The components are mounted on a robust base plate (17) by means of two screws (18) insulated from the contact springs by tubes (19).

The relay is mounted with one screw (20) and is kept in position sideways by means of a pressed up projection (21) on the base plate.

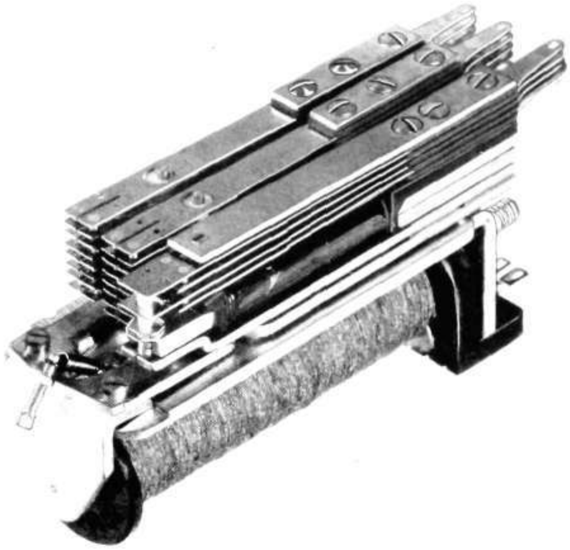


Fig. 3 X 6544

Relay RAG 500 assembled with a large telephone relay

Application

Apart from being employed as a separate element relay RAG 500 may be used assembled with the larger normal telephone relay. The midget relay is then fitted in spring set positions not utilized as shown in Fig. 3. In this way up to three relay functions may be obtained in the same space as that required for one ordinary telephone relay.

In addition to this it is possible to arrange functional co-operation between the larger relay and the midget relays as the armatures of the latter may be operated mechanically by the armature of the large relay.

When rebuilding and extending existing telephone exchanges and there is insufficient room for ordinary telephone relays, the midget relay offers possibilities, which have hitherto not been available.

L M Ericsson Exhibition in Helsinki

O Y L M Ericsson A B in Finland took part with a much frequented stand at the Finnish fair »Stormässan» opened in Helsinki on September 30th. The exhibition gave an interesting survey over the production and sales program of the Finnish LME company.

Plug-in Type Safety Signal Relays

S ENGER, L M ERICSSONS SIGNALAKTIEBOLAG, STOCKHOLM

U.D.C. 621.318.5:656.25

L M Ericsson's Signalaktiebolag has developed a series of plug-in type safety signal relays. The aim has been to design relays having the same high sensitivity and reliability as the safety signal relays now in general use, but of smaller size and having the added advantage of the plug-in feature, which eliminates the risk of making wrong connections when the relay is inserted.

Among the demands considered in the design of the new relay series the following may be mentioned:

1) The contacts shall be forcibly guided in order to ensure that all circuits actuated by the relay shall receive indications having the same signification.

2) The relay shall be enclosed in a sealed case to prevent the adjustment from being disturbed and the relay from being improperly acted upon. The contacts shall be visible through the case.

3) The relay shall be of the plug-in type, *i. e.* the relay terminals shall be automatically connected to the wiring terminals of the relay rack when the relay is inserted in its proper place in the rack.

4) It shall not be possible to connect a relay in a relay position where it will not function properly.

5) The electrical apparatus shall be built to allow a normal working voltage of 220 V. The apparatus shall have the necessary air gaps and surface leakage distances and shall also withstand the dielectric and insulation tests required for this working voltage.

6) The relays shall have a low power demand, as many safety signal circuits are normally closed circuits.

7) The relay shall be of small size and weight.

The track relays, which are the measuring apparatus for the track circuits, shall also fulfil the following demands:

8) The relay shall have a low ratio of operating voltage to drop-away voltage. The power required for the track circuit is largely dependent upon this ratio and may be many times greater than the power consumed by the relay.

9) When the relay voltage is gradually changing, the moving system shall remain in the starting position until the voltage has reached the change-over value. Thereafter the relay shall move to the opposite position without any tendency to stop in an intermediate position. This will ensure that all the working contacts are closed and receiving full contact pressure, thus preventing the contacts from becoming heated and at the same time ensuring that all the connected circuits will receive co-significant indications.

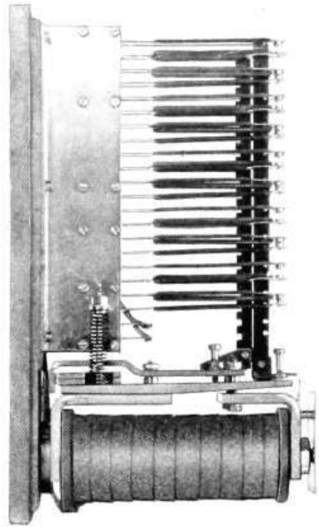
The new relay series consists of the following types:

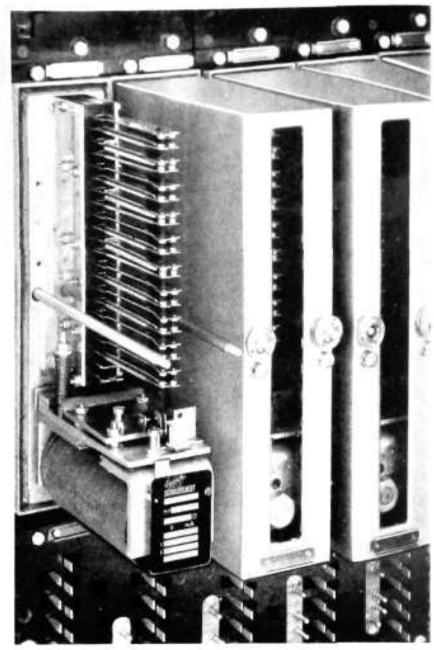
Relay type	Supply system	Power demand W	Number of contacts	Width mm	Height mm	Depth mm	Weight kg
JRJ 11	2 phase local track	15.0 0.300	12	125	250	170	6.2
JRK 10	D.C.	0.065	10	62	250	170	3.6
JRK 11	D.C.	0.140	22	125	250	170	6.6
JRK 12	D.C.	0.350	54	125	525	170	0.2

Fig. 1 X 6552

D.C. relay JRK 10

On the left: the relay with the case removed. At the bottom the driving system is visible, the contact system with the contact spring is seen above; the left end of each spring is fixed in the contact spring block, the right end being guided by one of the strips on the right. The left strip is attached to the magnet frame and the right strip to the armature. The winding is connected to terminals at the bottom of the contact spring block.
On the right: relays inserted in a relay rack.





Design

The relays, see Fig. 1, consist of a cast aluminum frame plate carrying the contact spring system with the connecting jacks, the driving system, the case and the registering code plate. The relays are inserted and connected to bakelite panels mounted on relay racks. The wiring is located at the back of the panels.

The main parts of the different relay types are very similar with the exception of the driving systems. Thus, a description is first given of the parts common to all types, and is followed by a description of the different driving systems.

The Contact Spring System

The contact springs are flat springs of german silver, see Fig. 3. The front ends carry solid silver contacts. The rear ends are enclosed and rigidly held by slotted bakelite blocks. Onto the rear end of each contact spring eight forked thin plates are spot-welded and form a multiple prong having sixteen contact points for connecting the contact spring to the corresponding rack panel terminal. During manufacture the quality of each spot-weld is tested by subjecting the weld to a shearing force of 15 kilograms.

In the front end of the contact springs oblong holes are punched for the spring-supporting and actuating strips. These strips are made from phenolic laminate.

The lower end of the front strip, the actuating strip, is attached to the driving system. The upper end is guided by the movable spring of the upper contact spring pair, Fig. 1. In the front edge of this strip slots engage the movable spring of each contact spring pair. The lower end of the rear strip — the supporting strip — is fastened to the relay frame and is thus stationary. Its upper end is guided by the upper stationary spring. The rear edge of this strip has slots for supporting the stationary contact springs.

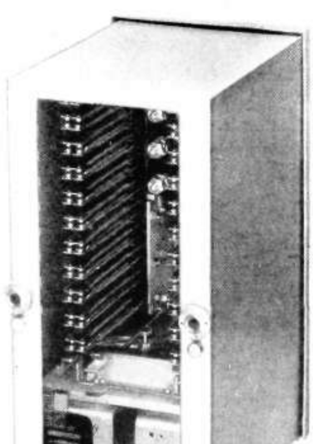


Fig. 2 X 4711

D.C. relay JRK 11

The edges of the contact springs are bent up in order to stiffen the springs, so that the contacts are positively guided by the motion of the strip, see Fig. 3. The rear ends of the springs are left flat and are recessed in order to make them flexible. The »front» contact springs carry twin contact studs, the stationary contact spring being slotted at the front end to give individual alignment to each twin contact stud.

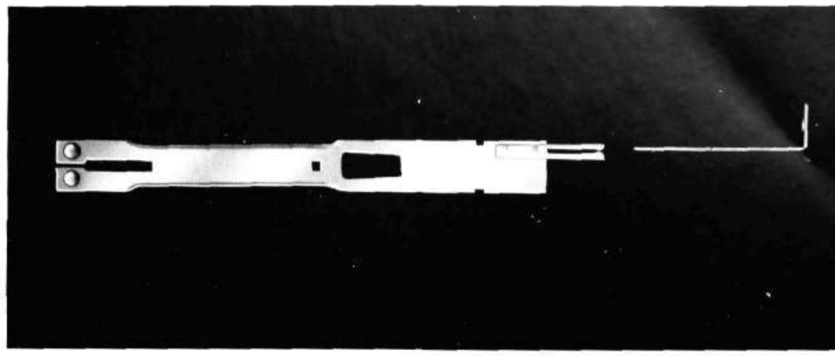


Fig. 3 X 6549

Contact spring

On the left: twin contacts with silver contact studs. At the right end of the contact spring a multiple forked prong for connection to the rack panel terminal plate which may be seen on the right.

The front ends of the stationary contact springs are supported by stiff springs, resting with their front ends in the slots of the supporting strip and having their rear ends fastened to the contact springs. During the closing of a contact, the movable spring moves towards the stationary spring until the contact studs engage each other. The motion continues until the stationary spring has left its support. The contact pressure will then have attained the full value for which adjustment has been made by the preliminary bending of the stationary spring.

Independent front and back contacts are built up from stationary and movable springs, following each other in proper sequence when the contact spring group is being assembled. A special movable spring with contact studs on both faces is also made. This is used together with the ordinary stationary contact spring for building up dependent contacts. Thus, any desired contact combination may be built up with a few elements.

The contact spring system also contains the terminal plates for the relay windings. These terminal plates carry multiple connecting prongs of the same type as the contact springs.

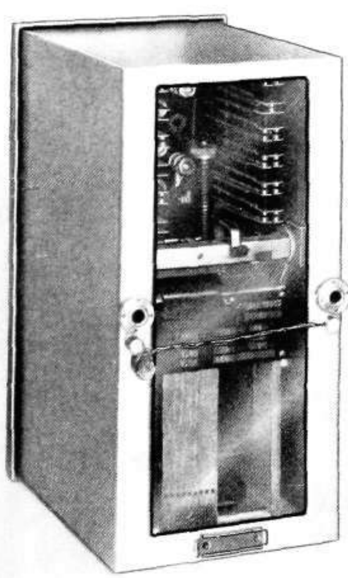


Fig. 4 X 4705

A.C. relay JRJ 11

On the front of the cover to the right and left of the window are the heads of the tubular screws sealed with a lead seal.

Relay Cases

Each relay is enclosed in an aluminum-laquered sheet brass case, see Fig. 4. A window of transparent plastic material is fitted in the front through which the contacts and the data plate of the relay are visible. The case fits into a felt-packed groove which runs along the edge of the relay frame. It is retained by tubular screws, which also serve as guides when the relay is inserted in the rack.

Relay Racks

The relays are plugged into moulded bakelite panels, mounted on racks. The relay rack consists of a supporting framework, constructed of aluminum-laquered sheet steel profiles, at the same time forming a dustproof, fire-resistant cover for the wiring, see Fig. 5. The wiring is connected to the rack panel terminal plates by screws with hexagonal nuts. The terminal plates pass through the panels and project on the relay side of the latter.

Guide rods are mounted on the rack panels, which pass through holes in the relay frame and the tubular screws, see Fig. 6, and serve as supports for the relays. When the relay is inserted, the rack panel terminals enter the forked prongs of the contact springs and terminals of the relay windings, thus ensuring reliable electrical contact.

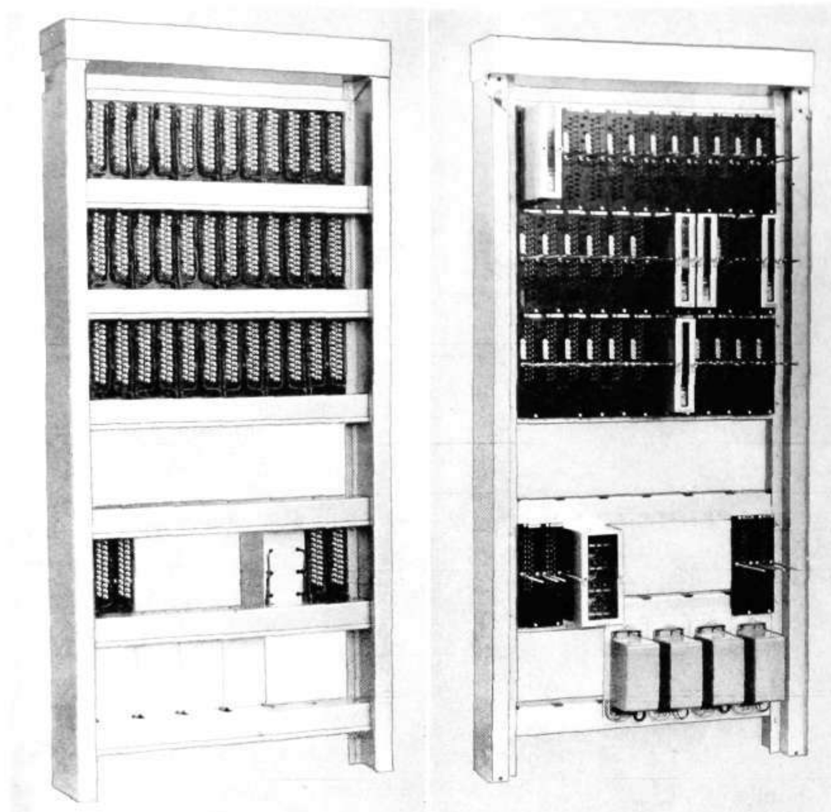


Fig. 5 X 6553

Relay rack

Left: the wiring side with three filled panel rows. The cables connected to the terminal screws run in horizontal and vertical channels formed by the sheet steel profiles of the rack frame. Right: the relay side with only five relays inserted.

In order to prevent a relay from being plugged into a panel intended for a different relay, each relay position on the panels carries a registering code plate with four pins. The location of these pins is determined by the type number of the relay, according to a certain code giving 3 240 possible combinations. A similar code plate with four holes is provided in the relay frame. Each hole must fit a corresponding pin in order to allow the relay to be connected to the rack panel.

If the arresting screw has not been removed before the relay is inserted, the connection of the relay is prevented by a projection on the panel which comes up against the head of the arresting screw.

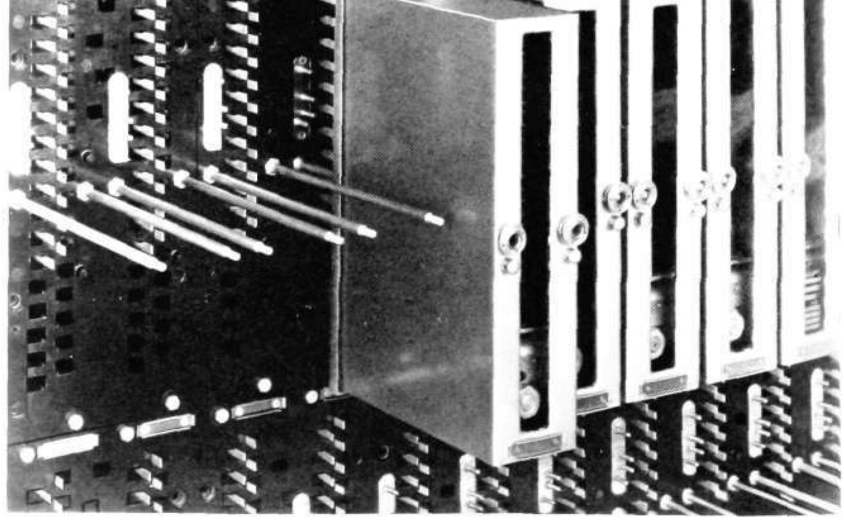


Fig. 6 X 6551

Panel row in relay rack with JRK 10 type relays

On the bakelite panels to the left the terminals and guiding pins may be seen. Above the latter are the registering code plates, each with four code pins. The lefthand relay is not fully inserted. The relays and relay positions on the panels are provided with a designation strip which indicates the function of the relay.

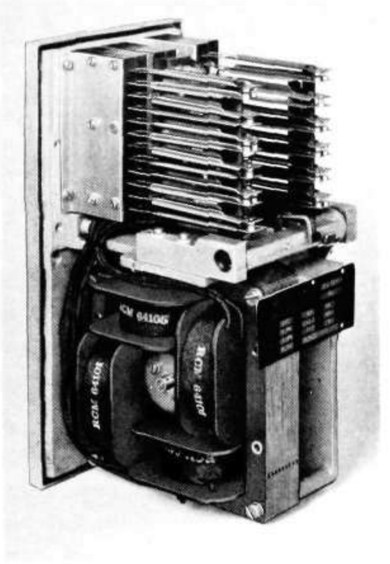


Fig. 7 X 4703

A.C. relay JRJ 11

with the case removed, seen from the motor side

The bakelite panels are made in one size only which can take one relay *JRJ 11* or *JRK 11*. Two relays *JRK 10* can be mounted on each panel, whilst the relay size *JRK 12* requires two panels located one above the other.

The rack panels as well as all other bakelite parts of the relays are injection-moulded from mineral-filled bakelite, and have an exceedingly low water absorption and electric surface leakage.

The A.C. Relay Driving System

The Motor

The A.C. relay is driven by a two-phase induction motor, see Fig. 7. The stator has a laminated iron core. This takes the form of a square frame with four legs projecting inwards through the coils. The ends of the legs form arc-shaped pole-pieces surrounding the cylindrical air gap in which the rotor revolves. The rotor consists of a cylindrical brass drum, surrounding an iron core with a shaft running in ball bearings.

Each opposite pair of coils are connected in series, thus forming one phase winding. The winding which surrounds the horizontal legs constitutes the local phase winding and is fed with a constant alternating current.

The track phase winding surrounds the vertical legs and is connected to the track circuit protected by the relay. The power required in the track phase winding for operating the relay amounts to 300—500 mW, depending on the frequency of the current and on the contact combination.

The voltage in a phase winding drives a current through this winding. The current produces an alternating magnetic flux which passes diametrically through the rotor. Around the flux a voltage is induced which drives an alternating current through the rotor drum. This current circulates around the generating poles, and passes under the other pole faces. When this current is acted upon by the flux from these other pole faces, the resulting force produces a torque on the rotor.

On account of the symmetry of the rotor and the magnetic system, no voltage is induced by one phase winding in the other when the rotor is at rest. For the same reason, the rotor torque is independent of the rotor position.

Transmission

The load from the contact springs varies during the relay movement. In order to make the relay follow up the motion during the operating- as well as during the return movement, it is necessary to transform the driving torque in a suitable manner. This transformation must also be such, that the ratio between the operating and the drop-away voltages will have a minimum value.

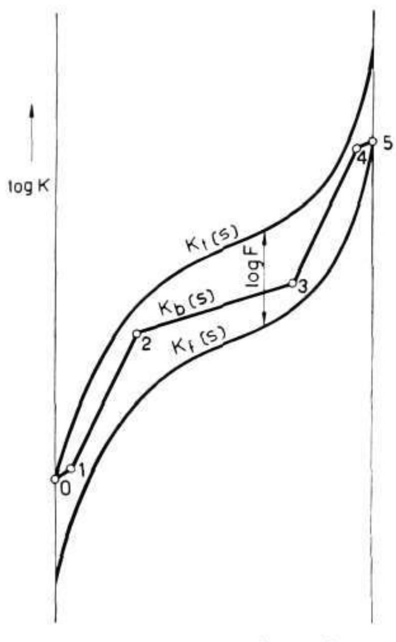


Fig. 8 X 4697

Load and driving forces shown as functions of the contact spring movement

F operating voltage/drop-away voltage
K_b load from the contact spring system
K_t driving force at operating voltage
K_f driving force at drop-away voltage
S movement
0 resting position
5 operating position

Load Characteristic

The actuating strip carries the load from the movable springs at both the front and back contacts. In the resting position (*0* in Fig. 8), the back contacts are closed and the stationary springs, which are raised from their supports, take up the contact pressure and thus partly relieve the load on the actuating strip. When the operating movement starts, the tension in the moving springs increases while he back-contact stationary springs relax. The load on the actuating strip increases accordingly. When the back-contact stationary springs touch their supporting strip, position *1*, the contact pressure rapidly decreases and a corresponding part of the tension in the back contacts' movable springs must therefore be taken up by the actuating strip. In the position *2* the back contacts open after which only the movable springs move until in position *3* the front contacts close. The front contact pressure then increases rapidly thus raising the load on the actuating strip. When in position *4* the front contact stationary springs leave their supports, the front contact pressure increases more slowly and finally, the working position, *5*, is attained. Thus, the load increases according to the broken curve *0—1—2—3—4—5*, shown in Fig. 8, which is plotted in accordance with a logarithmic scale.

To enable the relay to follow up the motion, the driving force must exceed the load during the whole operating movement. Under such conditions the relay will not exhibit any tendency to stop in an intermediate position. Similarly, the load must exceed the driving force during the whole drop-away movement.

The torque at the rotor shaft is proportional to the track phase voltage if the local phase voltage is maintained constant. In the logarithmic diagram, Fig. 8, the driving forces at different voltages are represented by congruent curves situated at different heights. The difference in height represents the logarithm of ratio between the voltages. The shape of the desired driving force curves may then be determined in the following way:

Two parallel, congruent driving force curves should be drawn, the one through point *0* and running entirely above the load curve, the other through point *5* and running entirely below the load curve. The difference in height between the curves should be as small as possible.

When the desired function has been determined, the next step is to construct a mechanical transmission which will transform the constant rotor torque into a driving force proportional to the given function. The transmission chosen takes the form of a simple link mechanism: a crank on the rotor shaft is connected by a link to a crank on an intermediate shaft. This latter shaft moves the actuating strip of the contact spring system, Fig. 9. This combination of two cranks and a link offers a very wide range of transmission possibilities. By choosing suitable lengths for the two cranks and the link in relation to the distance between the shafts and by determining the limiting angles of the rotor crank movement a fairly close approximation to the desired driving force function can be obtained. The mechanism is simple, strong and stable, and there is very little friction as the shafts run in ball bearings.

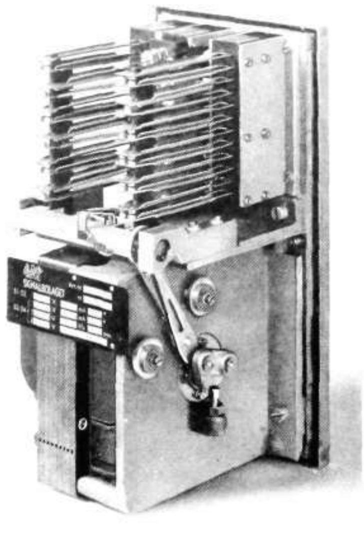


Fig. 9 X 4704

A.C. relay JRJ 11

with the case removed, seen from the linkage side. Above are the contact spring groups actuated by a horizontal intermediate shaft carrying a crank which is connected by a link to a crank on the rotor shaft.

The D.C. Relay Driving Systems

The driving systems of the D.C. relays are electromagnets. In the relay type *JRK 10*, the magnet consists of a coil with a cylindrical iron core and two pole pieces, bent at right angles so that they form two parallel pole faces above the coil, Fig. 1. The armature moves above the pole pieces. The relay types *JRK 11—12* have magnets with two coils, at the rear united by a yoke and are provided at the front end with pole-pieces. The armature is located across the two pole faces, Fig. 10.

In both types of magnets the armatures are balanced to eliminate the influence of mechanichal vibrations. The armatures move downwards during the operating movement. The actuating strips of the contact spring systems are directly attached to the armatures.

The driving force characteristic has been adapted to the load characteristic by suitable dimensioning of the air-gap area.

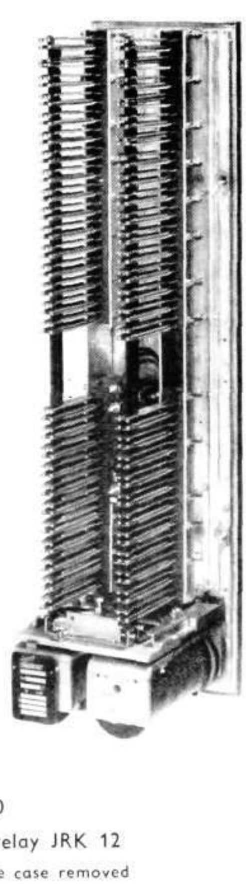


Fig. 10 X 4712

D.C. relay JRK 12

with the case removed

New Models of Engaged Signalling Equipment

A TRÄGÅRDH, TELEFONAKTIEBOLAGET L M ERICSSON, TELESIGNAL WORKS, STOCKHOLM

U.D.C. 654.915.2

Executives and others who often receive callers, do not want to be disturbed during important conferences. A caller on the other hand will feel rather uncomfortable if he is unwittingly interrupting a conference by looking in to find out if the wanted person is engaged or if the conference is an important one. With an engaged signal system the wanted person is able to signal that he cannot receive the caller without the latter having to open the door to obtain this information.
L M Ericsson have for a long time been marketing equipment for engaged signal systems but new models have recently been developed which differ from earlier ones.

An engaged signal system consists of a desk control set, wall signal box and optional cradle contact on the telephone instrument.

The desk control set, Fig. 1, moulded in white plastic material, is placed on or near the writing desk. It contains a push button switch with pilot lamp for indication of ENGAGED signal, four push buttons for COME IN and WAIT signals as well as for service and secretary signals. The set is provided with a $6^1/_2$ feet cord connected to a wall terminal box with buzzer. On the front part of the control set there is a space for a designation strip protected by transparent acetate which carries directions for the use of the buttons.

The wall signal box, Fig. 2, is intended for installation on the wall at the side of the door outside the room. The box contains three lamps with lenses, a push button and a buzzer. There are two types of boxes, one having lenses in green, red and amber and the other carrying designations COME IN, ENGAGED and WAIT on white paper.

The external cradle contact, Fig. 3, is fitted on the telephone instrument. When the receiver is lifted the amber lamp or the lamp carrying designation WAIT is operated in the signal box, indicating that the occupant of the room is engaged on the telephone.

Fig. 1
Desk control set KEM 1101

X 6556

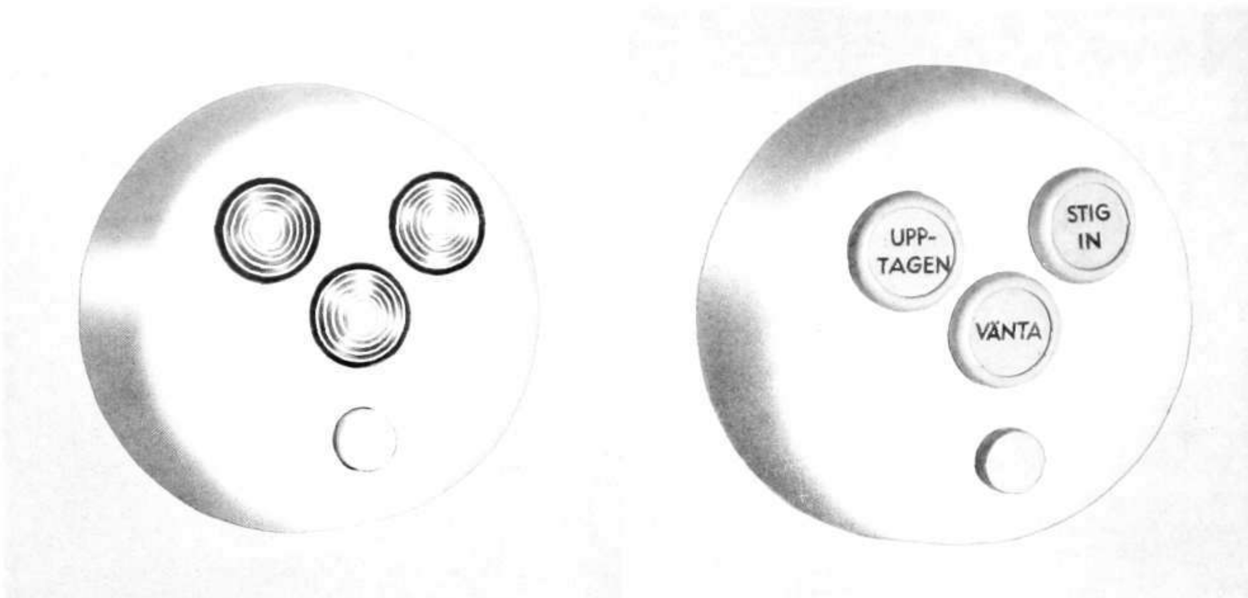


Fig. 2 X 7582

Wall signal box

left with coloured lenses KNH 8401, right with designations KNH 8402

Function

When a caller wishes to enter, he presses the button operating the buzzer in the wall terminal box for the control set. If the wanted person is disengaged, he will press button COME IN in the control set. The green lamp or the COME IN designation will be alight during the time the button is pressed at the same time as the buzzer is sounded in the signal box. If the person, on the other hand is engaged, he will press the ENGAGED push button switch operating the red lamp or the ENGAGED designation in the signal box as well as the pilot lamp in the control set. Both these signals remain operated until the ENGAGED push button switch in the control set is restored. The pilot lamp is serving as a reminder that the ENGAGED signal is in operation and that it should be restored, when the conference is terminated. The ENGAGED signal may, of course, be operated at the commencement of a conference without waiting for a call from the signal box.

The occupant of a room may not want to be disturbed during his telephone calls. For this purpose an external cradle contact is fitted on the telephone instrument. As soon as the receiver is lifted the amber lamp or the WAIT

Fig. 3 X 6557

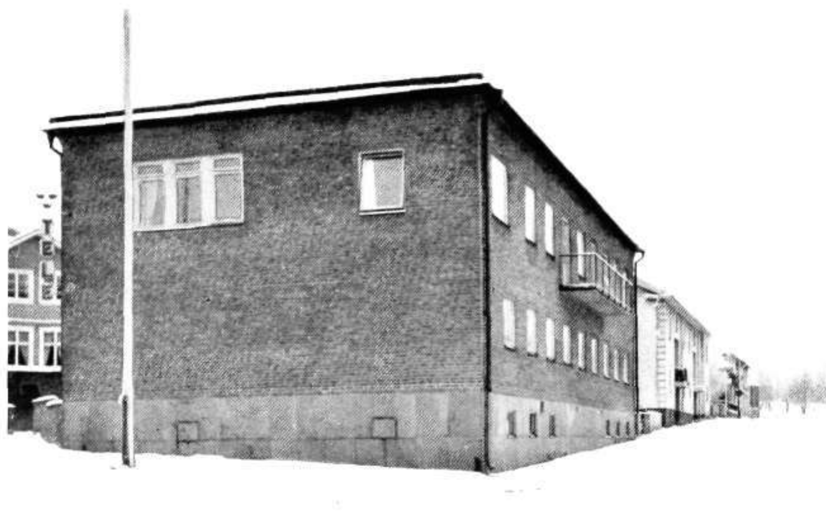
External cradle contact KEM 4004 for telephone instrument designation in the signal box is operated. This indication remains in operation until the receiver has been replaced.

If the wanted person is expecting to be disengaged in a few moments after being called from the signal box, he may press button WAIT in the control set and operate the amber lamp or designation WAIT at the same time sounding the buzzer in the signal box. This signal will remain in operation during the time the button is pressed. The caller may then remain outside the door and await the COME IN signal.

The control set contains a further two push button which may be used for service signals or to call the secretary.

The system is operated from 24 V A.C., the power consumption being approximately 0.25 A. The power supply may be 110 V, 127 or 220 V A.C. mains connected over a transformer.

The Most Northerly Automatic Exchange in the World



The most northerly automatic exchange, supplied by Telefonaktiebolaget L M Ericsson, was for many years the exchange at Skellefteå. Last summer, however, the new automatic exchange Akureyri on the north coast of Iceland was put into service depriving Sweden of this record. This state of affairs was not, however, allowed to continue until the middle of October, when the automatic exchange at Kiruna supplied by L M Ericsson was put into operation. This town, the northernmost in Sweden and the largest in area, does now possess within its boundaries the most northerly automatic exchange in the world, as far as is known.

The exchange is equipped with the L M Ericsson automatic telephone system with 500-line selectors for 2 500 numbers *of which about 500 are arranged for group numbers.* The exchange contains toll circuit equipment for two terminal exchanges and equipment for automatic trunk call dialling.

The above photograph shows the exterior of the new exchange building.

Equipment for Power-supplying at Constant Voltage and Frequency

S E LINDBERG, LM ERICSSONS MÄTINSTRUMENT AB, STOCKHOLM

U. D. C. 621.316.721.078:621.311

When carrying out precision measurements with indicating instruments, the voltage supplied to the measuring equipment must be constant and must also have a suitable wave form. These conditions are not satisfied by the voltages of the ordinary supply mains.

When calibrating electricity meters a testing outfit with built-in wattmeters is sometimes employed. For feeding current to testing outfits of this kind, Ermi, L M Ericssons Mätinstrument AB, has produced a series of power-supplying equipments which are described below.

The accuracy with which a voltage is to be maintained constant must be such that voltage variations will not exceed ± 0.1 % under normal service conditions, and that following a disturbance, regulation should be completed within 0.3 secs. This regulating speed is defined as follows.

In the event of sudden variations either in the magnitude and frequency of the input voltage or in the output, the *output voltage* shall be restored to values lying between the guaranteed values within the time allowed for regulation.

Deviations of the voltage from a pure sine wave form are defined by the term *harmonic content* which is equal to the sum of the root mean square value of the harmonic voltages, divided by the total r.m.s. value of the alternating voltage. According to the Swedish Standard Specification for electricity meters, SEN 32, when checking faulty indications in meters, the harmonic content of the voltages and currents must not exceed 5 %.

The line frequency often varies by ± 1.5 %. In the case of electricity meters this gives rise to additional errors which may be of disturbing magnitude when carrying out precision measurements. The demand is therefore sometimes made that the frequency of the output voltage shall be maintained constant.

In view of this requirement Ermi has produced a series of power-supplying equipments for meter testing outfits which even when they are designed for the calibration of single-phase meters are supplied with three-phase alternating current. Older meter testing outfits require an output up to 3 kVA whereas more recent types take about 1 kVA. Needless to say, this value is dependant to some extent upon the number of meters connected up simultaneously to the testing outfit. The main power consumption is obtained in induction regulators and regulating transformers.

In order to meet the demand for a good wave form, the whole output is always generated by amply dimensioned synchronous generators in the Ermi power-supplying equipments. The output voltage from the generator is maintained constant by a valve regulator which fulfils the requirements with respect to speed of regulation.

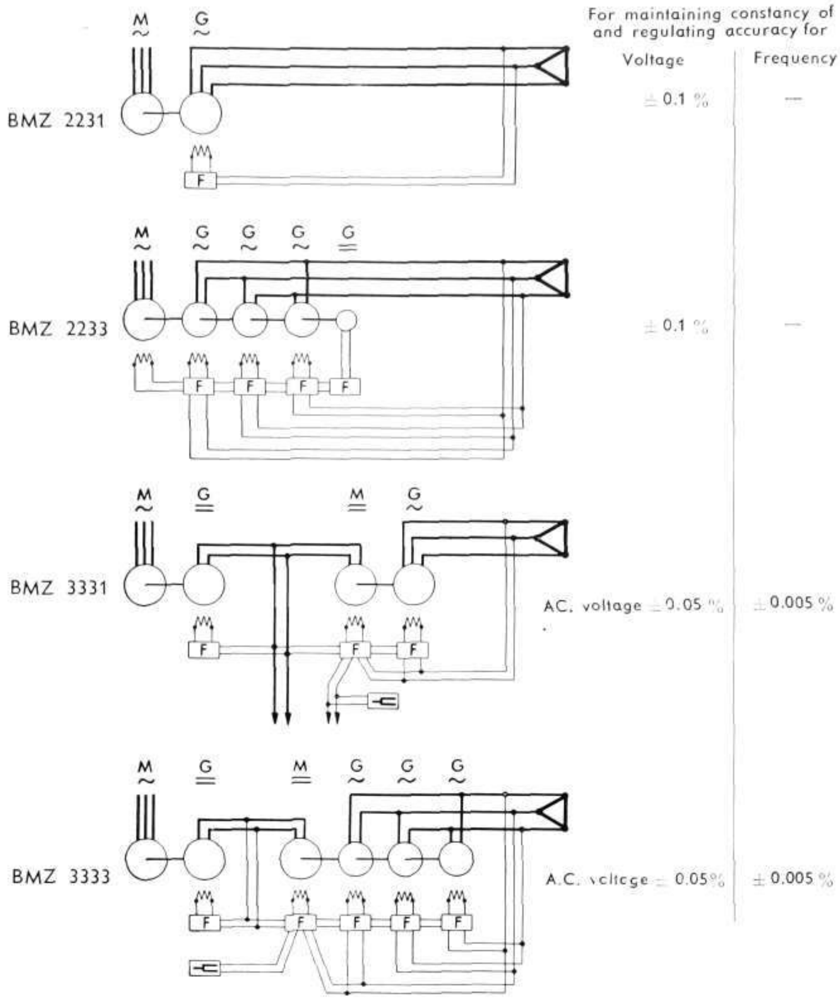


Fig. 1 X 6539

Schematic diagram for Ermi's power-supplying equipments

The values given apply to variations in the line voltage of ± 5% and in the frequency of ± 2%.

In such cases, as the influence of the line frequency on the measuring result is neglected, the generator is driven by a synchronous motor. When constant frequency is desired it is necessary to adopt a roundabout method with direct current, by which means the speed of the motor can be regulated. Ermi has chosen a method for synchronizing the output voltage with a very accurate frequency, from a tuning fork.

In installations where each meter testing outfit is fed by its own generator, equipments are employed in which the output voltage is controlled by only one of the three-phase voltages. The generator's exciter winding is common to all three phases. An installation of this kind cannot be used simultaneously for feeding two or more testing outfits as these will then interfere with one another.

For large installations it may be found economical to employ an equipment in which load fluctuations in one phase do not affect the others, that is to say, with which a number of outfits may be connected to the same equipment. This is effected by connecting together three-phase generators which are driven by the same motor and the output voltages of which are each maintained constant individually by valve regulators in the excitation circuits of the generators.

Fig. 1 illustrates the four main types of equipments manufactured by Ermi.

BMZ 2231 — Equipment for one Measuring Outfit

The voltage is maintained constant against variations in the line voltage and frequency. The output frequency is the same as the input frequency. The motor in the rotary converter, Fig. 2, is a reaction motor which starts asynchronously and then falls into step with the network frequency since it is provided with

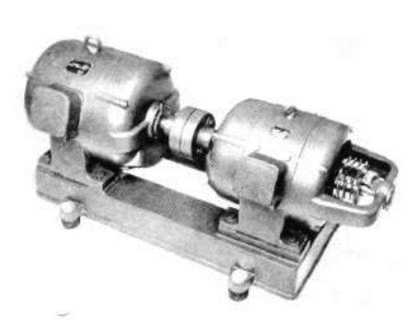


Fig. 2 X 4708

Rotary converter for BMZ 2231

salient poles. In view of the fact that the excitation energy is taken from the network the power factor is low, cos $\varphi = 0.5$. When starting a 380 V motor the starting current will be about 105 A but it is of such short duration that it will not cause a 25 A fuse with a time lag to blow.

The generator is rated for 3 kVA and is so amply dimensioned that the harmonic content is less than 2 %. The exciter winding of the generator receives its D.C. voltage from a valve rectifier built into the control cabinet. A resistance is connected in series with the winding and is so adjusted that the current flowing through the winding generates a field which gives the generator an output voltage of 80 % of the rated voltage. Three pentodes are connected in parallel with the series resistance and serve as a variable resistance of sufficient size to maintain the output voltage constant, that is to say, the remaining 20 % of the excitation current should pass through the valves on no-load. Under load, it will of course be more.

The pentodes are controlled by a voltage which is taken out between *R* and *S*, Fig. 3, and rectified in a valve and compared with a constant D.C. voltage obtained through a glow-discharge tube (voltage regulator). The potential difference is amplified one stage before acting on the grids of the pentodes.

The voltage which in this way regulates the output voltage depends on a peak value or mean value of the sine wave output voltage. Any harmonics may thus influence the final result. With this equipment only one testing equipment can be supplied, however, and this may be regarded as a constant load and there will then be no variation in the harmonics.

The valve regulator is mounted in a well-ventilated control cabinet which can be hung on a wall or placed on a bench, see Fig. 4. The dimensions of the

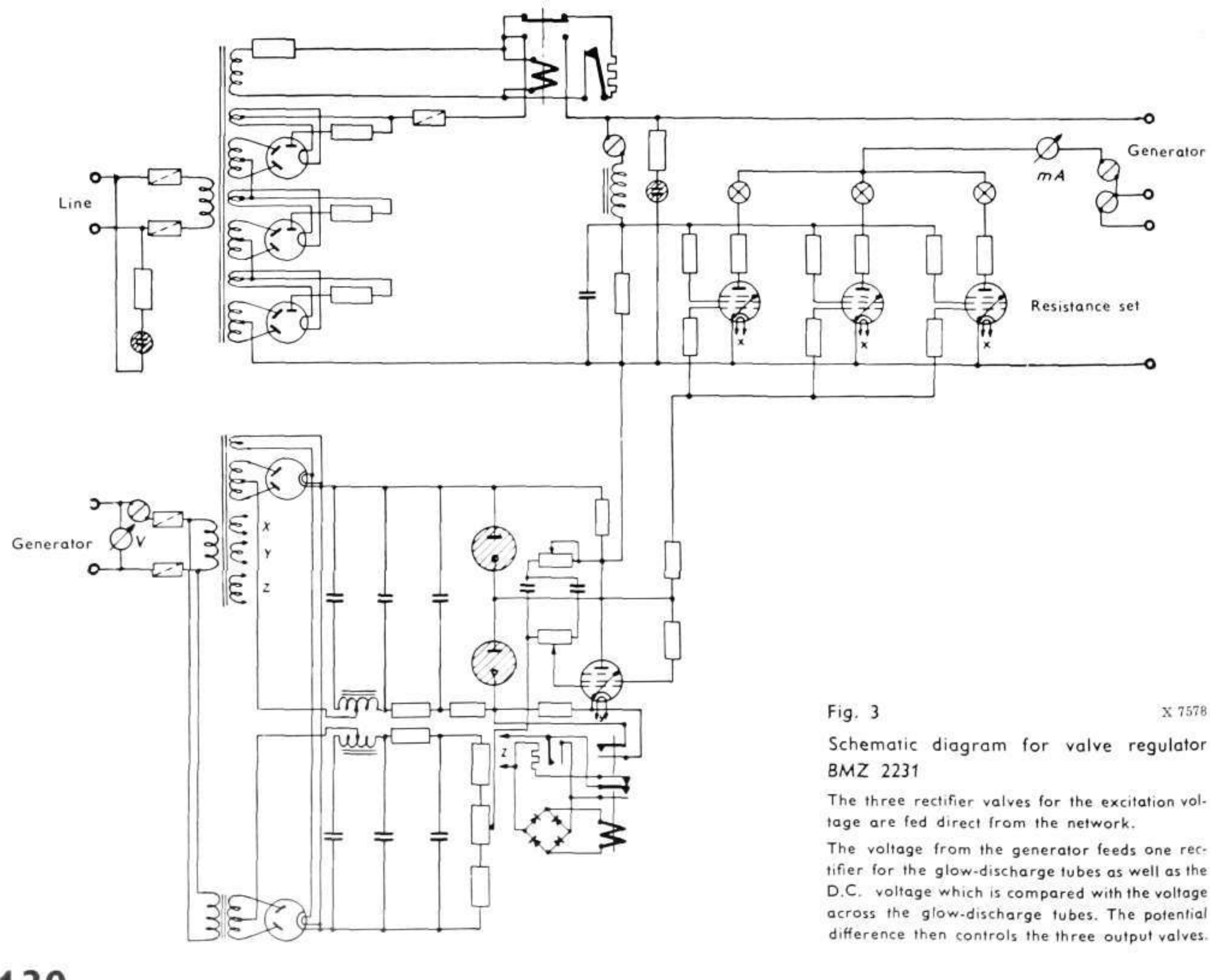


Fig. 3 X 7578

Schematic diagram for valve regulator BMZ 2231

The three rectifier valves for the excitation voltage are fed direct from the network.

The voltage from the generator feeds one rectifier for the glow-discharge tubes as well as the D.C. voltage which is compared with the voltage across the glow-discharge tubes. The potential difference then controls the three output valves.

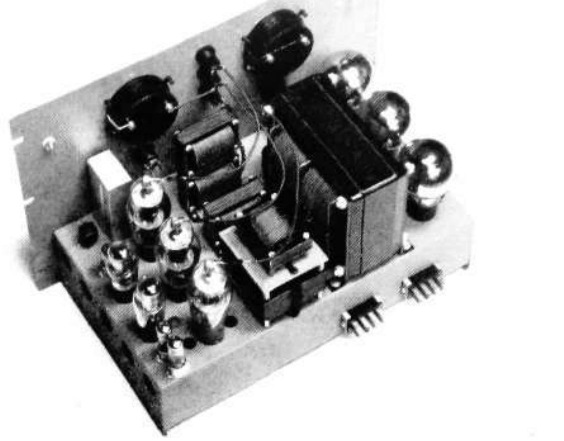


Fig. 4 X 7581

Valve regulator for BMZ 2231

On the right, chassis withdrawn from the control cabinet.

cabinet are 530 × 335 × 305 mm. The series resistance for the exciter winding is enclosed in a box placed in the vicinity of the rotary converter.

The regulator is connected in the cabinet by flat pin contacts and is normally currentless when it is withdrawn from the cabinet. For trimming and inspection when necessary, the regulator can be connected by means of extension conductors.

The life of the valves is increased if the load is applied after the cathodes have been heated up. On this account two thermal relays are available, one of which connects up the load to the rectifier valve after about 45 secs, whilst the other opens the choked pentodes after a further 30 secs.

The equipment is started by means of a press-button which closes the motor's contactor. As an indication that the motor is under current a lamp lights up on the left-hand front side of the control cabinet. Another lamp lights up when the rectifier is connected in circuit. The loading current on the pentodes and the generator voltage may be read off from instruments mounted on the control cabinet. The three lamps between the instruments are series-connected to the anodes of the pentodes and light up under heavy loads. If one of the valves is defective, for example, this is indicated by one of the lamps failing to light up, whilst the two remaining lamps give a stronger light than usual.

If the regulator fails to function for some reason or other and a repairing staff is not available, the generators may still be employed, however, if the change-over switch at the bottom to the right is turned a quarter-revolution. A fixed resistor is then switched on in place of the regulator. In this way a voltage is obtained which although it is not regulated, nevertheless has a good curve shape.

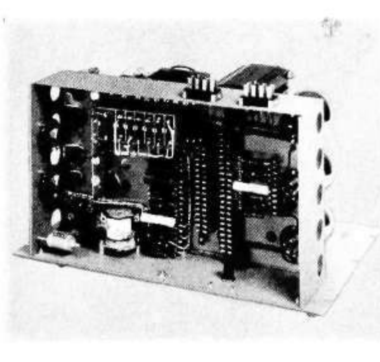


Fig. 5 X 4709

Valve regulator for BMZ 2231

viewed from below

BMZ 2233 — Equipment for a Number of Testing Outfits with Varying Loads

This equipment is designed for supplying a number of testing outfits the loads on which can be varied without interfering with the measurements at the different outfits. The voltage is maintained constant against variations in line voltage and frequency and against changes of load. The regulating speed is less than 0.3 sec with changes of load corresponding to half the rated output. The output frequency is the same as the input frequency.

The converter consists of a synchronous motor which drives three single-phase generators, each having an output of 3 kVA at $\cos \varphi = 0.8$, and an exciter. The speed of rotation is 1 500 r.p.m.

The exciter windings of the single-phase generators are divided into one winding for the fixed excitation and another for generating the flux required

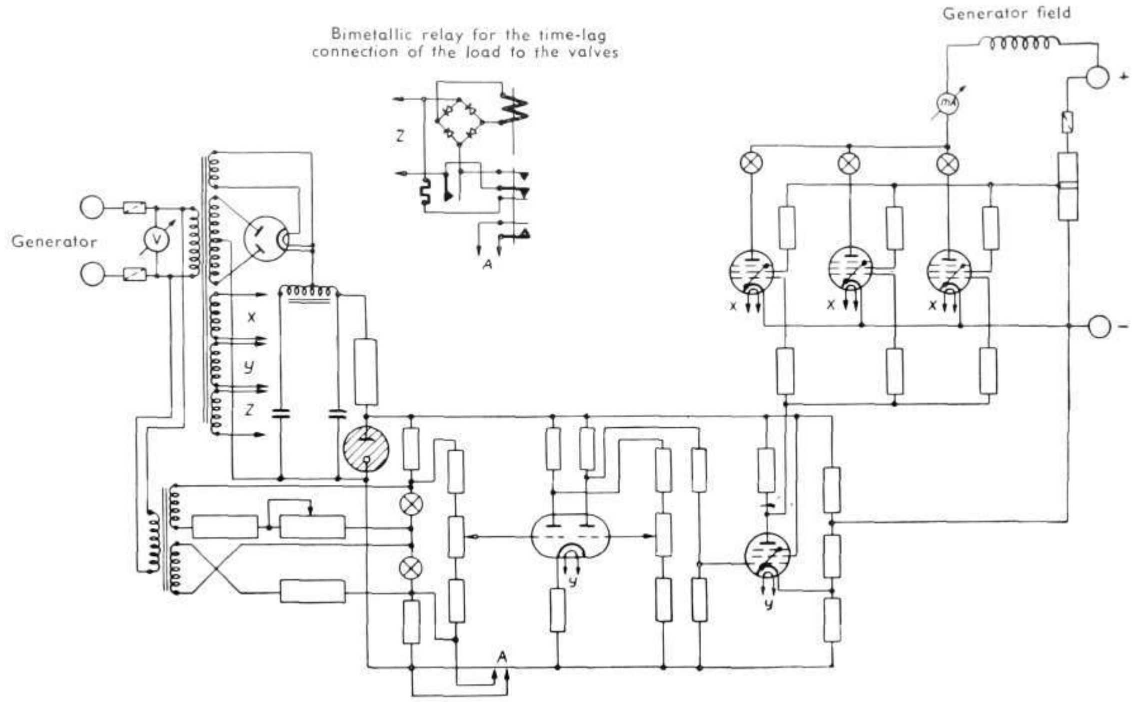


Fig. 6 X 7579

Schematic diagram for valve regulator BMZ 2233

for regulation. With this arrangement the output valves of the regulator are utilized to better advantage. The whole of the current flowing through the regulator winding passes through these valves.

The three generators are displaced in phase 120 electrical degrees in relation to one another, and are connected together in delta. With unbalanced loads harmonics are set up which, if the regulator's input circuit had the same form as that for *BMZ 2231*, would give rise to disturbances in excess of the permissible values. For this reason the regulators in *BMZ 2233* are differentiy connected so that they receive the r.m.s. value of the voltage instead of a peak value as in the previously mentioned type.

The generators are provided with effective damper windings and are amply overdimensioned in relation to the output so that the harmonic content will not exceed *2 % even under the most unfavourable unbalanced loads.*

The input circuit of the regulators, see Fig. 6, consists of a transformer with two secondary windings coupled in opposition to each other, to which two resistors with positive temperature coefficients are connected, which here take the form of incandescent lamps. The sum of the two alternating voltages across the lamps is zero. A direct current from a constant voltage source also flows

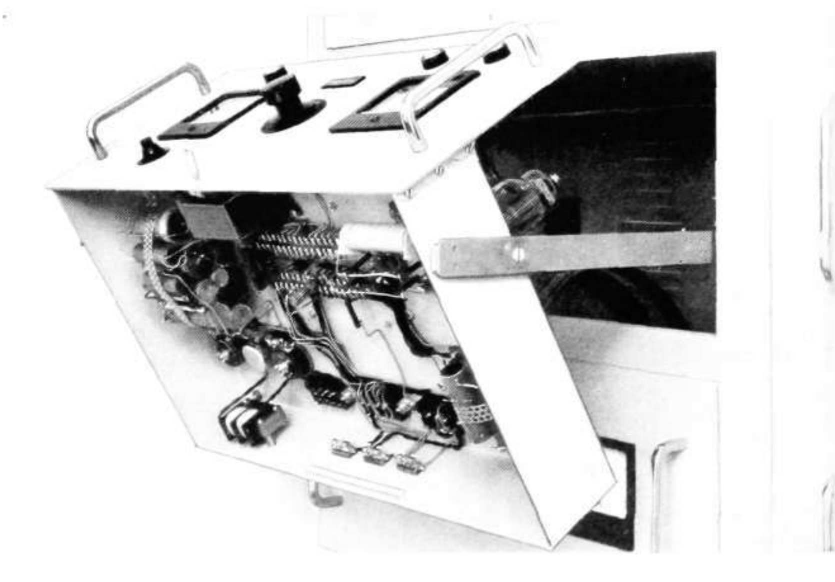


Fig. 7 X 6554

The regulator chassis in the control panels can be drawn out and turned over

thus rendering the regulators conveniently accessible

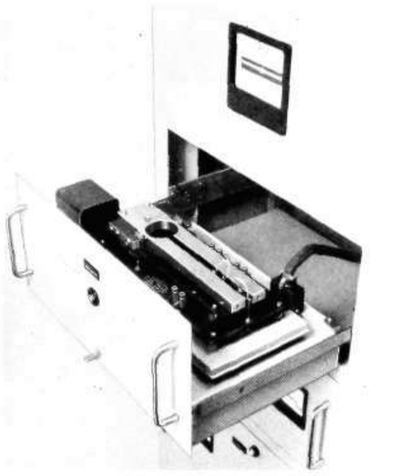


Fig. 8 X 4707

Tuning fork for 50 c/s

with the protective cover removed

through the lamps. If the alternating voltage taken from the distribution point of the three-phase system now changes in value, the current through the lamps will change, but the sum of the voltage drop due to the alternating current will still be zero.

The resistance of the lamps rises as the alternating current increases, and consequently the voltage drop due to the direct current also increases, this taking place in proportion to the change in the r.m.s. value of the alternating voltage. This voltage drop is amplified and controls the current flowing through the output valves of the regulator.

The regulators and control gear for the equipment are assembled on a control panel which is 600 mm wide and 2 200 mm in height. They are mounted on draw-out chassis which can be turned over, thus permitting trimming and inspection to be carried out during service, see Fig. 7. Each regulator is provided with an indicating instrument for the output voltage and for the current flowing through the output valves of the regulator. As in the case of *BMZ 2231*, each output valve is provided with a series-connected incandescent lamp to facilitate supervision.

The chassis can be locked so that unauthorized persons cannot come into contact with the relatively high voltages of the regulators.

BMZ 3331 — Equipment Driven by a Direct Current Motor

In cases where a more accurate output frequency is required, the generators must be driven by direct current motors. *BMZ 3331* is a development of *BMZ 2231*. When direct current is not available it must be generated in a separate rotary converter which in *BMZ 3331* has been selected of such a size that it can supply up to four converters.

To facilitate both frequency- and voltage regulation, the direct current voltage is maintained constant; as a voltage of 440 V has been selected, it is suitable for the excitation circuits with their valve regulators.

The regulator for maintaining the alternating voltage constant has the same input circuit as the regulator in *BMZ 2231*. The installation also includes a regulator for maintaining the frequency constant. The letter works on the principle that the generator frequency is synchronized with a very accurate frequency obtained from a tuning fork, Fig. 8. The output frequency is thus directly dependant upon that of the tuning fork. The tuning forks employed in the Ermi equipments have a calibrated accuracy of ± 0.0025 % and they have a temperature coefficient of 0.002 %/C°. Under continuous service conditions an accuracy of ± 0.005 % is obtained. Normally, no steps are taken to maintain the temperature constant since the frequency is sufficiently accurate for the calibration of electricity meters and for driving the stop watches used for this purpose.

The voltage from the tuning fork is amplified by an electronic amplifier which maintains the output voltage relatively constant against fluctuations in the input voltage. The tuning fork voltage and a voltage from the generator are added and rectified and then control the valve regulator in the excitation circuit of the direct current motor. When the two voltages are at different frequencies, the vector E_X will rotate in relation to the vector E_N in Fig. 9. At a certain moment in which the vectors are in relation to one another, as shown by the full-line vectors in the figure, the regulator is connected up and the vector sum E_S will act upon it. With an increase in the load the vector E_X will lag behind and at the same time E_S will increase, thus providing the motor with an impulse to increase its speed. By this means changes of load from the generator are counteracted.

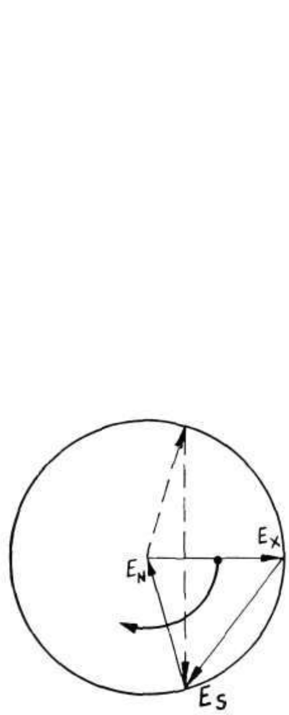


Fig. 9 X 4696

Vector diagram

showing the position of the voltage from the tuning fork, E_N, and the voltage from the generator E_X, as well as the vector sum E_S

As in the case of *BMZ 2233*, the regulators and control equipment are assembled on a control board with a panel for the conversion of the alternating network voltage to a direct voltage, and a panel for each of the direct current-alternating current converters. The tuning fork with its amplifier is also mounted on the first panel, see Fig. 10. The installation in its complete form may consist of five panels, each 600 mm wide and 2 200 mm in height. Here also certain automatic operation has been introduced for controlling the machines. The

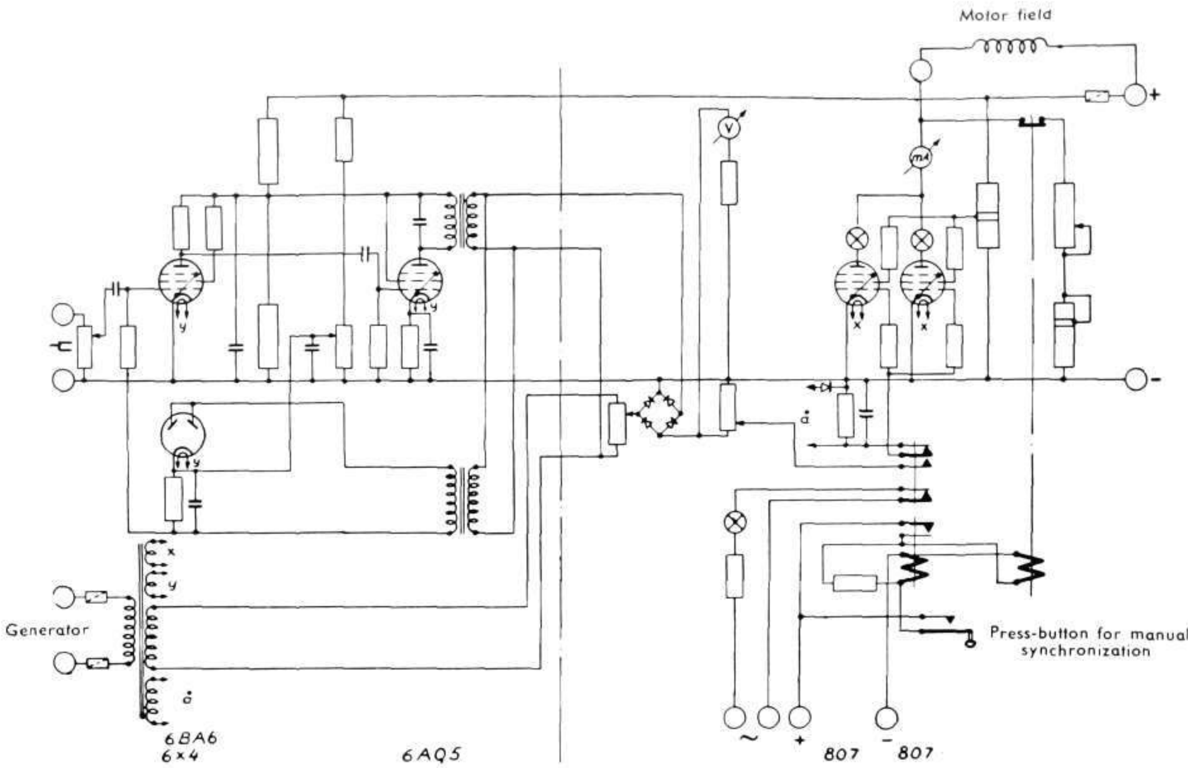


Fig. 10 X 7580

Schematic diagram for the tuning fork amplifier and D.C. motor regulator

valve regulators are connected in circuit after the cathodes have been heated up and signal lamps indicate that starting is taking place normally. Synchronization alone is carried out by hand. By throwing over the change-over switch the machines may be driven without regulators. Their voltages and speed of rotation are manually adjusted by knobs mounted on the lower part of the panels. The controls are blocked in such a way that when the change-over switch for the D.C. generator is set for hand regulation, the remaining regulators cannot be connected in circuit. Disconnection of the frequency regulator does not prevent the alternating voltages from being maintained constant. It is thus possible for the generators to give a constant voltage at frequencies between 46 and 54 c/s, but the frequency must then be adjusted by hand.

BMZ 3333 — Equipment with a Direct Current Motor Controlled by a Tuning Fork

The motor in the equipment *BMZ 2233* is here replaced by a direct current motor which receives its voltage from a generator driven by an asynchronous motor. As in *BMZ 3331*, the speed of rotation of the direct current motor is controlled by a tuning fork and the generators have the same regulators as in *BMZ 2233*.

The control board, Fig. 11, consists of two panels which, together, are 1 200 mm wide and in which the regulators are mounted on draw-out chassis which can be turned over. The tuning fork is placed at the top immediately under the frequency meter. The equipment is started automatically. The start is initiated by means of a press-button, after which the converters are started one at a time and the regulators are connected in circuit after the valves have been heated up. When all the regulators are functioning with the exception of the frequency regulator, a lamp lights up thus indicating that frequency synchronization can take place. This is effected manually by depressing a button at the moment in which the pointer on an instrument passes an index mark.

Loading is supervised by ammeters mounted at the top of the second panel. The same types of signal lamps are used here as for the equipments described previously. A change-over switch for passing from automatic operation to hand operation is mounted at the bottom of the panel, together with knobs for adjusting the frequency and voltages.

The equipments described above represent the main types manufactured by Ermi. These equipments can, of course, be modified and combined to meet the most varied requirements.

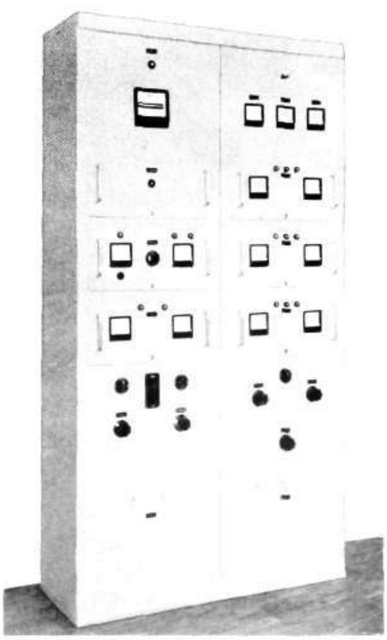


Fig. 11 X 4706

Control board for BMZ 3333

The ATU-system — a New Form of Light Fitting

E. JENSEN, SIEVERTS KABELVERK, SUNDBYBERG

U. D. C. 683.854

Sieverts Kabelverk have recently placed a new form of light fitting on the market to supplement the Gebe-system. This fitting, which is known as the ATU-system, was designed by Sieverts Kabelverk in collaboration with AB Alpha, and is produced exclusively by the latter firm. The new system differs from the Gebe system in the smaller size of the boxes employed and the construction of the lampholders to take threaded glass globes.

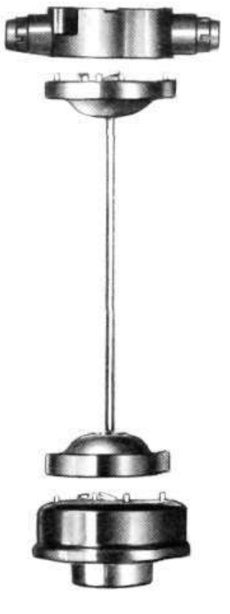


Fig. 1 X 4698

Connecting box, pendant and lampholder for the ATU-system

The ATU-system comprises a number of connecting boxes, lampholders and pendant covers which can be assembled similarly to the corresponding parts in the Gebe system, see Fig. 1. All parts are constructed of plastic material. The ATU-system is primarily intended for the connection of Gebe conductors. The box may, however, also be employed as a tight-fitting box for Kuhlo wiring, and as a conduit box by using nipples.

The internal diameter of the box is 70 mm and its internal depth is 26 mm. The inlets are provided with Pg 13.5 threads corresponding to a thread diameter of 20.4 mm. The boxes are constructed with a maximum of five inlets. The packing for the conductors consists of high grade rubber. The bottom of the inlet and the internal end surface of the packing are designed in such a form that the packing is prevented from creeping in through the hole when small conductors are used. Both the cylindrical surface and the inner end surface exercise a tightening effect.

Boxes with more than one inlet, see Fig. 2, and in which sheath connections can consequently be made, are fitted with a slotted clamp at the centre of the box in which the Gebe conductors' earthing wires are connected. The terminal plate is fixed by means of this clamp. In boxes with one inlet the plate is screwed down by means of an ordinary screw. The terminal plate, Fig. 3, is provided with two, three or four slotted clamps. The conductors are fixed in a clamp by a sliding nut which presses on the conductor over the whole width of the slot. The clamp is of such a length that it affords ample space for six 2.5 mm² conductors. The connection of the lampholder or pendant cover to the terminals on the plate is carried out by U-shaped phosphor-bronze springs with a spherical contact surface which fits into the rounded top of the clamp.

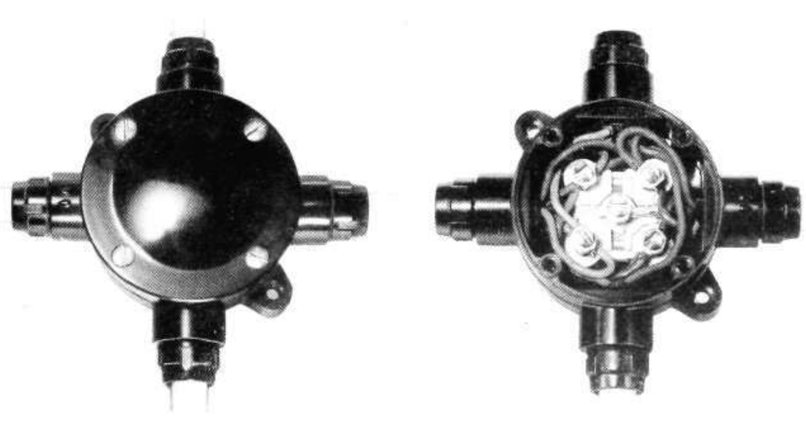


Fig. 2 X 6541

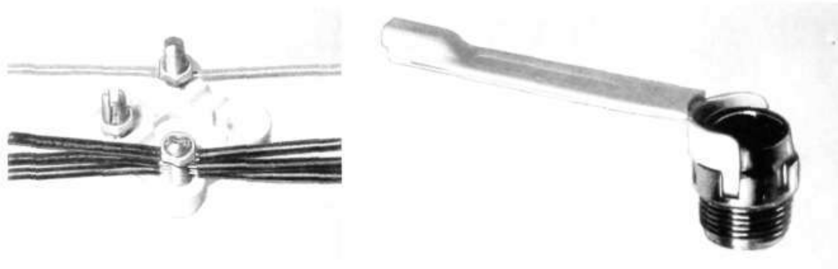
Connecting box

right: with cover removed and with four 4-core conductors and corresponding earthing conductor connected up

Fig. 3 X 6540

Terminal panel and spanner

for tightening the tubular screw securing the conductor packing and the nuts of the connecting clamps



The tubular screw by means of which the conductor packing is tightened is circular and is provided with six grooves around its circumference for the reception of the spanner used for tightening the tubular screw. Thus, when employing a double inlet where two screws are mounted close to one another, it is also possible to tighten the latter satisfactorily even when the box is installed in a position which is difficult of access. The spanner is further provided with a box key which fits the nuts for the connecting clamps, see Fig. 3.

Fig. 4 X 4699

Lampholder with thread for holding the glass globe

The box has been designed in a low form, thus rendering the terminal plate conveniently accessible, and therefore the plate itself has not been constructed larger than is necessary for various reasons. Consequently, ample space is available for the maximum number of conductors a box is capable of taking, and it is easy to connect them up.

The lampholder and threaded sleeve for screwing in the glass globe constitute a single unit, see Fig. 4. One type is available with an 84.5 mm thread and another with a 99 mm thread. Both the bottom contact and the side contacts are resilient. The tightening between the lampholder and globe is carried out with a packing which lies between the front flat flanged surface of the lampholder and the globe, and this packing is so shaped that a reflector can also be attached without the packing being affected.

The pendant cover is not provided with an external tubular screw and packing around the conductors, but is fitted instead with a packing on the inside which is tightened by a pressure ring and two screws. This imparts a more attractive appearance to the pendant cover amongst other features.

In designing the ATU-system an effort has been made to produce a system having small external dimensions and at the same time providing ample space, and which is convenient to work with whilst possessing mechanical strength. The intention has also been to retain smooth surfaces which do not collect dust, combined with an attractive finish.

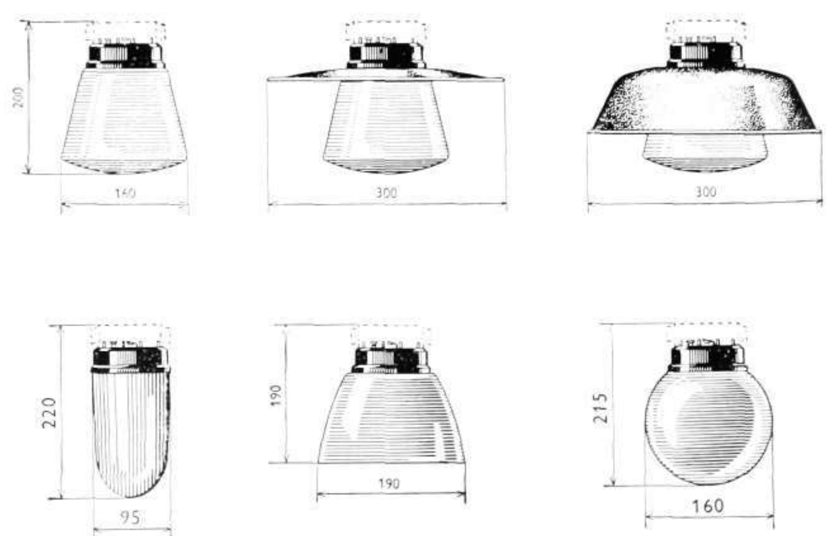


Fig. 5 X 6538

Some types of ATU-fittings

ERICSSON REVIEW

Vol. XXVII 1950

Responsible Publisher: HEMMING JOHANSSON
Editor: SIGVARD EKLUND, DHS
Editor's Office: Stockholm 32
Subscriptions: one year $ 1.50; one copy $ 0.50

CONTENTS

Printed in Sweden, Esselte AB., Stockholm 1951

U.D.C. 621.395.344

KARLSSON, S A: *The L M Ericsson Crossbar Switch System in Helsinki.* Ericsson Rev. 27 (1950) No. 4 pp. 106—115.

The article describes the principles of the L M Ericsson by-path system with crossbar switches and the features of the system making this to be used when extending the central telephone exchanges in Helsinki. The author gives an account of the circuit lay-out as well as the mechanical lay-out and gives an account of operating results obtained so far and the extension schemes which have later been decided upon.

U.D.C. 621.318. 5: 621.395

WIBERG, E: *A Midget Telephone Relay.* Ericsson Rev. 27 (1950) No. 4 pp. 116—118.

In the lay-out of a telephone system it frequently happens that full advantage cannot be taken of the technical possibilities of the telephone relay which causes unnecessary space at excessive cost. L M Ericsson has therefore developed a new relay, RAG 500, with a fewer number of contact combinations than the ordinary relay. An account is given of the construction and application possibilities of the new relay.

U.D.C. 621.318. 5: 656.25

ENGER, S: *Plug-in Type Safety Signal Relays.* Ericsson Rev. 27 (1950) No. 4 pp. 119—124.

L M Ericsson's Signalaktiebolag has developed a series of plug-in type safety signal relays having the same high sensitivity and reliability as the safety signal relays now in general use and having the added advantage of the plug-in feature. An account in given of the demands considered in the design of the relays as also of the design and of driving system for A.C. and D.C. respectively.

U.D.C. 654.915.2

TRÄGÅRDH, A: *New Models of Engaged Signalling Equipment.* Ericsson Rev. 27 (1950) No. 4 pp. 125—127.

Description of L M Ericsson's new engaged signal systems, their design and function.

U.D.C. 621.316.721. 078: 621.311

LINDBERG, S E: *Equipment for Power Supplying at Constant Voltage and Frequency.* Ericsson Rev. 27 (1950) No. 4 pp. 128—134.

L M Ericssons Mätinstrument AB has produced a series of power-supplying equipments for feeding current to testing outfits with built-in wattmeters for calibrating electricity meters. These equipments have a voltage which, as distinguished from that of the supply mains, is constant and has a good wave form. The author describes these features and gives an account of the main types of equipments, which are manufactured.

U.D.C. 683.854

JENSEN, E: *The ATU-system — a New Form of Light Fitting.* Ericsson Rev. 27 (1950) No. 4 pp. 135—136.

The ATU-system is designed by Sieverts Kabelverk in collaboration with AB Alpha, and is produced exclusively by the latter firm. The system supplements the Gebe-system and differs from that in the smaller size of the boxes employed and the construction of the lampholders to take threaded glass globes.

The Ericsson Group

Associated and Cooperating Enterprises

EUROPE

Danmark L M Ericsson A/S — *København V*, Trommesalen 5
Telefon Fabrik Automatic A/S — *København K*, Amaliegade 7
Dansk Signal Industri A/S — *København-Vanløse*, Skalbakken 10

Deutschland Ericsson Verkaufsgesellschaft m. b. H. — *Kronberg im Taunus*, Parkstrasse 1

España Cía Española Ericsson, S.A. — *Madrid*, Conde de Xiquena 13

France Société des Téléphones Ericsson — *Colombes* (Seine), Boulevard de la Finlande

Great Britain Swedish Ericsson Company Ltd. — *London*, W.C. 1, 329 High Holborn
Production Control (Ericsson) Ltd. — *London*, W.C. 1, 329 High Holborn

Italia Setemer, Soc. per Az. — *Milano*, Via dei Giardini 7
SIELTE, Soc. per Az.— Società Impianti Elettrici e Telefonici Sistema Ericsson — *Roma*, C.P. 24 (Appio)
F. A. T. M. E. Soc. per Az. — Fabbrica Apparecchi Telefonici e Materiale Elettrico "Brevetti Ericsson" — *Roma*, C.P. 4025 (Appio)
S. E. T. Soc. per Az. — Società Esercizi Telefonici — *Napoli*, C.P.C. 20833

Nederland Ericsson Telefoon-Maatschappij, N. V. — *Rijen* (N. Br.)

Norge A/S Elektrisk Bureau — *Oslo*, P. B. Mj 2214
A/S Industrikontroll — *Oslo*, Teatergaten 12
A/S Norsk Kabelfabrik — *Drammen*

Suomi O/Y L M Ericsson A/B — *Helsinki*, Fabianinkatu 6

Sverige Telefonaktiebolaget
LM Ericsson — *Stockholm 32*
AB Alpha — *Sundbyberg*
AB Ermex — *Solna*
AB Rifa — *Ulvsunda*
AB Svenska Elektronrör — *Stockholm 20*
L M Ericssons Driftkontrollaktiebolag — *Solna*
L M Ericssons Försäljningsaktiebolag — *Stockholm*, Kungsgatan 33
L M Ericssons Mätinstrumentaktiebolag — *Ulvsunda*
L M Ericssons Signalaktiebolag — *Stockholm 32*
Mexikanska Telefonaktiebolaget Ericsson — *Stockholm 32*
Sieverts Kabelverk — *Sundbyberg*
Svenska Radioaktiebolaget — *Stockholm*, Alströmergatan 12

ASIA

India Ericsson Telephone Sales Corporation AB — *Calcutta*, P.O.B. 2324

Indonesia Ericsson Telefoon-Maatschappij N. V. — *Bandung*, Djalan Tubagus Ismail 13

AMERICA

Argentina Cía Sudamericana de Teléfonos L M Ericsson S.A. — *Buenos Aires*, Belgrano 894
Corp. Sudamericana de Teléfonos y Telégrafos S.A. — *Buenos Aires*, Belgrano 894
Cía Argentina de Teléfonos S.A. — *Buenos Aires*, Peru 263
Cía Entrerriana de Teléfonos S.A. — *Buenos Aires*, Peru 263
Cía Comercial de Administración S.A. — *Buenos Aires*, Peru 263
Industrias Eléctricas de Quilmes S.A. — *Buenos Aires*, Julio A. Roca 733

Brasil Ericsson do Brasil Comércio e Indústria S.A. — *Rio de Janeiro*, C.P. 3601
Empresa Sul Americana de Telefones S.A. — *Rio de Janeiro*, C.P. 4684

Chile Cía Ericsson de Chile S.A. — *Santiago*, Casilla 2118

Colombia Cía Ericsson Ltda — *Bogotá*, Apartado Aéreo 4052

México Cía Comercial Ericsson S.A. — *México D.F.*, Apartado 9958
Teléfonos de México S.A. — *México D.F.*, 2:a calle Victoria 59

Peru Cía Ericsson S.A. — *Lima*, Apartado 2982
Soc. Telefónica del Peru, S.A. — *Arequipa*, Casilla de correo 112

Uruguay Cía Ericsson S.A. — *Montevideo*, Uruguay 1258

United States of America Ericsson Telephone Sales Corporation — *New York 17*, 100 Park Avenue

Venezuela Cía Anónima Ericsson — *Caracas*, Apartado 3548

Agencies

EUROPE

Belgique Électricité et Mécanique Suédoises — *Bruxelles*, 14 Rue van Orley

Grèce »ETEP», S.A. — *Athènes*, 41 Rue W. Churchill

Ireland E. C. Handcock, Ltd. — *Dublin, C 5*, Handcock House, 17 Fleet Street

Island Johan Rönning H/F — *Reykjavik*, P.O.B. 883

Portugal Sociedade Herrmann Ltda — *Lisboa*, Calçada do Lavra 6

Schweiz RIBAG — L M Ericsson Generalvertretung — *Basel 9*, Türkheimerstrasse 48

ASIA

Burma Vulcan Trading Co. Ltd. — *Rangoon*, P.O.B. 581

China The Ekman Foreign Agencies Ltd. — *Shanghai*, P.O.B. 855
The Swedish Trading Co. Ltd. — *Hongkong*, Prince's Building, Ice House Street

Iraq Swedish Oriental Company AB — *Bagdad*, Eastern Commercial Building, Mustansir Street

Iran Irano Swedish Company AB — *Teheran*, Khiabane Sevom Esfand No. 201

Israel Jos. Muller, A. & M. — *Haifa*, P.O.B. 243

Jordan H.L. Larsson & Sons Ltd. Levant — *Jerusalem, Old City*, P.O.B. 4065, via Amman

Pakistan Vulcan Trading Co. Ltd. — *Karachi*, Forbes Building, Dunolly Road

Philippines Koppel (Philippines) Inc. — *Manila*, Boston and 23rd Streets Port Area

Saudi Arabia Mohamed Fazil Abdullah Arab — *Jeddah*

Syrie et Liban Swedish Levant Trading — *Beyrouth*, B.P. 931

Thailand The Borneo Co., Ltd. — *Bangkok*, Chartered Bank Lane

Türkiey Genel Sanayi Techizati T.A.O. — *Istanbul*, P.K. Galata 1455

AFRICA

British East Africa Transcandia Ltd. — *Nairobi*, P.O.B. 5933, Kenya

Egypt Swedish Industries — *Cairo*, P.O.B. 1722

Ethiopia Swedish Ethiopian Company — *Addis Abeba*, P.O.B. 264

Moçambique J. Martins Marques — *Lourenço Marques*, P.O.B. 456

Tánger Elcor S.A. — *Tánger*, Calle de Fez No. 9

Union of South Africa Reunert & Lenz, Ltd. — *Johannesburg*, P.O.B. 92

AMERICA

Bolivia Johansson & Cía, S.A. — *La Paz*, *Casilla 678*

Costa Rica Tropical Commission Co. — *San José*, Apartado 661

Curaçao N.W.I. S.E.L. Maduro & Sons Suc. — *Curaçao*

Dominikanska Republiken A.T. Holsteinson — *Ciudad Trujillo*, Apartado 53

Ecuador Ivan Bohman y Cía — *Guayaquil*, Casilla 1317

El Salvador Dada-Dada & Co. — *San Salvador*, Apartado 274

Guatemala Agencia de Fosforos Suecos, S.A. — *Guatemala*, C. A. Apartado 125

Honduras Cía de Comisiones Inter-Americana S.A. — *Tegucigalpa*, P.O.B. 114

Nicaragua J.R.E. Tefel & Co. Ltd. — *Managua*

Surinam C. Kersten & Co. N.V. — *Paramaribo*, P.O.B. 216

Venezuela Electro-Industrial "Halven", O. L. Halvorssen C.A. — *Caracas*, Apartado 808

AUSTRALIA & OCEANIA

Australia L M Ericsson Telephone Co. Pty. Ltd. — *Melbourne*, 128 William Street

New Zealand ASEA Electric (NZ) Ltd. — *Wellington, C.L.*, Huddart Parker Building