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On cover: Winding of loading coils at the L M Ericsson factory.

Maintenance of Crossbar Switch Exchanges

K G HANSSON TELEFONAKTIEBOLAGET L M ERICSSON, STOCKHOLM

U.D.C. 621.395.004.5

The introduction of the L M Ericsson new by-path system with crossbar switches has focused attention on the question of maintenance of automatic telephone exchanges built on this system and of the organization of such a service on a practical and commercial basis.

The essential conditions prevailing in a crossbar switch system with reference to maintenance are outlined below as well as general views on the running of the service and the use of available auxiliary equipment.

Economical Features of the System

Irrespective of system of operation the maintenance of an automatic exchange includes as a rule inspection, supervision, testing, recording, tracing and reporting of faults. Depending on the type and number of circuit elements which are contained in the exchange these operations require a varying number of working hours. Automatic exchanges with mechanical selectors will, as an example, require a comparatively large number of working hours per year for the cleaning and oiling of the mechanical components in order to reduce wear and maintain a high standard of operation.

In automatic exchanges of the L M Ericsson by-path system the connecting devices consist of crossbar switches and relays exclusively. These components are very reliable and require a very small amount of maintenance. Cleaning and oiling is, thus, not necessary and it is, therefore, possible to dispense with a great proportion of the staff otherwise required for routine work in exchanges with mechanical selectors.

The maintenance operations which require the highest skill, i.e. testing and fault tracing, can in a by-path system be simplified and carried out in less time by introducing simple and reliable supervisory devices. As the essential connection procedure is controlled by a small number of markers, these can be provided with equipment that effects automatic supervision and automatic fault indication.

For satisfactory operation it is also very important that the reliability of the fundamental circuit elements in the system is of the highest order. This is attained by means of duplicated pairs of twin contacts in parallel and arrangements for successive occupation of switches. A temporary fault in the marker will, therefore, not cause large groups of circuit components to be put out of operation.

With a well organized and rationally operated system of maintenance, automatic exchanges of the L M Ericsson by-path system have, therefore, extremely good qualifications for low maintenance costs and high standard of operation. The principal considerations for the maintenance work on crossbar switch exchanges will be outlined below.

Inspection

The inspection operations are of purely prophylactic character and cover cleaning and oiling of moving parts which are subject to wear and exposure. As mentioned above the system contains no elements or parts which are likely to wear to any appreciable extent.

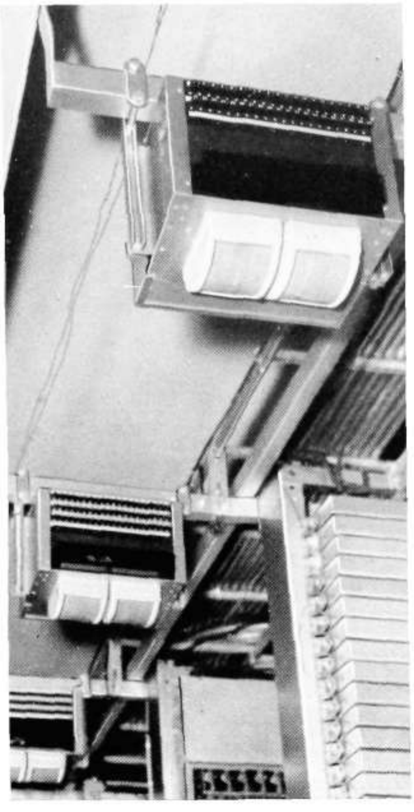


Fig. 1 X 6734

Alarm jack boxes

with alarm indication, listening jacks and disconnection buttons for the signal circuits

The crossbar switch operates generally over long periods without attention provided that it is correctly adjusted and is well protected against dirt and dust. As a rule the crossbar switch should only be attended to when actual faults occur. The inspection in connection with the fault will decide whether a thorough cleaning or mere correction of the adjustment is required.

If a thorough cleaning of the selectors in the exchange is necessary, this is carried out in accordance with the maintenance specification for the crossbar switch, which contains detailed instructions regarding procedure and tools.

The relays in the crossbar switch exchanges are mainly ordinary telephone relays without narrow adjustment limits. A relay, although a very sensitive device, is extremely reliable, if left alone. Certain marker relays which operate frequently and regularly may be inspected once in two years. Local conditions such as damp or extremely dusty premises may cause the armature to stick, i.e. the residual stud sticks mechanically to the core face. Such faults are usually discovered fairly soon and relays particularly exposed, as a rule those with a low spring set load, should be inspected once every other year. Generally the relays are now, however, provided with nylon residual plates which completely eliminate all sticking tendencies. Otherwise the same conditions apply to the relays as to the crossbar switches, viz. that no action should be taken unless a fault has occurred. The adjustment or cleaning of armature or contact which are then found to be necessary, are carried out according to applicable specifications.

Among preventive measures should also be included the cleaning of the exchange premises. From the point of view of operation and maintenance it is very important that the premises are kept free from dust and as clean as possible and that satisfactory ventilation is provided. The special instructions which are issued with reference to the maintenance of the exchange premises, inventories, stationary fixtures, &c should be carefully followed.

Supervision

By a systematic supervision of the automatic exchange equipment immediate fault detection is considerably facilitated. In large exchanges it is advisable, at least during busy hours, to appoint one man specially for this purpose.

Supervision should in the first place be directed to the alarm system of the exchange. In automatic exchanges of the L M Ericsson by-path system each row of panels is provided with an alarm jack box, fig. 1. This box contains lamps indicating different kinds of blocking conditions and equipment fault relating to the associated row. It also includes listening jacks and disconnection buttons for the various kinds of signal circuits which are distributed in the row. A fault alarm should, as a rule, result in immediate action on the part of the exchange staff. The reasons for a blocking alarm should be immediately ascertained, especially during busy hours, in order to prevent unnecessary blocking of the traffic routes in the exchange. Supervision should also include a control that no unnecessary blocking of elements is caused by faulty operation of blocking buttons for selectors or relay sets, &c. Units which have been put out of operation by the exchange staff due to faults or otherwise should be clearly marked on a slip tied to the blocking button indicating the reason for the blocking.

The exchange maintenance chief should also make certain that the protection covers are always fitted on the crossbar switches and relay sets and that the rear doors are on the racks.

Testing

The testing included in the maintenance work covers on the one hand routine testing of the exchange equipment and on the other individual testing of separate elements.

The purpose of a routine test is to check the connecting devices and traffic routes in order to trace deficiencies or weaknesses which may cause faults or to find already existing faults.

The experiences from the L M Ericsson exchanges with 500-line selectors have proved that it is sufficient and advisable to check the switching procedures for calls to free and busy subscriber's number within the exchange itself, for trunk call cut-in on local connections and for the establishment of connections to other exchanges. The crossbar switch system should be particularly well adapted to routine testing since it incorporates distributors which arrange for successive occupation of the various selector stages. Connection can, therefore, easily be obtained over all connecting devices at times of both light and heavy traffic. During slack hours it is also possible to carry out a number of routine tests over the same route by means of a special connection of the distributors.

The routine test is carried out with an automatic routiner, fig. 2, which is connected to test numbers in each 1,000-group. It is usually sufficient to arrange 4 test numbers per 1,000-group. The routiner is set on the required test operation and will then automatically call the exchange, dial the number, check tone signals and reply from called number, check line connection and disconnection. When a fault is found, the routiner stops in the position where the fault occurred and transmits an alarm signal.

Fig. 2
Routiner for automatic test

X 6729

Fig. 3 X 6732

Test set

for checking individual connection stages in a decimal by-path system

Testing of certain connection stages such as first or second group selector or subscriber stages can be carried out with special test instruments which are connected to the equipment in question over test jacks arranged in the panels. For the decimal by-path system (see Ericsson Review No. 4, 1951) a simple test set has been developed, fig. 3. The set is connected over plug and cords to battery positive and negative and to the equipment which is to be tested, e.g. finder or final selector relays. Connection is effected by means of a key and the required number is dialled on an ordinary dial. Tone signals and line connection are checked with the hand microtelephone. The set is provided with means for trunk call cut-in.

A similar set has been devised for register controlled by-path systems. This set is somewhat larger as it contains equipment for code transmission to the connected marker.

The routine test does not cover the testing of separate elements. Individual testing is carried out only if the adjustment or wiring has been interfered with in one way or another. Such a test is made in special jigs according to applicable specifications.

Operation Records

Economical maintenance of automatic exchanges is very much facilitated if arrangements are made for suitable operation records. Ample provisions for this purpose have been made in the L M Ericsson by-path system and such exchanges can be provided with equipment which automatically records the faults which occur. The equipment consists of a central recording instrument, a Centralograph recorder, which is connected to separate control sets for the markers.

The control is based on the fact that a certain fault in the marker puts an element or a group of elements out of function. Conversely, by checking which element or elements are out of operation it is possible to establish the fault in the marker. If the control set for the marker signals a fault, the central equipment is automatically called and the number of the faulty element is transmitted to this equipment. The number is pointed on a paper strip and fault records are thus obtained automatically.

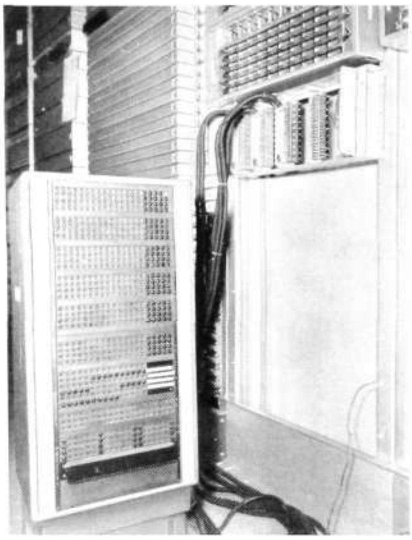


Fig. 4 X 4886

Lamp panel

connected to a subscriber stage group

The control of the individual elements is made possible by the fact that these elements have a uniform occupation due to the distributors in the markers. If a connecting device has not been occupied after a certain number of marker calls the control set in the marker operates and calls the central recording equipment.

The control takes place as follows. Each selector (vertical in the crossbar switch) is provided with a special make contact, which is connected to the control set. If the vertical is occupied, this connection is earthed. The control set for the marker tests 10 selectors simultaneously and the test continues until the marker has carried out a certain number of connections. The selectors, which have not been occupied for a minimum of 4 secs, are recorded. The test is then continued with the following 10 selectors, &c.

Selectors with contact faults in the multiple are detected by means of this 4 secs control as they cannot be occupied more than 2 secs before the connection is released. The testing speed varies for the different selector stages depending on the rate of occupation in the stage. The control equipment can be set for supervision of one selector stage only or groups of selector stages. It can also be set for control of any selector remaining operated after the termination of a call.

It is clear that crossbar switch systems provided with this means of operational control will offer a considerably reduced maintenance in the form of routine tests and will be more economical on this score.

As a further check on the different selector stages the make contacts supplied on the verticals for control purposes are also connected to jacks. These jacks can be connected either to a lamp panel, fig. 4, or a small occupation indicator, fig. 5.

The lamp panel generally gives a picture of the grouping plan for the selector stages and offers considerable advantages for fault tracing in connection with routine tests &c. The lamp panel shows how the connection has been established over the different selectors and it is easy to ascertain if a faulty operation takes place, if other than the correct selectors are connected, if a selector does not remain operated or if the vertical releases immediately.

The occupation indicator is a specially designed plug in which a paper can be inserted. This paper is provided with an electrically conducting layer connected to the battery voltage. A number of pointed springs are resting against the paper and each of these springs is connected to a selector over the make contact on the vertical described above. When a selector is occupied the associated spring is earthed, and a circuit is closed through the conducting layer. A hole is burnt in the paper through which the spring passes, so indicating that the vertical in question has been operated.

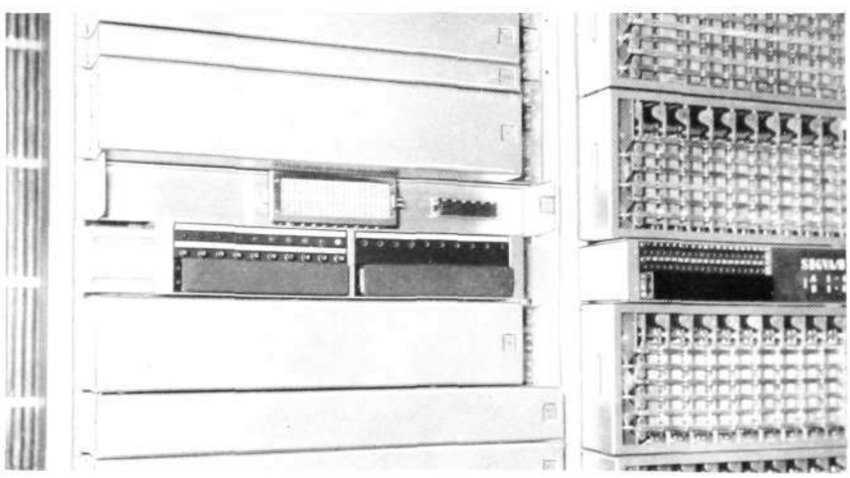


Fig. 5 X 6730

Occupation indicator

connected to a first group selector rack

The occupation indicator can be used for all selector stages and is a valuable supplement to the operation records. By connecting it to one or more groups, for instance during heavy traffic, the paper will provide an indication that all selectors have been in operation. If this has not been the case, immediate information is received as to which selectors have not been taking part by the fact that no holes have been made in the corresponding positions on the paper.

Register controlled by-path systems are provided with register control boards on which the connections in the exchange may be followed in order to supervise the traffic and obtain statistics of reliability. For the purpose of reliability tests a routiner can also be used, which is connected up to a group for a couple of days or so to complete a few thousand connections.

Fault Tracing, Fault Reporting and Fault Statistics

Faults found during inspection, supervision and routine tests, or from operation records and subscribers' complaints, should immediately be traced and corrected. The control devices for the exchange equipment described above will simplify fault tracing considerably. It is very important that fault tracing is carried out methodically and thoroughly and by well trained personnel in order to obtain a satisfactory result.

Fault tracing in itself is a fascinating task, like doing a crossword puzzle. Apart from circuit and wiring diagrams fault tracing requires nothing but a voltmeter, an ammeter, a receiver and most important of all a fair share of imagination.

All faults detected must be carefully recorded. The method adopted may, of course, vary with the requirements of the different telephone administrations. It is advisable to record all faults in a fault ledger and to make a monthly analysis on a statistics sheet. The following particulars should be recorded: the character of the fault, location in the exchange equipment, total faults of similar kind, number of faults per 100,000 connections, number of faults per subscriber's line, &c. This analysis should be made by the exchange superintendent and is sent to a central office which decides upon the action to be taken with reference to the reported fault rate.

For large exchanges it may be advisable to use a fault report form instead of a fault ledger. Each complaint or fault detected during inspection, maintenance or routine test is entered on a separate sheet. The form should cover all particulars in connection with fault tracing and repair. It is passed on to the exchange superintendent and is used as basis for the fault analysis in the same way as the fault ledger.

Maintenance Plan

For each exchange a detailed plan of maintenance work should be made up. The plan should cover a period of one year and specify the dates for the various maintenance operations. A recommended form of maintenance schedule is a table with columns for each week in the year in which symbols for the different maintenance operations are entered with a reference to which groups they apply.

The progress of the maintenance work is also entered in the table as a check that the schedule is followed.

At the same time as the fault analysis and operation records are sent each month to the central office of the administration, e.g. the engineer in charge of exchanges, an extract from the maintenance schedule should be enclosed. The reason for this is that a proper understanding of the fault rate is impossible without knowing the frequency of maintenance, and these two factors coupled together actually decide the optimum cost of maintenance.

New Loading Coils

J FRENNING, TELEFONAKTIEBOLAGET L M ERICSSON, STOCKHOLM

U.D.C. 621.318.42
621.315.2.054.3

The employment of new materials and development of new manufacturing methods have provided means for the re-designing of Telefonaktiebolaget L M Ericsson's loading coils with a resultant reduction in the coil volume of 40 % as compared with the earlier types. The volume and weight of the box have been reduced by approximately 30 %. The technical quality has remained substantially unchanged. The following article contains a brief description of the factors that determine the quality and dimensioning of the loading coils, together with particulars of their design.

Factors Determining Quality. Dimensioning

The electrical properties of loading coils are dependent upon the magnetic properties of the core material, the shape and volume of the core, the material of the insulation of the wire for the windings, the coil's mechanical construction and the degree of precision with which manufacture is carried out.

The core material's permeability, stability and alternating current losses are the magnetic properties that influence the electrical properties of the loading coils. For given core dimensions the direct current resistance of the coil will be inversely proportional to the permeability of the core. The core material must have a high stability to enable it to be subjected to magnetization by direct current loading of the loading coils. This magnetization may be produced by induction in the line cable due to electric earth currents. The alternating current losses in the core material may be divided into eddy current, hysteresis and residual losses which together with the direct current resistance of the coil winding, the copper eddy current losses and the dielectric losses set up a resistance in the coils which rises with the frequency. This rise in resistance contributes to an increase of the attenuation exponent in the loaded circuit with a rising frequency, which is undesirable from the point of view of transmission.

In the new coil designs carbonyl iron powder manufactured from iron pentacarbonyl is used as core material as before. The grain size is 8 to 10 μ. This method of producing the iron powder is found particularly suitable owing to the fact that the shape of the grains is spherical which facilitates the insulation of the grains before they are pressed into cores. The insulation of the iron powder grains implies that their surfaces are coated with an extremely thin layer of electrically insulating material in order to prevent metallic contact between the grains and thus reduce the occurrence of eddy current losses in the core. The thickness of the insulating layer influences the permeability of the core, however, so that in practice a compromise is always effected between low eddy current losses on the one hand and high permeability on the other.

Fig. 1 X 4882

The new coil design, right, compared with the old type

The core, the coil and quad unit for coil grade 1 may be seen in front.

The employment of new insulating materials and a new method of applying the layer of insulation to the iron powder grains have been the important factors enabling a reduced coil volume to be obtained. It has been possible to reduce the amount of the insulation to less than half whilst at the same time the eddy current losses have been reduced to approximately a quarter.

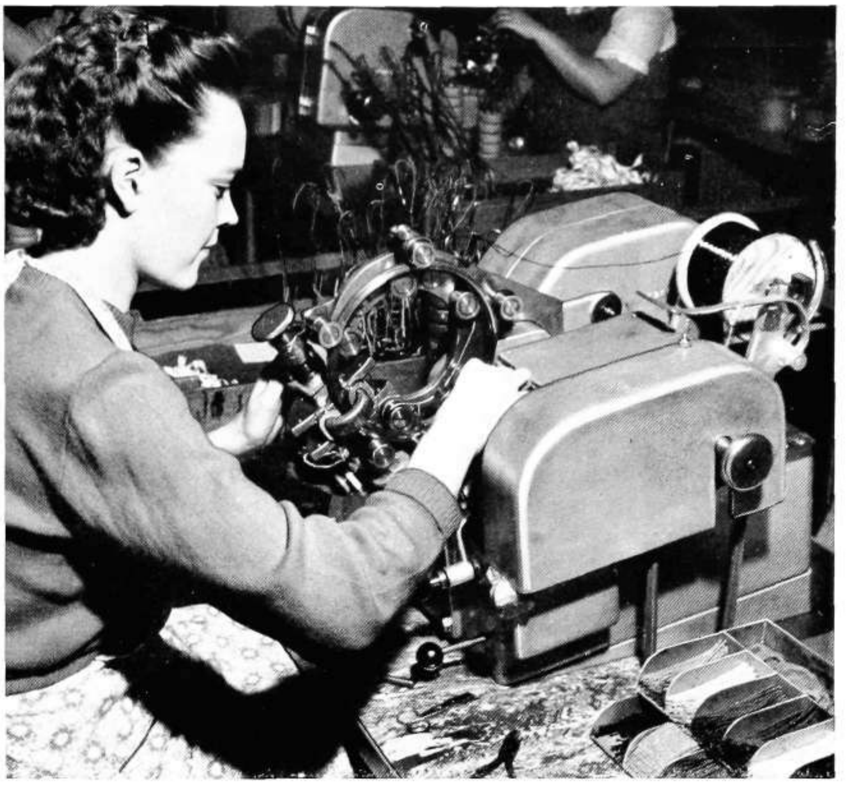


Fig. 2 X 6733

Toroidal winding machine for loading coils

The reduced quantity of insulating material and a slight increase in the pressure adopted for compression when forming the cores have resulted in a higher core permeability which has permitted approximately half of the reduction in the coil volume obtained.

The carbonyl iron powder used can be produced with different properties insofar as the hysteresis losses are concerned. On this account it can be employed for purposes with widely varying requirements from the point of view of hysteresis, such as the loading of two-wire circuits, four-wire circuits with a superimposed carrier frequency system and circuits for the transmission of radio broadcast programmes, without it being necessary to change the volume of the core and coil.

The residual losses factor of the core material varies with the permeability and is independent of both the frequency and field strength.

Coil Designs

The new coil designs, similarly to the earlier types, have a toroidal core. This form of core is found suitable, as the wound coils have a very small magnetic stray field, which permits high cross-talk attenuation between adjoining coils in the loading coil box to be obtained more easily. The core is so dimensioned that it gives the lowest possible direct current resistance in the coil windings for a given core volume. Thus, definite relations exist between the external diameter, the internal diameter and the axial height. The section is oval which facilitates the work of winding.

Apart from the shape of the core, the quality of the loading coils is also dependent upon the core volume regarding the hysteresis losses and the direct current resistance. The greater the volume, the better will be the properties of the loading coils in this respect.

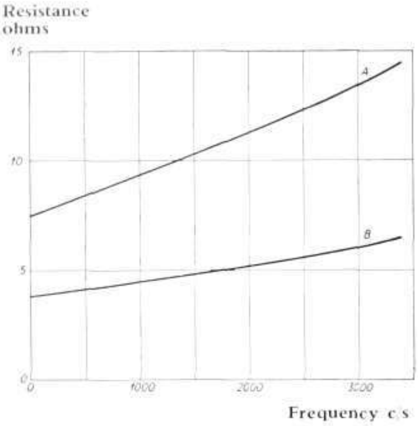


Fig. 3 X 4867

Resistance/frequency characteristic for a quad unit of coil grade 1

Side circuit inductance (A)	132 mH
Phantom circuit inductance (B)	55 mH
Measuring current	1 mA

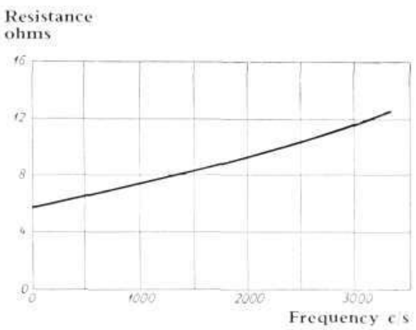


Fig. 4 X 4868

Resistance/frequency characteristic for a side circuit coil grade 2

Inductance	132 mH
Measuring current	1 mA

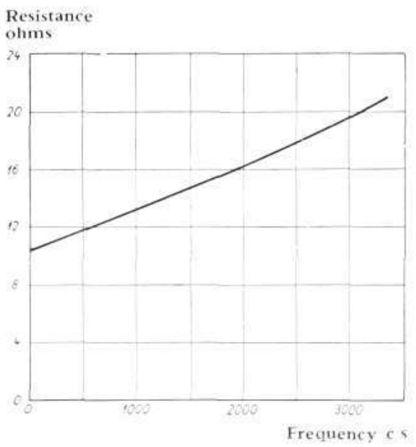


Fig. 5 X 4869

Resistance/frequency characteristic for a coil grade 3

Inductance	177 mH
Measuring current	1 mA

The insulation of the winding wire plays a very important part in the dimensioning of loading coils. On the one hand, the layer of insulation must possess sufficient strength to withstand the stresses in the winding machine, and on the other hand it must be as thin as possible to obtain the greatest possible copper filling factor in the available winding space on the core.

In the earlier coil designs enamelled textile-covered winding wire was employed. In the new designs, however, a winding wire is used the insulation of which consists of a synthetic lacquer the layer thickness of which is less than half that of the winding wire previously employed. In view of the fact that the copper filling factor in the winding space has been increased, it has been possible to reduce the coil volume by about 20 %.

Thus, the increase in the core permeability and the use of an improved winding wire have brought about the 40 % reduction in volume.

An important assumption for satisfactory transmission on loaded circuits is that the cross-talk attenuation between the different circuits should be kept as high as possible. Very exacting demands with regard to freedom from cross-talk must be made of the loading coils. In particular regarding loading coils for side/phantom circuit loading, it is necessary to have an entirely symmetrical design for the coils both from a mechanical and electrical point of view in order to keep the inductive, capacitive and ohmic couplings and unbalances sufficiently low. The cores must be homogeneous, that is to say, they must have the same permeability around their entire periphery. The insulation between the winding and the core must be of the same thickness over the whole core and the winding turns must be distributed in exactly the same manner in the different sections of a coil.

A special semi-automatic winding machine is used for winding the coils. It is operated manually but works entirely automatically and with precision as regards the distribution of the turns. Fig. 2 shows the latest type of these machines.

Loaded telephone lines may be divided into three categories according to their range of use: interurban lines, rural lines for short communications without amplification and local lines—such as the connecting lines between automatic exchanges located close to one another. The transmitting properties vary for lines coming within these categories. It is then necessary from an economic point of view to adapt the quality of the loading coils to the requirements made of the different categories of lines.

The production of loading coils therefore covers three quality grades. The chief technical difference between the grades lies in the direct current resistance and the hysteresis losses.

Coil grade 1 is mainly intended for side/phantom circuit loading of quadded cables of the Dieselhorst-Martin type. They are constructed as a unit for each quad with one coil for each side circuit and one coil for the phantom circuit.

Coil grade 2 is mainly intended for the loading of the side circuits in star-quadded cables.

Coil grade 3 is only intended for the loading of short local lines, usually paired cables.

The coil grades 1 and 2 are also manufactured using a core material having specially low hysteresis losses for loading coils intended for loaded circuits for the transmission of broadcast radio programmes.

Fig. 6 X 4883

Comparative illustration of (left to right) grades 1, 2 and 3 of the new design

From front to rear are to be seen: core, coil and quad unit for grade 1, and core, coil and coil mounting group for grades 2 and 3.

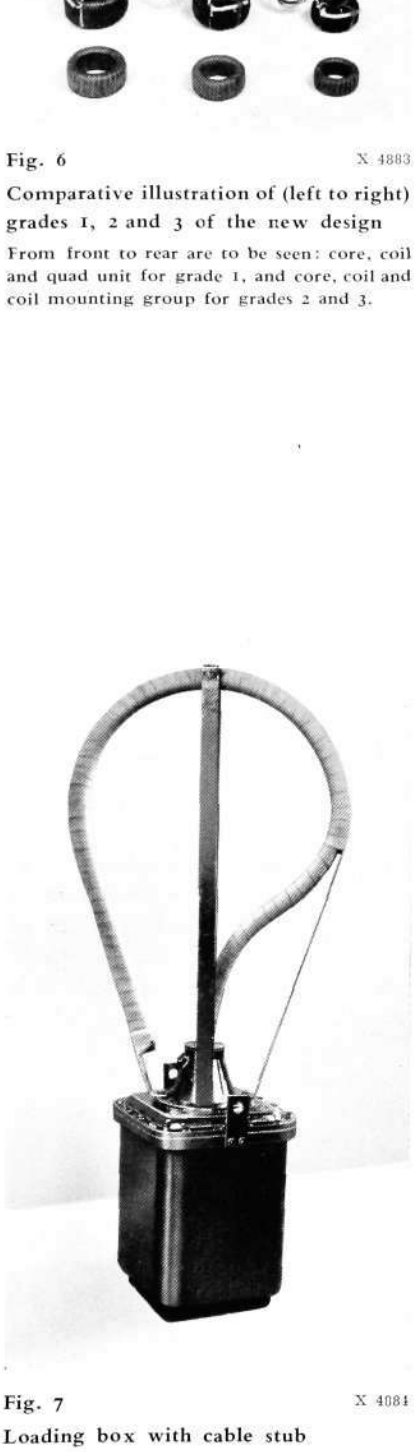


Fig. 7 X 4084

Loading box with cable stub

Box Construction

All loading coils that have to be connected to a line cable at the same point are housed in a common case, a box. The box provides mechanical protection for the coils and must have a high resistance to corrosion. It must be absolutely tight so that water or moisture cannot penetrate into the box and interfere with the transmission due to leakage of current between the different conductors or the conductors and the box.

The boxes are constructed of cast iron. Before the mounting of the loading coils the tightness of the boxes is tested by raising the air pressure inside them while they are submerged in water. Any leakages in the casting are detected rapidly and effectively by this method. In order to increase the resistance of the cast iron to corrosion the boxes are tarred when they have been subjected to the above pressure test. After the coils have been mounted in the box the remaining space in the latter is filled with an asphalt compound under vacuum and heat.

The loading coil boxes are manufactured with arrangements for connection to the line cable according to two different systems, namely, by means of a cable stub and a joint box respectively.

Boxes with cable stubs are chiefly intended for placing in cable pits for connection to unarmoured line cables but they are also used in combination with lead-sheathed line cables suspended on poles. In the latter case the boxes are mounted on the poles immediately below the cables. The connection of loading coil boxes with cable stubs to line cables is carried out by means of a branch-off of the conventional type. The cable stub consists of 0.8 mm copper conductors each insulated with two layers of cellulose paper wrapped in reverse directions. The conductors are twisted into quads in accordance with the Dieselhorst-Martin system and the cable core is surrounded by a pressed lead sheath alloyed with tin. To permit the cable stub to be bent over small diameters the pitch is extremely low for quadded conductors, the cable core is compact and the lead sheath is relatively thick. Fig. 7 shows a loading box with a cable stub. For protection during transport the cable stub is fixed to an iron supporting yoke.

Loading boxes with a joint box are intended for connection to lead-sheathed and armoured line cables. They are placed in pits in the ground close to the cable, which are filled in after jointing is completed. It is not necessary to provide mechanical protection round the boxes. The joint box consists of an internal jointing cap and external protection, see fig. 8. The jointing cap is constructed of tinned sheet brass and consists of a lower part and a cover. At the jointing the two ends of the line cable are each led in through the neck of their respective jointing sleeves, whereupon the joint is formed inside the cap. The cover for the cap is then soldered to the lower part and tightening between the cap and the cable is effected by placing a ball of solder over the neck of the jointing cap and the cable sheath. The cover for the cap is provided with screw-threaded holes for the connection of the compressed-air pipe and pressure gauge for testing the tightness of the soldered joint. After the pressure test, the connecting holes are closed by soldering.

The external protection of the joint cap consists of an iron casting in two halves which serves exclusively for the mechanical protection of the jointing cap. The protective device is fitted with sleeves for securing the armoured cable, so that tensile stresses are prevented at the ball of solder between the lead sheath and the neck of the jointing cap. The space between the cap and the external protection is filled with an asphalt compound after jointing, through a hole on the upper side of one half.

The joint box is constructed in four different sizes to meet the varying demands for jointing space due to the different numbers of coils in the loading boxes and numbers of conductors in the line cable.

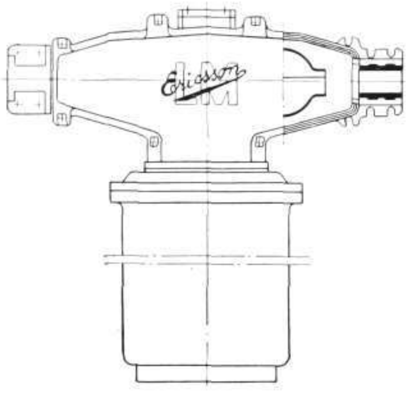


Fig. 8 X 4872

Diagrammatic view of a loading box with joint box

Fig. 9 X 4885

Loading box with joint box

The conductors between the coils in the boxes and the jointing space in the cap consist of 0.8 mm tinned copper conductors insulated with a layer of rubber. The rubber insulation of the conductors is necessary to enable the latter to be bent at very sharp angles in the confined jointing space without damage to the layer of insulation. Fig. 9 shows a loading box provided with a joint box.

It has been possible to reduce the volume and weight of the loading boxes in the new designs. It was not feasible, however, to reduce the box dimensions in the same proportion as those for the coils, since certain spaces in the boxes—for jointing the conductors and for the mechanical supporting structures which hold the coils—are largely independent on the coil volume. The volume and weight of the new designs have been reduced by about 30 %. A loading box of the new type which contains 48 quad units has a volume of about 75 dm^3 exclusive of the joint box or cable stub, respectively, whereas the earlier designs for the same number of units had a volume of about 105 dm^3.

Where the loading of cables with a small number of circuits is concerned, such as small rural cables, operating circuits in coaxial cables or long subscribers' cables, the standard loading boxes are unnecessarily large and expensive. The mounting groups shown in fig. 6 with coils of grades 2 and 3 which are placed in the loading boxes may, however, also be placed directly in a standard cable joint and connected to the line cable. The coils are inserted in tubes of moulding material and impregnated with a moisture-resistant material. They can be packed for transport and storage so that they are protected against moisture. The length of the tubes varies with the number of coils required. For cable joints which contain such coils it may be necessary to increase the dimensions of the jointing box. In such cases a larger standard dimension for the jointing box is usually selected in practice. The costs for the latter will then be appreciably less than if the coils were mounted in a standard loading box.

Guarantees

The loading coils of grades 1 and 2 satisfy the C.C.I.F. recommendations relating to loading coils for interurban loaded lines. There are no international recommendations relating to the quality of the coils for the purposes for which loading coils of grade 3 are employed, namely, local lines of various kinds.

The electrical properties of the coils for which guarantees are given are as follows: inductance, inductance accuracy, inductance stability on direct current loads, inductive unbalance, direct current resistance, effective resistance at two frequencies within the transmission band, direct current resistance unbalance, capacitive unbalance, working capacitance, hysteresis factor, cross-talk attenuation, insulation resistance and dielectric strength.

L M Ericsson's Emergency Telephone System

A HEDÉN, TELEFONAKTIEBOLAGET L M ERICSSON, STOCKHOLM

U.D.C. 621.395.9:654.147.2

L M Ericsson has for a long time past been supplying fire alarm telegraph systems which afford the public a rapid means of calling for help from the fire brigade or police. The growing demand that ordinary telephone lines should be used for such systems, and that the systems should be available for other purposes as well, has led to the construction of the emergency telephone system described below.

During the 1940s a new feature was added to the fire alarm telegraph system in the form of the telephone. This meant that the public could now also communicate directly with the police when help was needed which could not be rendered by the fire brigade. This addition to the fire alarm telegraph system has been a development of extreme significance, and the telephone communication is today equal in importance to the original form of fire alarm comprising a morse signal to the fire brigade. It is this experience which forms the basis of the emergency telephone system.

Principles and Operation

An emergency telephone installation consists of telephone boxes placed at convenient street and road locations. The boxes—the main parts of which comprise a handset and cradle switch, induction coil, etc.—are connected by two-wire lines to an alarm centre which may, for example, be the nearest fire station. To send out a call for assistance, the box is pulled open by means of the handle. An alarm call signal is automatically transmitted to the fire station and at the same time an indication is given of the location of the box. The call is answered by the duty fireman, and the caller can use the telephone to give any further information that may be required. Thus the alarm is received at the fire station as soon as the door of the box is opened, irrespective of whether the telephone is used or not. This is a very important point since, on account of shock or other circumstance, the person in need of assistance may be incapable of passing an intelligible message.

If the box is instead opened with a key, in which case the seal on the handle is not broken, a different signal is received at the fire station indicating a service call. Priority can therefore always be given to alarm calls. Thanks to the excellent speech transmission a call from an emergency telephone box can be switched over at the fire station to the ordinary telephone network. This may be of great value in an emergency when special personnel, material and equipment are required.

The apparatus incorporated in the system is constructed in such a way that it can be used for many different kinds of installation. Fig. 1 shows a layout of a locality possessing a main and two subsidiary fire stations as well as a police station connected to the emergency telephone system. The system permits the automatic relaying of alarm signals from a subsidiary to the main fire station. This facility can be made use of either if the subsidiary station is unmanned or if a quick report is to be given to the main fire station of an incident in a subsidiary district. When the emergency telephone system is used for service calls of this kind, it may be inadvisable to lay the extra burden on the fire stations, but such calls are instead automatically put through to the police.

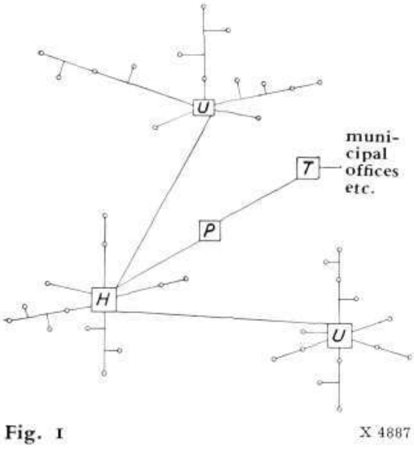


Fig. 1

Layout of emergency telephone system

H main fire station
U subsidiary fire station
P police station
T telephone exchange

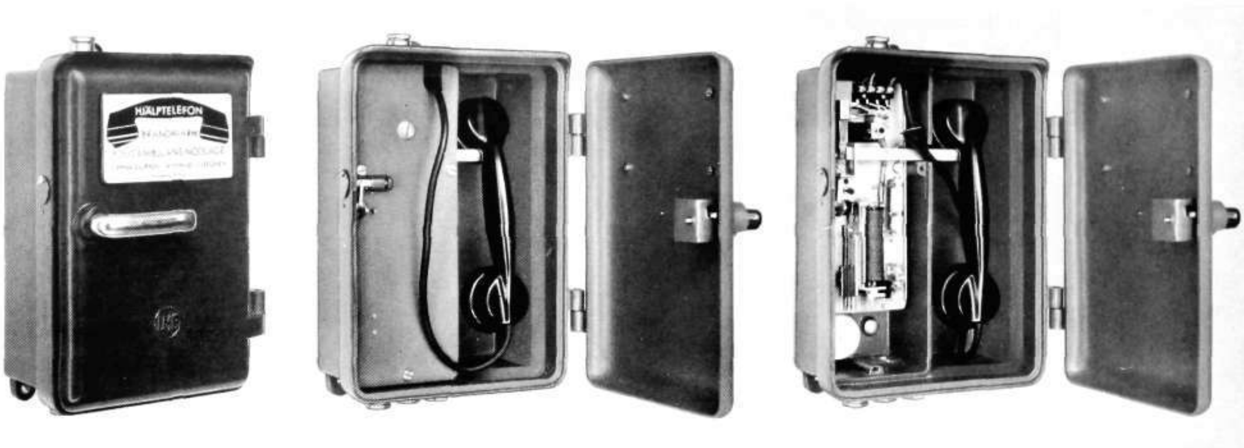


Fig. 2 X 7641

Emergency telephone box KEC 35

with door open (centre) and with internal parts exposed (right)

To enable the police station to obtain rapid communication with policemen on patrol duty, flash signals can be given on lamps placed above the emergency telephone boxes. These signals can be sent to groups of ten boxes. One or more groups can be arranged to cover a given patrol area. The policeman answers the flash signal by opening the nearest box with his key and reporting on the telephone. Neither service calls nor police flash signals interfere with alarms to the fire station.

Line Network

Ordinary telephone lines, with resistance not exceeding 1,200 ohms, are used both for box lines and branch lines between fire stations. All the lines are controlled by supervisory current, so that fault signals in the event of disconnection, short-circuit or earthing are automatically transmitted to the respective stations. Up to eight boxes sending individual alarm signals to the fire station can be coupled to one line. If several boxes are placed on the same line—a multi-box line—it should preferably be drawn so as to form an unbroken loop up to the last box. For the relaying of signals from a subsidiary to main fire station one line is required per eight boxes associated with the subsidiary station, while for relaying of signals to the police station one line is required for every group of ten box lines irrespective of the number of boxes on them.

Emergency Telephone Box KEC 35

The emergency telephone box shown in fig. 2 is made of a light alloy and is coloured signal-red. The dimensions of the box are: height 360 mm, width 245 mm, depth 190 mm. When the door is opened (fig. 2, centre) a handset is found hanging in the right-hand section of the box, and in a covered compartment are induction coil, contact spring sets, rectifier units, etc. The compartment also contains space for a relay with heavy duty contacts (fig. 2, right) to receive the flash impulses from the police station and to break and make the current to the lamp above the box.

The box can be opened, as already said, either by means of the handle or with a key. When the handle, which is normally sealed, is pushed down, the seal is broken and a contact device sends an alarm signal to the fire station. When the door is opened with the key on the other hand, the contact device is blocked and a calling signal is not transmitted until the handset is lifted off the rest. At the bottom of the box are cable bushings for mains, lamp, fire station line and earthing.

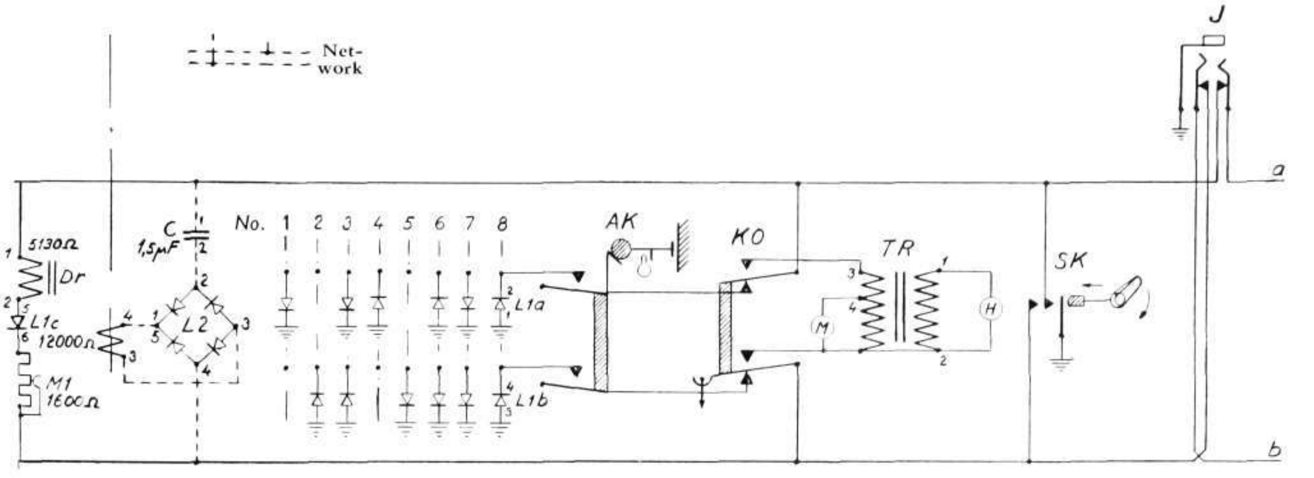


Fig. 3 X 7640

Circuit diagram of emergency telephone box KEC 35

- AK switch operated by opening of door
- SK switch operated by handle
- KO cradle switch
- BR police flash relay
- TR induction coil
- LIa, LIb rectifiers for identification of box
- H receiver
- M transmitter

No critical parts such as relays, selectors, batteries or the like are involved for the most important functions of the boxes, which consist of alarm and service calls. In order to be able to distinguish between alarm calls from different boxes on the same line, each box is provided with rectifiers which are normally not connected into circuit. Not until an alarm call is made are the rectifiers brought into connection between the two branches of the line and earth in such a way that a distinct identification of the calling box is indicated at the fire station. The rectifiers are brought into connection by the contact device which is operated by the handle, and are disconnected on the handset being raised.

In fig. 3 is shown the circuit diagram of a terminal box on a multi-box line. The circuit diagram of a box to be used on a single box line is somewhat simpler.

Fire Station Control Board

The control board is constructed in a light polished oak frame. In front is seen a horizontal panel containing the common equipment and, above it, vertical panels containing lamps and jacks for the box lines. The vertical panel equipment is composed of a number of assembled units. The panels for

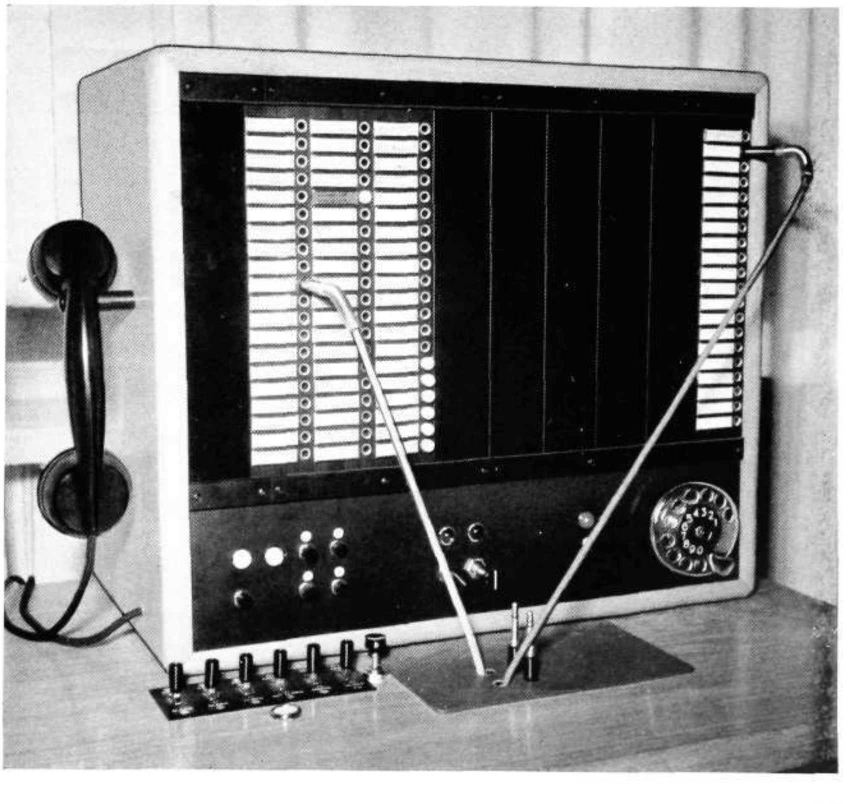


Fig. 4 X 6735

Control board for 10 vertical panels

single box lines are provided with lamps and jacks for 20 lines each, while panels for multi-box lines each serve two multi-box lines, i.e. 16 boxes. Control boards are made in two sizes with space for 10 and 15 vertical panels respectively.

In order to be able to transfer calls from the emergency telephone boxes to other locations, arrangements are provided for incorporating extension line panels as well in the control board. These panels are made for 20 lines. Calls are answered in the same way as with an ordinary cord switchboard, and the necessary cords and plugs may well be mounted in the table on which the control board stands. Fig. 4 shows a control board for 10 vertical panels. In this board 3 panels are mounted for single box lines, i. e. a maximum of 60 boxes, and one panel for extension lines. The vacant spaces are covered in with blind panels. It will also be seen from the photograph that there is space beside each jack for an identification plate to mark the location of the box. Behind these plates are lamps which light when a call is made. An alarm call is signalled by flashing of the lamps, and service calls by a steady light.

Fig. 5 X 4888
Time recorder

A further board, placed beside the control board and mounted in a similar frame, contains equipment for transmitting internal alarm signals within the fire station itself. This equipment is also constructed in the form of units for loudspeaker and bell alarm signals or for the operation or lighting inside or outside the station, while other equipment contains a stop watch for taking the time of going into action.

The fire station equipment may also comprise an apparatus for recording of all alarm calls received, fig. 5. The date, time and number of the calling box are stamped on a roll of paper which moves forward one step for every call made. The conversation can also be taken up on a tape recorder, fig. 6.

Other equipment required at the fire station comprises relay sets which are mounted in racks 1.860 mm in height and 755 mm in width. Various types of relay sets are used, depending on their function in the system. There are thus different sets for single and multi-box lines, for the transmitting of alarm signals, for connection to the police station, and so on. The racks are so constructed as to enable practically any combination of relays to be installed and to facilitate extensions and additions to the plant.

Police Station Equipment

The police station equipment comprises a control board similar to that described above, containing the necessary devices for receiving service calls and for the starting and stopping of flash signals. Here again the line equipment is constructed in the form of vertical panels, the board being constructed for 10 such panels. No extra relay equipment is required here, but the necessary relays are mounted in the control board.

Fig. 6 X 4889
Tape recorder

Power Requirements

A 48 V storage battery with centre-point tappings is required at the fire stations for operation of the plant. The capacity is calculated on a closed circuit consumption of 8 mA per line, but with a minimum capacity of 20 Ah. The flash signals at the emergency telephone boxes are sent out in the form of alternating current impulses, which may suitably be supplied from a ringing current converter *BKL 1303* operated by the 48 V battery. At the police station a 24 V battery with about 20 Ah capacity is required.

Automatic Fire Alarm Installations

Automatic fire alarm installations may be connected to the emergency telephone system. A special connecting unit is then provided at the control units of these installations. An alarm is sent to the fire station in the same way as from an emergency telephone box, while faults are dealt with similarly to service calls, telephone communication being obtainable between the control unit and the fire station.

Outstanding Features of the System

1) Network consists of two-wire telephone lines.

2) Box lines and branch lines alike are controlled by supervisory current, and fault signals are automatically received in the event of disconnection, short-circuit or earthing.

3) The boxes contain no relays or other critical parts for their main functions.

4) The boxes can be provided with heating elements.

5) Up to 8 boxes can be coupled to one line. An indication of the box originating the alarm is given at the fire station.

6) An alarm is automatically sent from the box as soon as the door is opened with the handle, whether the telephone is used or not.

7) The emergency telephone system can be used for service calls as well. The latter are signalled in a different manner from alarm calls.

8) The transfer of alarm calls from, for example, a subsidiary fire station to headquarters can be arranged automatically. The call can be answered at either station.

9) The time of an alarm being given and the number of the box can be automatically registered by a time recorder, and conversations can be taken up on a tape recorder.

10) Service calls can be automatically transferred to the police station and answered there.

11) Flash signals can be transmitted to lamps at the boxes from the police station (or fire station).

12) Service calls and flash signals do not prevent the sending of an alarm.

13) All types of telephone call can be transferred to the public telephone network.

14) Automatic fire alarm installations can be linked to the emergency telephone system.

15) The central equipment at fire stations can be implemented by arrangements for internal alarm, etc.

16) An already installed system can easily be expanded.

30-Line Selector for Small Automatic Telephone Exchanges

C O SOHLBERG, TELEFONAKTIEBOLAGET L M ERICSSON, STOCKHOLM

U.D.C. 621.395.2

The L M Ericsson small automatic telephone exchanges were earlier provided with rotary step-by-step 25-line selectors. The development of the automatic systems type ALD 10—20, however, required a selector with a larger capacity than that of the 25-line selector.

A new type of selector was, therefore, developed based on the same principle as that of the 25-line selector but with 30 contact positions, better contact properties, less power consumption and considerably longer life.

The design and general properties of the new selector are outlined below.

Design

The step-by-step 30-line selector, fig. 1, has been type coded *RVF 10—20*. It is mounted with spring suspension on 4 spiral springs in the same way as the 25-line selector. The mechanism and the multiple bank of the selector are built up on both sides of a mounting plate with the rotor, fig. 6, pivoted inside the multiple bank. The fixing hole pitch for the two selectors is the same and no modifications were, therefore, required in the rack construction.

The selector mechanism, fig. 2, consists of chassis and driving system with coil, magnet bracket, armature with armature lever, driving spring and armature pawl. A stud is also provided for adjustment of armature stroke, a detent spring and stop bracket for the armature pawl.

The chassis also carries a spring set containing home position contact springs as well as interrupter contacts. The latter consist of one fixed and one flexible contact spring, both provided with twin tungsten contacts, and are operated by a sliding interrupter arm made of fabric reinforced phenolic and

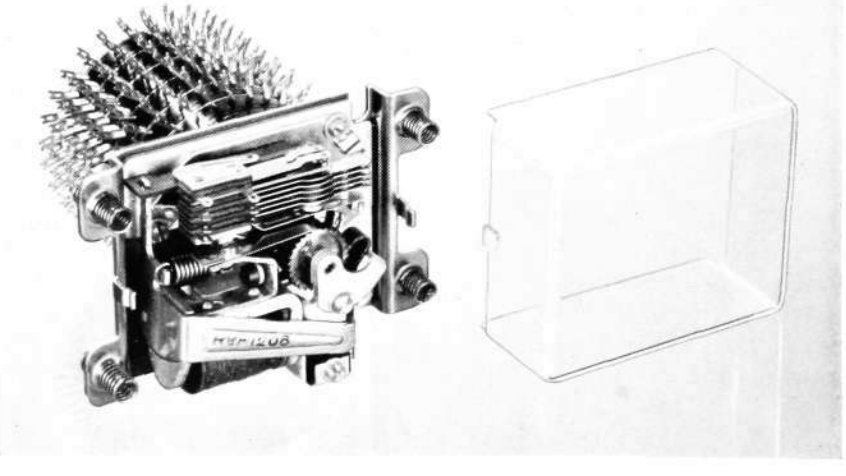


Fig. 1 X 6725

30-line selector, viewed from the mechanism end

Right plastic cover

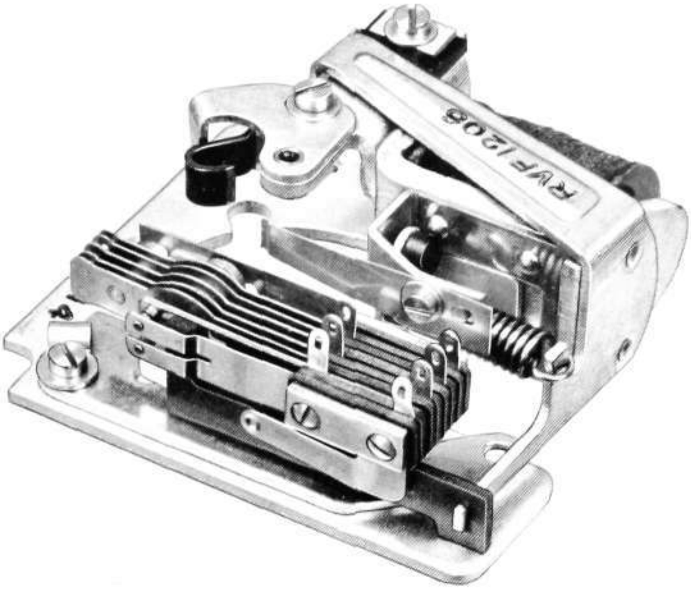


Fig. 2 X 6726

Mechanism of 30-line selector

Commencing from the front are seen chassis, spring set (the two shorter springs being the interrupter set) detent spring and, behind it, the driving spring; to the left, ratchet pawl and stop bracket; behind and to the right, magnet bracket, armature with armature lever, coil and stop stud.

fitted on the armature lever. When the armature operates, the interrupter arm parts the contact springs and breaks the circuit. A certain amount of play is arranged between the armature lever and the aperture in the interrupter lever, and the contacts, therefore, break and make just at the end of an operation or release of the armature, making the action of the selector very reliable. The interrupter arm acts upon the whole width of the flexible spring and the wear is thus insignificant. A correctly adjusted interrupter mechanism will, therefore, maintain its adjustment for a very long time.

The multiple bank, fig. 3, consists of 6 rings of thermosetting material, which on both sides are provided with slots for the contact plates. When a contact plate is fitted in a slot, a portion of the plate projects outside the width of the ring, figs. 4 and 5.

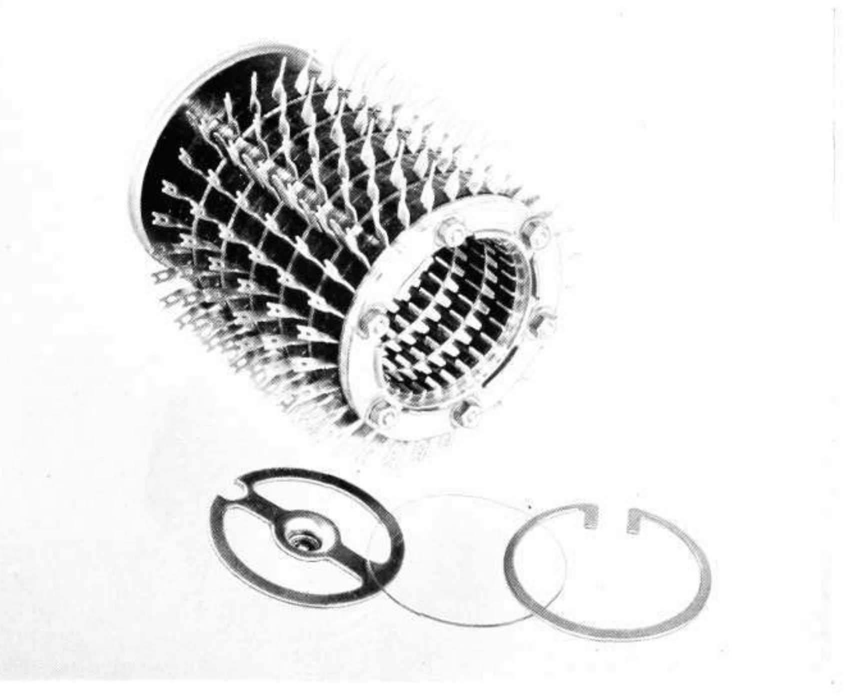


Fig. 3 X 6727

Multiple bank with, from the left, bearing plate, protection glass and locking ring

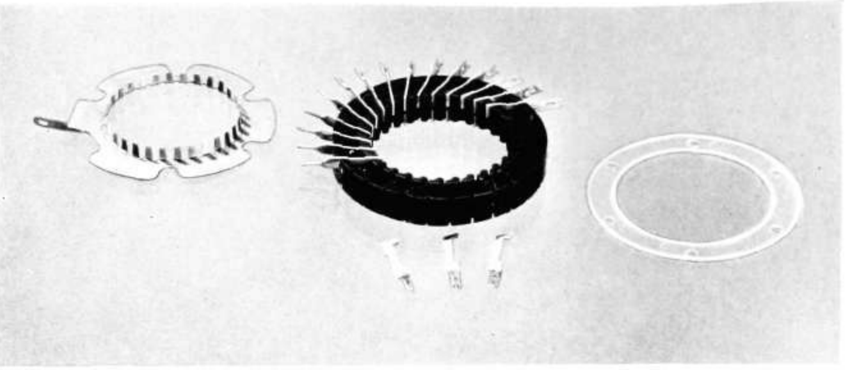


Fig. 4 X 6728

Multiple ring with contact plates fitted (centre), contact ring (left) and insulating ring (right)

Instead of contact plates a closed contact ring, fig. 4 left, may be fitted on one side of the multiple ring.

Between each multiple ring an insulating ring is fitted. Each side of the insulation ring is provided with two raised sealing ribs. When the multiple bank is pressed together, which is carried out in a pneumatic tool, the projecting edges of the contact plates are pressed into the sealing ribs and the latter close up tightly against the multiple rings. Dust can consequently not penetrate between the multiple rings. The extreme end of the bank carries a bearing plate for the rotor and a protection glass, both held by a spring ring, fig. 3. By means of this arrangement the inside of the selector is made readily accessible, the rotor can be removed, cleaning can be carried out, and so on, without dismantling the bank assembly.

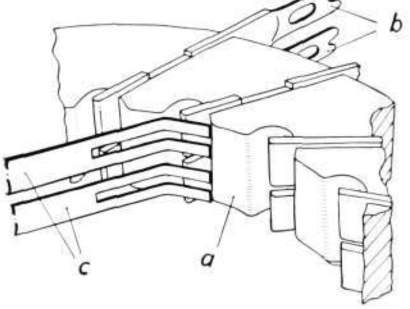


Fig. 5 X 4871

The position of the wipers on the contact plates in a multiple ring

a multiple ring
b contact plate
c wiper spring

The rotor, fig. 6, consists of a spindle, *a*, fitted with a ratchet wheel, *b*, and a bracket, *c*, carrying an insulating plate, *d*, with rivetted wiper springs, *c*. The bracket also carries an index disc, *f*, indicating the position of the selector. A cam disc, *g*, is fitted between the bracket and the ratchet wheel and operates the home position contact springs. If the two screws on the ratchet wheel are loosened, the cam disc can be turned to the required position. The rotor is pivoted in the bearing plate at the end of the bank and in a bearing bush on the driving mechanism.

The favourable operating properties of the 30-line selector are mainly due to the fact that the wiper springs are provided with twin contacts, see fig. 5, and that the contact points for making, breaking and rest are situated on different parts of the springs. When the selector rotates, contact making is effected near the bent point of the wiper spring whereas breaking takes place at the end of the spring. The rest position is situated somewhere between these two points and this part of the wiper is, therefore, not affected by the sparking which often takes place when a circuit is closed or opened. The contact plates are not placed radially in the multiple rings, but at a slight angle with the round side of the blank against the wiper springs. In this way good contact surfaces free from burrs are obtained.

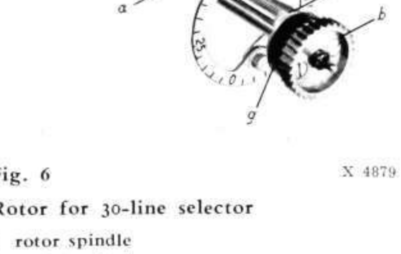


Fig. 6 X 4879

Rotor for 30-line selector

a rotor spindle
b ratchet wheel
c wiper spring
d insulating plate
e bracket
f index disc
g cam disc

Similarly to the 25-line selector the 30-line selector is indirectly driven, i.e. the movement of the rotor takes place on the release of the armature. On the operation of the armature the driving spring is loaded up and the armature pawl is moved from one tooth of the ratchet wheel to another. On release the driving spring returns the armature lever and the armature pawl moves the ratchet wheel and the wiper springs on the rotor to the next contact position.

The selector is made for a maximum of 6 pole switching but is also supplied for 4 and 5 poles. If duplicated wiper springs are fitted on the rotor diametrically opposite each other, the selector can also be used as 8, 10 or 12 pole 15-line selector.

As mentioned above, the multiple bank is completely enclosed and sealed against dust. The selector mechanism is protected by a transparent cover and the whole selector is, thus, well enclosed and efficiently protected. The position of the selector can easily be ascertained without removing the cover.

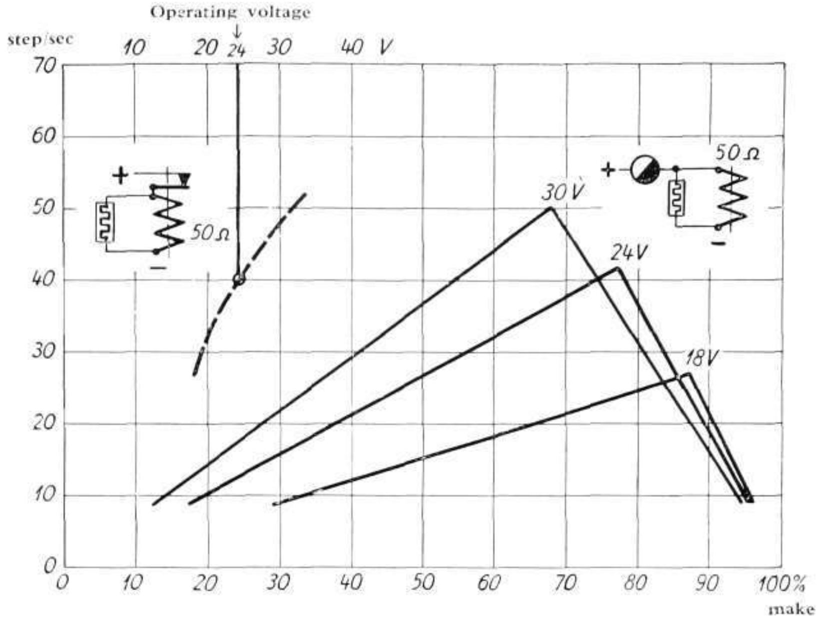


Fig. 7 X 6731

Speed of interrupter operation (left) and impulsing rate for 30-line selector

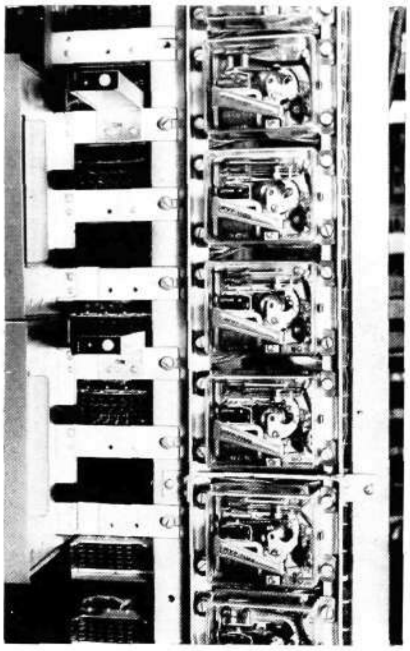


Fig. 8 X 4881

30-line selectors fitted in an ALD exchange

General Properties

The magnet circuit has proved to be very efficient, having a comparatively short coil which stands up to continuous rated current without exceeding permissible temperature. It has, therefore, been possible to reduce the power consumption to 11.5 W in spite of the fact that the selector is provided with twin contacts with a comparatively high contact pressure.

A varistor across the coil is used as spark-quench. It is fitted under the magnet coil and soldered to the two tags of the coil.

The operation of the selector is very uniform and stable. This applies to interrupter operation as well as to external impulsing. The diagrams in fig. 7 show the impulsing rate at 18, 24 and 30 V and the speed of interrupter operation at different voltages.

Fig. 9 shows an oscillogram for a selector during interrupter operation.

Life tests have proved that the selector still operates satisfactorily after 10 million revolutions, i.e., 300 million steps.

By making the main parts in the multiple bank of plastic material it has been possible to reduce the weight to 0.6 kg (1 lb 5 ozs).

The dimensions are: height 69 mm (2 $^{23}/_{32}$″), width 107 mm (4 $^{7}/_{32}$″) and depth 111 mm (4 $^{3}/_{8}$″) with cover included.

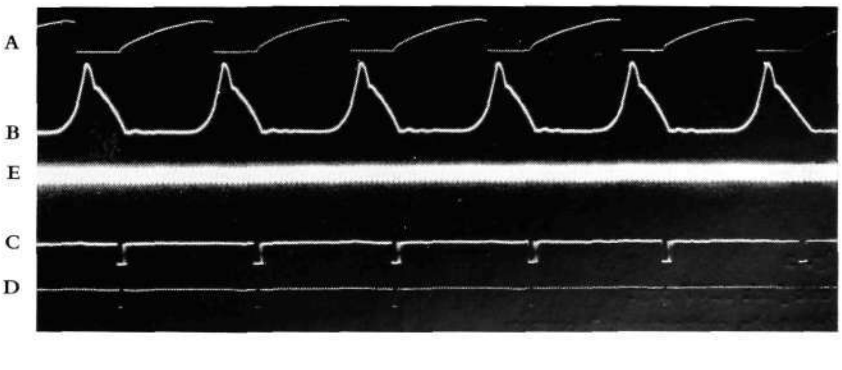


Fig. 9 X 6722

Oscillogram showing interrupter operation in 30-line selector

Coil: 50 ohms
Operating voltage: 24 V

Diagram	A	current through coil
	B	the movement of the armature lever at the fixing point for the driving pawl (operating direction up)
	C, D	current through contacts in two multiple rings (make contact up)
	E	time reference (1 cycle = 1 msec)

New Coupling Components

E A WIBERG, TELEFONAKTIEBOLAGET L M ERICSSON, STOCKHOLM

U.D.C. 621.315.67

The interconnection of the various teletechnical apparatus requires an increasing amount of multi-point coupling components of high quality but inexpensive in production. L M Ericsson has developed two new 20-point elements, the fork jack RNV 2051 and the pin plug RPV 2051, which are described below.

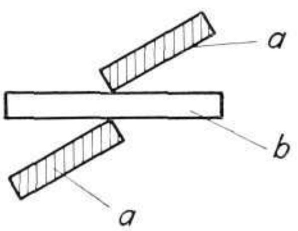


Fig. 1 X 4870

Principle of contact making in the new coupling components

a prongs of fork contact
b flat pin contact

The distinguishing feature of the new coupling components is the method of contact making. The contact members consist of flat plates, one shaped as a fork and the other as a knife-like flat pin. The forked contact member is placed at an angle in relation to the making flat pin, see fig. 1. When the flat pin is inserted into the forked contact, a contact point is obtained on each side of the pin. The two contact points for each connection receive adequate contact pressure through the torsion set up in each prong of the fork. In order to reduce the contact resistance the contact members are silver plated.

The fork contacts and the flat pins are mounted in their bodies in such a way that each member has a certain amount of free movement. In this way the contact members are automatically adjusted in alignment when the jack and plug are coupled together.

The width of the flat pin contacts is large in relation to the fork contact points and a certain amount of displacement between the jack and the plug is, therefore, permissible without jeopardizing the connection.

Fork Jack RNV 2051

The fork jack, fig. 2, consists of a body in thermosetting material provided with 20 recesses. The bottom of each recess has an open rectangular aperture arranged at an angle with the sides of the body. The fork contact, which is terminated by a soldering tag, is inserted through the aperture at the bottom of the recess and is secured by the soldering tag being twisted into parallel

Fig. 2 X 6723

Fork jack RNV 2051

Right body, centre two fork contacts

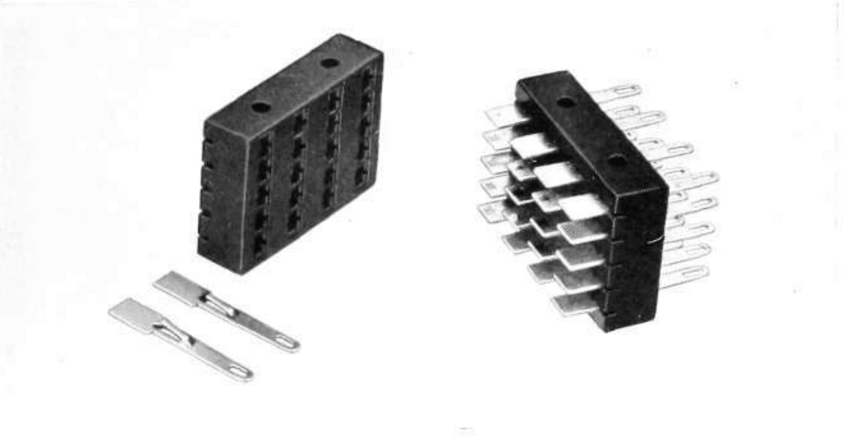


Fig. 3 X 6724

Pin plug RPV 2051

Left body and in front of this two flat pin contacts

with the long sides of the body. The depth of the recesses is such that the fork contacts are nested below the surface of the body and they are, therefore, mechanically protected.

The shape of the jack body is arranged in such a way that the flat pins in the plug are guided by the body and not by the fork contacts. Two open holes are arranged for fixing the jack.

Pin Plug RPV 2051

The flat pin contact, fig. 3, has a knife shaped front part and a narrower part terminating in a soldering tag. In the centre of the narrow part a spring tongue is sheared up intended for the fixing of the contact pin.

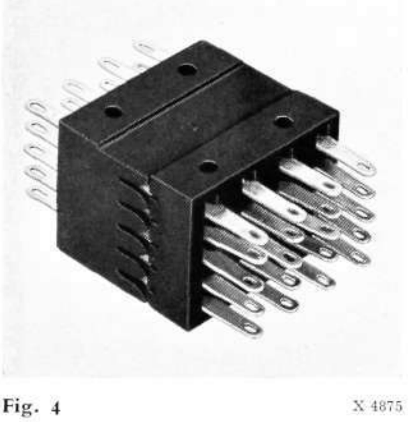


Fig. 4 X 4875

Coupled plug and jack

Left fork jack RNV 2051, right pin plug RPV 2051

Similarly to the fork jack the pin plug has a body of thermosetting material. The body is provided with 20 open holes. These holes are larger on one side than on the other forming a step inside the body. The contact pins are inserted from the side with the small holes, soldering tag first, and are pushed in until the shoulder of the pin rests against the body. The pins are secured in position by the spring tongue snapping into the large part of the hole and engaging the step referred to above. Two open holes are arranged for the fixing of the plug.

Fig. 4 shows the jack and the plug coupled together.

The fork jacks and pin plugs may be used as solid fixtures on the units which are to be connected. A flexible connection may be obtained by enclosing one or both members in covers and connecting them to a multi-core cable or a cord.

Static Frequency Converters for Track Circuits

C AHLBERG, L M ERICSSONS SIGNALAKTIEBOLAG, STOCKHOLM

U.D.C. 621.314.26:656.259.12

To meet the need for A.C. sources for feeding track circuits on electrified railways with 16 2/3-cycle traction current L M Ericsson's Signalaktiebolag has designed special frequency converters without moving parts which convert 50-cycle energy into 75- or 125-cycles. The frequency converters designed for this purpose are described in the following article.

On electrified railways the rails are used as common conductors both for the signalling current and the traction current. The signal-receiving relay, which is known as the track relay, must be constructed or connected in such a way that it is not actuated by the traction current but by the signalling current only. Apart from bridge couplings by means of impedance bonds which afford adequate reliability in certain cases, this can be achieved with frequency-selective relays. The frequency of the signalling current is then so selected that it does not conflict with the frequency of the traction current or of its harmonics.

If the traction current consists of alternating current of $16^2/_3$ cycles, odd, and in certain cases also even harmonics are set up on the voltage drop in the rails. The third and fifth harmonics are specially pronounced, and if the rails are magnetized or have recently been magnetized with direct current the fourth and sixth harmonics are sufficiently marked to exert a disturbing effect. Direct current magnetization of this kind may occur in the event of earth magnetic disturbances.

When direct current is employed for traction purposes the choice or frequency for the signalling current is not so restricted as in the case of alternating current, but the risk of stray 50-cycle currents from power nets cannot be neglected, and a frequency of 50-cycles for the signalling current should consequently be avoided.

Since track circuits, as a rule, are continuously under current, very exacting demands are made as regards the durability of their current sources. Rotary converters meet these demands but they require a certain supervision and instrumentation, on which account they are not very suitable for installation in relay cabinets along the line. They are therefore placed in the stations and the track circuits are supplied through special feeders. A more satisfactory solution is provided by a static converter which when connected to the power network converts current of the power frequency to current of the signalling frequency. Thus, in 1945 the Signalbolaget took up the development of static converters which have now been employed in service for some years with excellent results.

Let us first review the development of static frequency converters which have been known from the infancy of radio-telegraphy. Prior to the introduction of the vacuum tube these converters were employed for the conversion of low-frequency energy generated by rotary machines to high frequency energy which was supplied to the antenna. The raising of the frequency was carried out as a multiplication of the basic frequency by a whole number. At a much later date it was discoverd that it was possible to obtain a division of frequency by means of static elements. It appears that the first patent for a frequency divider of this kind was applied for in France in 1926 by *Fallou* who stated that he had succeeded in effecting a frequency division by three, four and nine. After Fallou had demonstrated

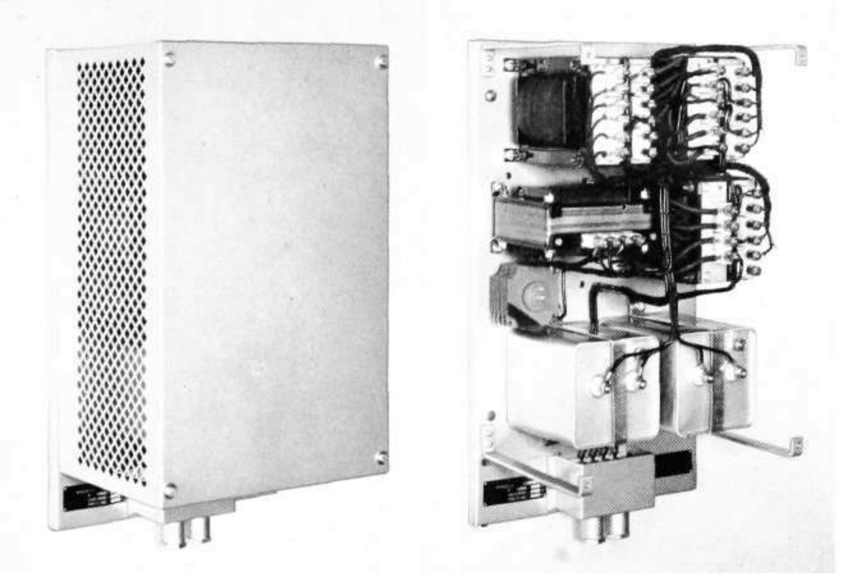


Fig. 1 X 6721

Frequency converter JLM 1102
right: with the casing removed

the possibility of frequency division, several devices were designed and patents applied for. In the United States in particular a »subcycle ringing converter» on Fallou's principle has been in use for many years as a source of ringing current in telephone exchanges. Since then static »frequency reducers» which provide several frequencies simultaneously for party-line ringing have also been introduced.

An undesirable form of frequency division to which attention has been drawn in power engineering during recent years is found in the subharmonics set up in »capacitor transformers» and in big power lines provided with series capacitors. These subharmonics may give rise to overloads with resultant cut-outs which interrupt the service and measures have therefore been taken to prevent such phenomena.

Principles

The frequencies of the harmonics in a $16^2/_3$-cycle traction current referred to in the introductory part are spaced at a mutual distance of $16^2/_3$-cycles. Thus, it is quite natural to place the signalling frequencies exactly in the middle between the harmonics. The latter are $33^1/_3$, 50, $66^2/_3$, $83^1/_3$, 100, $116^2/_3$, $133^1/_3$, 150 cycles, etc. or in other words, $^{50}/_3$-times 2, 3, etc. The frequencies in the middle between them are $^{50}/_3$-times $2^1/_2$, $3^1/_2$, etc, or after the positions of the denominators have been changed, $^{50}/_2$-times $^5/_3$, $^7/_3$, $^9/_3$, $^{11}/_3$, $^{13}/_3$, $^{15}/_3$, $^{17}/_3$, $^{19}/_3$, $^{21}/_3$, etc. As will be seen, amongst the frequencies that can be employed $^{50}/_2 \times 3$, $^{50}/_2 \times 5$, $^{50}/_2 \times 7$, etc, occur, that is to say, when the standardized power frequency of 50-cycles is halved and then multiplied by an odd number in a static device, such a device could be used for the purpose in question.

In previously known methods of static conversion the frequency could be either multiplied or divided. It seemed that a combination of the two methods would be possible, and this was confirmed by preliminary experiments. The experiments were primarily directed towards the halving of the 50-cycle current which was found to be possible with a capacitive impedance connected in the low-frequency secondary circuit. As anticipated, the secondary current was found to have numerous harmonics, particularly odd, and consequently it became possible with the help of a simple filter circuit to emphasize the desired harmonic and in that way effect the multiplication.

The static frequency converter possesses very marked advantages, first and foremost in the absence of moving parts, in addition to others. The voltage obtained is unexpectedly stable under fluctuations both of the primary voltage and secondary load. When the latter rises above the full-load value the voltage collapses to zero so that no damage can occur due to overloading.

The necessary components in this converter, as in all other static frequency converters, are transformers or reactors with saturable iron cores. Consequently the converters absorb a considerable amount of material and are heavy in relation to rotary converters. This is accompanied by the fact that the efficiency is relatively low and the converters take a comparatively heavy reactive (inductive) power from the feeding net.

In track circuits where the selective relay is of the two-phase type with one phase fed locally and the other phase fed through the rails it is often desirable that the voltage vectors of sources of supply for the local phase and the track phase should have a mutual phase displacement of 90°. This can easily be effected by means of two converters connected to the same supply. When starting the converters, the voltage vectors may at random assume one of four positions, namely, at 0, 90, 180 and 270 degrees from one another and it is only necessary to confirm by means of a phase-shifting network between the converters that the angle is the one required. If this is not the case a relay automatically picks up and interrupts the current to one converter or both of them. They start again when the relay drops. If necessary this is repeated a number of times until the desired phase relationship appears and the relay is no longer actuated.

Design

The frequency transformers placed on the market by the Signalbolaget are all designed for wall mounting. The component parts, transformers, reactors, capacitors and in certain cases rectifiers, are mounted on a supporting baseplate and covered with a perforated, aluminium-lacquered sheet metal casing. The connecting terminals are placed under a separate cover so that connection can be effected without removing the casing.

The frequency converters thus far designed are made in four geometrical sizes designated *JLM 10*, *JLM 11*, *JLM 12*, and *JLM 13*. Variants are available in each main type for different outputs and frequencies. All variants are designed for a 220 V primary voltage and a 110/220 V secondary voltage.

A list of the frequency converters available at the present time is given in the following table. It should be noted that a frequency doubler is included in the list. It has a higher efficiency than the other converters but is not self-protecting against overloads.

Frequency converters for 220 V, 50 c/s

Article No.	Freq./sec. c/s	Sec. voltage V	Sec. output VA	Dimensions length mm	width mm	depth mm	Weight approx. kgs
JLM 1001	75	110/220	20	265	250	170	10
JLM 1002	125	110/220	15	265	250	170	10
JLM 1003	100	110/220	30	265	250	170	10
JLM 1101	75	110/220	70	270	465	205	30
JLM 1102	125	110/220	80	270	465	205	30
JLM 1201	75	110/220	180	450	503	232	60
JLM 1202	125	110/220	140	450	503	232	60
JLM 1301	75	110/220	300	450	720	260	100
JLM 1302*	75	110/220	300	450	720	260	100
JLM 1303	125	110/220	240	450	720	260	100
JLM 1304*	125	110/220	240	450	720	260	100

* JLM 1302 and JLM 1304 are provided with phase-compensating capacitors on the primary side.

The operating temperature of the frequency transformers is 55° C above that of the ambient air, irrespective of whether the transformer is running on no-load or fully loaded.

A Heavy Duty Protector for Outdoor Installation

A HENCKEL, TELEFONAKTIEBOLAGET L M ERICSSON, STOCKHOLM

U.D.C. 621.316.923

In an article on binding wire lightning arresters which appeared in the Ericsson Review No. 1, 1950, a simple method of protecting open wire telephone lines against atmospheric discharges with the help of a spark gap was described. In most cases the reduction of overvoltages obtained by means of binding wire arresters is inadequate, however, and must be supplemented by heavy duty lightning protection in the form of a pole fuse. This protective device should be capable of withstanding heavy overloads set up by voltage surges on telephone lines without ceasing to function. For this purpose Telefonaktiebolaget L M Ericsson has now designed a protector with a three-pole spark gap, NFA 2011—NFA 2014, which is described in the following article.

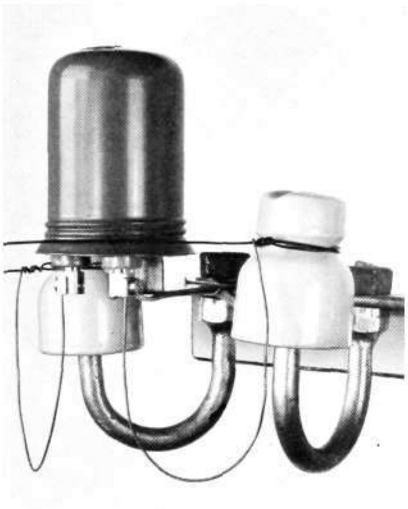


Fig. 1 X 4876
Protector NFA 2012

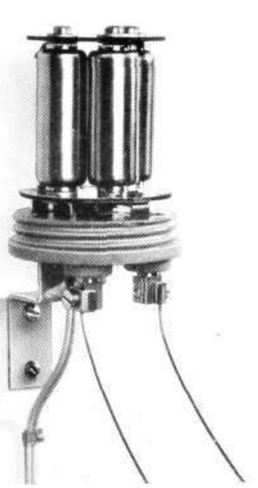


Fig. 2 X 4877
Protector NFA 2013
with hood removed

An open wire line is always exposed to induction from lightning discharges in the vicinity of the conductor. Atmospheric discharges of this kind may sometimes attain very high values (exceeding 100 kV). In order to protect the telephone apparatus and exchange, and before everything else the person or persons attending them, against dangerous voltage surges, overvoltage protective devices of carbon or metal or in the form of rare gas tubes are connected in the circuit. These protective devices are frequently combined with fuses and heat coils.

It is undesirable for reasons of safety to allow too high voltages to reach the subscriber's protectors or the protector strips. Thus, in order to obtain the maximum protective effect the step-down principle should be adopted. In this system an effort is made to reduce the overvoltage progressively. In an article, »The Binding Wire Lightning Arrester—a New Form of Lightning Protection for Telephone Open Wire Lines» in the Ericsson Review No. 1, 1950, a very simple method for installing an effective spark gap was described. In order to obtain a maximum reduction of the voltage a number of these binding wire arresters should be installed. The higher the earth resistance is, the greater will be the number of these arresters required for reducing the voltage to the lowest possible limits. According to circumstances, the binding wire arresters are capable of reducing overvoltages to values between about 2 and 8 kV.

But although the binding wire arresters are very effective under satisfactory earthing conditions, they are not absolutely reliable in all circumstances, and in any case the voltages should be reduced to 1—2 kV before they come in on the indoor subscriber's protector or the protector strip. For this purpose an overvoltage protective device should be mounted on the last pole; if necessary, a number of these protective devices should be placed one after the other on some of the last poles. In this respect those poles should be selected at which the minimum earth resistance is obtained. The latter can be further reduced if necessary by treating the ground surrounding the pole with L M Ericsson's Sanick Gel NTV 5101. The overvoltage protection should be capable of discharging heavy currents and continue to function again satisfactorily after the overvoltage wave has passed away. Should the current loading be so heavy, however, that the overvoltage protection is damaged, the latter should be so constructed that it becomes welded together and forms a permanent earth for the line. However great the overloads may be, the overvoltage protection will provide a guarantee that overvoltages exceeding the operating voltage for which the gap is adjusted, 1 kV for example, will always be discharged to earth. From the point of view of maintenance the welding together of the electrodes should only take place

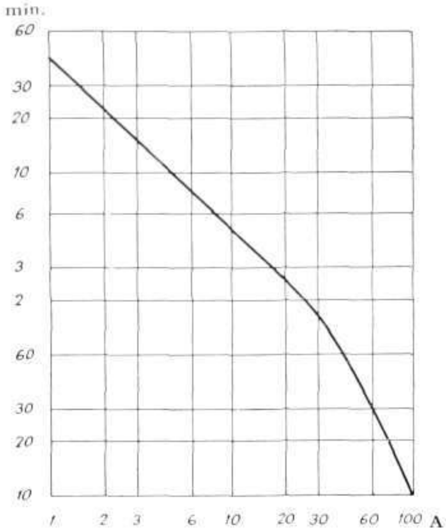


Fig. 3 X 4874

Time taken for welding the electrodes together with a 50 c/s sine wave alternating current

after the line has been subjected to a very heavy current, as for example, when a power line has fallen down onto one or both of the wires of a telephone line. Furthermore, the overvoltage protection must be capable of resisting corrosion even under tropical conditions. To this end L M Ericsson have designed a protector with a three-pole spark gap in accordance with a new system on which a patent has been applied for.

The electrode system consists of 3 massive cylinders of a copper alloy patented by L M Ericsson. The axes of the cylinders are mounted vertically in such a way that they form the corners of an equilateral triangle in a section at right-angles to the axes. By loosening the screws which represent the axes, the distance between the electrodes can be adjusted and the electrodes can be turned so that they offer a new flash-over surface when the previous one has been burnt asunder. After adjustment the cylinders are fixed in their position by spring washers when the screws are tightened. Even when electrodes of pure copper are used this spark gap has been found to possess a longer life than those previously employed by L M Ericsson. When using the patent copper alloy referred to above, the life of the spark gap is increased considerably, and in view of the further possibility of constantly obtaining new flash-over surfaces by giving the electrodes a slight twist the new fuse box can be used for a practically unlimited period without its being necessary to re-grind the electrodes. If the spark gap is overloaded by a power line falling down onto the telephone line for example, the electrodes are welded together and thus provide an effective earth for the telephone line, see fig. 3.

In view of the fact that the distance between the electrodes can be adjusted so that operating voltages between about 600 V and 2,000 V can be obtained, it is possible to produce a spark gap having the exact operating voltage best suited to the particular case in question in a very simple manner, see fig. 4.

A special feeler gauge *LMT 1011* has been introduced for adjusting the spark gap. It consists of leaves of 0.10, 0.13, 0.18, and 0.22 mm, corresponding approximately to operating voltages of 650, 800, 1,000, and 1,200 V. There are two leaves for each thickness which are located in such a position that the spark gap can be adjusted at two points simultaneously. The gauge and method of using it are illustrated in fig. 5. It should be pointed out that adjustments should only be carried out when the electrodes have been damaged by abnormally heavy discharges or when it is desired to alter the operating voltage for any reason. When no special requirements are indicated with respect to the arcing voltage the protectors are supplied with an electrode spacing of 0.18 mm corresponding to an arcing voltage of about 1,000 V.

The fuse boxes, which bear the designations *NFA 2011—NFA 2014*, are constructed with four different fixing brackets so that they can be mounted in the same way as the outdoor subscriber's protectors NFA 1011—NFA 1645. The new protectors are constructed with the same porcelain bases, hoods, connecting terminals for the connection of the open wires and sealing thimbles for single-pair cables as the subscriber's protectors.

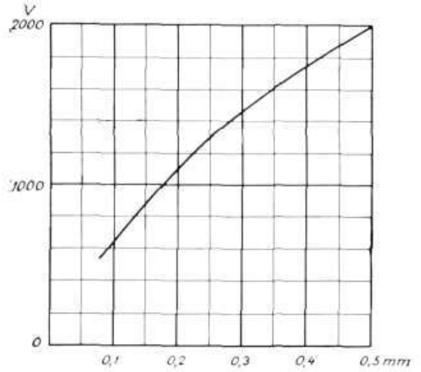


Fig. 4 X 4873

Operating voltage as a function of the electrode spacing

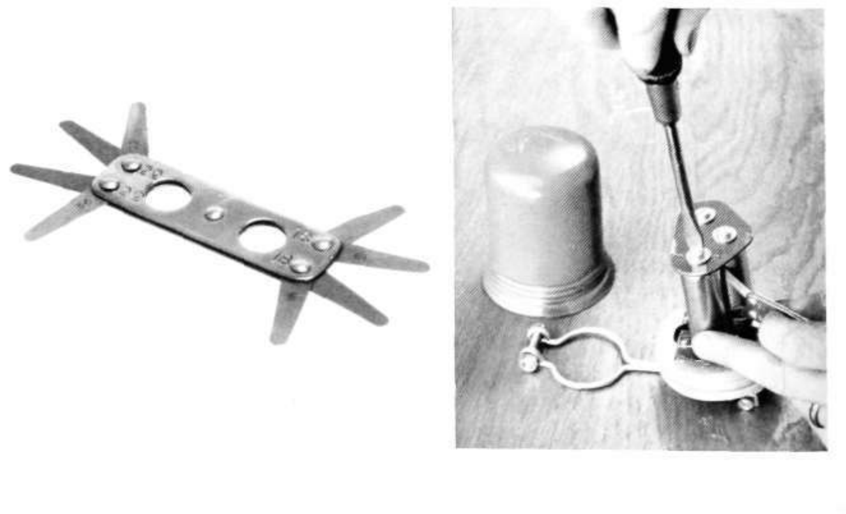


Fig. 5 X 6736

Feeler gauge LMT 1011

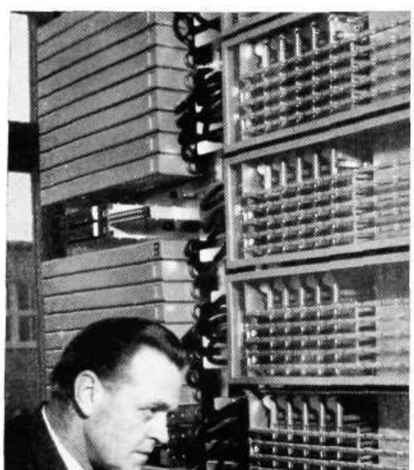
left: with all 8 blades extended; right: in use for adjusting the spark gap in protector NFA 2014

Ericsson LM NEWS *from All Quarters of the World*

L M Ericsson's Crossbar Switch in Ultra-Rapid Calculating Punch

A new field of use has been found for L M Ericsson's crossbar switches and telephone relays, which are now used in the rapid operating calculating punches being manufactured by the associated company, L M Ericssons Driftkontroll AB. This company, in cooperation with Powers-Samas Accounting Machines (Sales) Ltd. of London, is engaged on the sale and installation of punch-card machines on the Swedish market. The calculating punch, which carries out multiplication and other calculations in conjunction with punch-card machines, is based on the experience gained in telephony. A prototype was completed in November, 1951, which carried out multiplication of 5×6 figure numbers at a speed of 10 000 counting operations an hour. The calculating punch has now been in service for over a year and has lived up to the very high expectations placed in it.

LME equipment is found in practically every part of the machine. The coupling panel of the sensing and punching register may be compared to a telephone switchboard on which the different jack strips are coupled together by ordinary telephone cords and plugs. The calculating panel which is connected to the register by a cable, resembles a modern automatic telephone exchange. The crossbar switches used in the panel multiply single figure numbers, from which two-figure part products are obtained, in 0.03 seconds. It is technically impossible for the crossbar switches to give a wrong answer other than by a figure being omitted. This is, however, immediately noticed by the calculating punch, and an indication given.



In spite of the fact that the plant can get through 10 000 punched cards to the hour and has the highest speed in the world for this type of machine, the calculating panel is able to make an automatic check of its figures before handing on the result to the register. If the figures are correct, a check hole is overpunched in the card. After the crossbar switches have yielded the two-figure part products, the machine carries out addition and carry-over. The answer is then sent back to the register and, after being rounded off, it is punched on the respective card.

There is a wide field open to this rapid punch-card machine. In spite of its great rapidity it is not a mathematical machine in the true sense of the word. The mathematical machine used in science works out a limited number of data by means of lengthy calculating operations. In commercial calculations the contrary is the case. A large volume of data are subjected to few operations. Banks in particular have shown extreme interest in the machine. A skilled man can perform about 200 interest calculations in an hour. The machine gets through 10 000 operations in the same time, or as much as 50 men.

Other examples of uses for the calculating punch are the working out of salaries, costs and data for invoicing.

Left: The crossbar switch panel of the calculating punch. Right: the coupling panel in the sensing and punching register.

Night Watchman Control on New Finnish Ship »Bore III»

The Bore Shipping Company in Åbo, Finland, has recently put its new passenger ship »Bore III» into service on the route between Stockholm and Åbo. This fine ship, built at the Oskarshamn shipyards, is modernly equipped throughout. »Bore III» and its sister ship »Aallotar» are Finland's two largest passenger vessels.

L M Ericsson's automatic fire alarm equipment has been installed throughout the ship and gives warning to the bridge immediately a fire breaks out. The alarm is then spread to the various sections of the ship over the loud-speaking equipment.

A night watchman control plant, specially constructed by L M Ericsson, has also been installed. When the night watchman does his round of the ship every half hour, he records the fact by pressing a button. If this button is not pressed on every watchman's round, an alarm is sent out by the control equipment.

New LME Installations in Colombia

Automatization of Telephones in Barranquilla and Cartagena

As far back as the 16th century Cartagena was the most strongly fortified town in South America. Most of its ramparts are preserved intact to this day.

In two Colombian towns, Barranquilla and Cartagena, L M Ericsson are to build automatic telephone exchanges and to construct the networks. The present telephone installations were previously owned by an operating company, but were sold to the respective municipalities some time ago. Both Barranquilla and Cartagena possess automatic exchanges of a competitive make, but they will now be replaced by L M Ericsson's automatic system.

It was in 1932 that the first automatic exchanges equipped with L M Ericsson's 500-line selectors were put into service in Colombia. That was in the two towns of Honda and Ibaqué. Since then LME have constructed a large number of telephone installations in the country, including the extensive projects of converting the capital city of Bogotá and industrial town of Medellin to automatic systems. The total number of LME plants installed and on order for the whole country is 23 exchanges located in 13 towns. Several of these exchanges have been considerably extended in the course of the years, two of them as many as four times. The total number of direct lines in exchanges under construction and in service now amounts to 121,000.

L M Ericsson's Colombian company, Cia Ericsson Ltda. was formed early in the 1930s, and for some years has had as its President Mr. Arne Stein. The Head Office is in Bogotá and, in addition, LME is represented in several other towns. In Barranquilla our representative is Mr. Ivar Hilstad, and our agent in Cartagena is Mr. G A Quarzell, whose firm, Skandia, represents a number of Swedish export industries.

Of the two Colombian towns of Barranquilla and Cartagena the former is the larger with about 300,000 inhabitants. Here, apart from the network installations, L M Ericsson are to construct three telephone exchanges with a total of 15,000 lines. Barranquilla possesses Colombia's most important harbour on the west bank of the River Magdalena about 35 kilometres from its mouth in the Caribbean Sea. Very considerable sums were spent on making the river navigable for ocean-going steamers to reach Barranquilla. The previous port, Puerto Colombia, at the mouth of the river, has in recent years become a popular seaside resort which, with its long beach, offers recreation to countless numbers of people.

Barranquilla shares with Medellín the position of being Colombia's second-largest town. Barranquilla possesses modern buildings, numerous industries, and is of especial importance for the Colombian coffee trade.

View of Barranquilla, which shares with Medellín the position of Colombia's second-largest town.

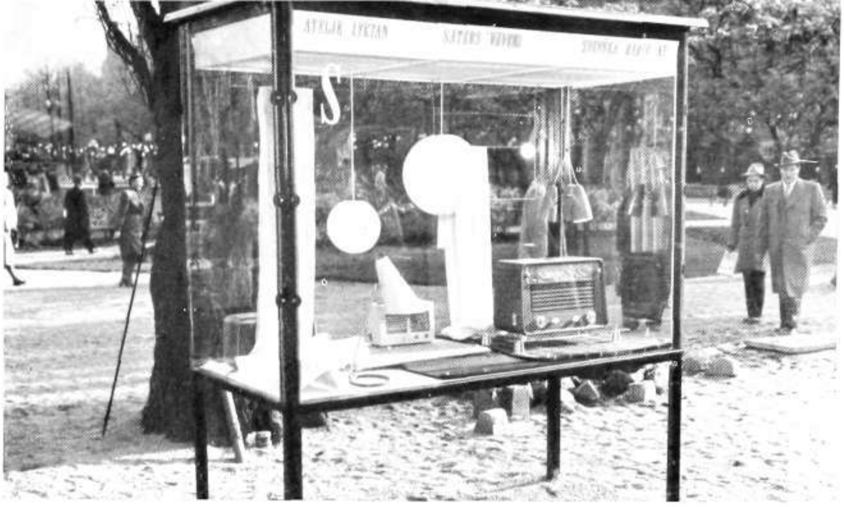
Cartagena, which is reached after two hours' journey by car on a fine road from Barranquilla, is one of Colombia's three Atlantic coast towns. Cartagena is a naval base and also the centre of a rich agricultural district. It is a very interesting old town dating from colonial times, and was even then one of the finest ports on the South American continent. The opening up of trade soon brought great riches to the town, and it became a favourite goal for pirates. The town was, therefore, strongly fortified during the 16th century and was turned into South America's most redoubtable fortress. The magnificent bastions, which in the course of the centuries have been extended and strengthened at enormous costs, are extremely imposing even to-day. In Cartagena L M Ericsson are to install two automatic telephone exchanges for 4,000 lines with their associated networks.

Colombia is primarily an agricultural country and is at present at a stage of rapid development. The interest of the government in various kinds of improvement is seen in their extensive planning policy in the spheres of culture and industry alike. A number of factories have grown up and given work to a large portion of the population.

Private branch exchanges from L M Ericsson have been installed in the majority of Colombian towns. At the end of 1952 there were 230 such exchanges in operation with over 6,000 lines.

Stockholm's 700th Anniversary

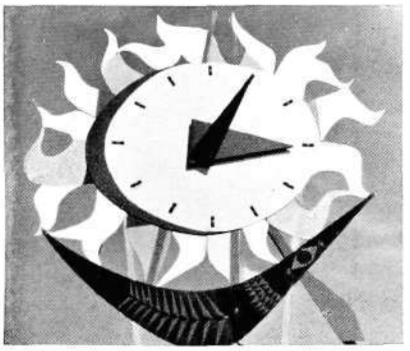
SRA at Jubilee Exhibition



The celebrations this summer of Stockholm's 700th Anniversary are centered in the old Royal Park of Kungsträdgården. Every evening thousands of people gather in front of the modernistic open-air stage to witness the multifarious programmes arranged by the Town of Stockholm and by private firms. The opening ceremony, which took place in the presence of the King and Queen, attracted enormous crowds. The police were given a delicate problem in directing traffic and keeping a friendly eye on the vast crowd of spectators. They were greatly aided by SRA portable radio sets, by means of which the various patrols could maintain contact with one another.

The northern part of Kungsträdgården has been turned into an open air exhibition arranged by the Swedish Guild of Arts and Crafts, which shows the beauty of the work achieved by Swedish handicraft today. Different SRA models were shown as representative of Swedish radio sets.

Sunflower-Clock



Solliden, the Skansen restaurant and popular summer resort of thousands of Stockholmers and tourists from abroad, has been enriched by a new work of art. The sunflower that now decorates the ceiling of the restaurant forms an attractive framework to a clock supplied by LM Ericsson.

The dial of the clock is polychrome-enamelled on steel plate. It was designed and painted by Stig Lindberg and made at Gustavsberg. The clock face depicts a sun which, according to old Nordic tradition, is sailing in a boat across the heavens. The sun is a warm yellow colour, the boat blue, red and black, while the hands of the clock are decorated red and black.

New Use for Electric Fencing

L M Ericsson's multifarious manufacturing programme includes electric fencing for the enclosure of pasture. A new employment for electric fencing is reported from Oslo. During the flood-lighting of the University a disturbing effect was produced by the small "mementoes" left by the pigeons. Various methods of keeping the pigeons at a distance were tried out, but without conspicuous effect.

An electrical contractor then put forward the suggestion of electric fencing, and experiments were immediately launched with different strengths of current and wiring arrangements. A carrier-pigeon was used for the experiments. The most effective system was found to be two wires about a centimetre apart, the lower wire serving as return circuit, so that the pigeons would have to grip onto the two wires simultaneously when they alighted on the fence.

A lengthy study of the pigeons' habits showed that they always alighted on the outer edge of the cornice and from there strutted in to their favourite spots. It was therefore considered sufficient to lay a »belt of mines» along the edge. When the fence was ready, however, the pigeons quietly alighted on the wire without appearing to be at all disturbed by the electric shocks. These University pigeons proved to be hardier, and their feet better insulated against electric shocks, than the carrier-pigeon. They very soon discovered, moreover, that there were safe and particularly pleasing habitats—on top of the insulators! The wiring had therefore to be relaid so that it passed over the insulators instead of round them in the normal way.

The fence was completed in the spring of 1951 and has since then functioned to full satisfaction.

From the Visitor's Book

Prince Prem Purachatra of Siam and his wife, Princess Ngarmchita, were in Stockholm at the beginning of June and paid a visit to LM Ericsson at Midsommarkransen. During their tour of the factory the Prince and Princess saw the manufacture of various items of equipment and, in addition, the Health Department and Day Nursery. The Prince and Princess are here seen with Mr S T Åberg.

The Milan Fair

At the Milan Fair this year a joint exhibition was arranged by the two Italian companies associated with LM Ericsson, FATME and SIELTE. Below is a snapshot taken during the visit to the Fair of the Italian Minister of Posts and Telecommunications, Signor Spataro (centre, in dark suit). Signor Baggiani, the Head of FATME, acted as his guide, and is seen to the left of Signor Spataro in the photograph.

Tele Speaks

The Swedish Board of Telegraphs is celebrating its centenary this year and in honour of the occasion has opened an exhibition at Skansen in Stockholm. The exhibition has been given the title of »Tele Speaks» and includes some of the latest developments in telecommunications such as the telephone answering machine, telex, teleprinter, television, radio-telephony, and last but not least the automatic car telephone. In the photograph taken at the opening ceremony Mr. Sven Andersson, Minister of Communications, has just dialled a number, while Mr. Helge Ericson and Mr. Håkan Sterky, Director General of the Board of Telegraphs, are interested spectators.

Telesignal Installations

The latest acquisition of the Svea Shipping Line, s.s. »Birger Jarl», was launched from the Finnboda yards in Stockholm this spring. The »Birger Jarl» is the first passenger vessel delivered by Swedish shipyards to Swedish shipowners that has been built in accordance with the regulations of the 1948 International Convention for Safety of Life at Sea, which are now in force. These new regulations are very much more comprehensive than earlier as regards buoyancy, fire safety and life-saving appliances. Among suppliers of equipment to the vessel are LM Ericsson with their fire alarm, order telephone and loudspeaker systems. These installations will be described in a later number of Ericsson Review.

More Swedish Towns Convert to Automatic

A milestone was recently passed when LM Ericsson received an order from the Board of Telegraphs for an extension of the Storängen automatic exchange in Stockholm by 1.000 lines. This order brought the total number of lines in exchanges ordered by the Board of Telegraphs, for operation on the 500-line selector system, to over 1,000,000. The first public exchange to operate on this system in Sweden was Norra Vasa in Stockholm, supplied in 1923.

New orders for automatic exchanges in Gothenburg have also been received from the Board of Telegraphs, namely Västra Frölunda with 9.500 lines and Kortedala with 6.000 lines. Further, in Halmstad and Nässjö for 13,000 and 4.000 lines respectively. All these will be 500-line selector exchanges.

Interior of the new automatic exchange in Jönköping.

At the beginning of June a new automatic exchange was cut into service in Jönköping for 13.000 lines. As a matter of interest may be mentioned that 95 kilometres of exchange cable with a total length of wire of 5.210 kilometres was used in the exchange equipment.

Large Order for Balancing Machines

The Swedish Army Administration, Ordnance Division, has placed an order for 20 L M Ericsson automobile wheel balancing machines. These machines will be delivered during the summer and placed at the Ordnance Workshops of the various Regiments.

The majority of the larger Swedish garages have now adopted LME balancing machines. Four machines are installed at Philipssons' in Stockholm and several others at Ostermans' and I.C.

U.D.C. 621.395.722.004.5

Hansson, K G: *Maintenance of Crossbar Switch Exchanges.* Ericsson Rev. *30* (1953) No. 2 pp. 34—39.

In the article the essential conditions prevailing with reference to the maintenance of automatic telephone exchanges built on the L M Ericsson bypath system with crossbar switches are outlined. Some general views on the running of the service are also given.

U.D.C. 621.318.42
621.315.2.054.3

Frenning, J: *New Loading Coils.* Ericsson Rev. *30* (1953) No. 2 pp. 40—44.

Thanks to new materials and development of new manufacturing methods it has been possible to reduce the volume of the L M Ericsson loading coils by 40 % as compared with the earlier design. At the same time the volume and weight of the box have been reduced by approximately 30 %. The technical quality has remained substantially unchanged. The article contains a brief description of the factors that determine the quality and dimensioning of the loading coils, together with particulars of their design.

U.D.C. 621.395.9:654.147.2

Hedén, A: *L M Ericsson's Emergency Telephone System.* Ericsson Rev. *30* (1953) No. 2 pp. 45—49.

L M Ericsson has for a long time past been supplying fire alarm telegraph systems which afford the public a rapid means of calling for help from the fire brigade or police. The demand that ordinary telephone lines should be available for other purposes as well, has led to the construction of the emergency telephone system described in the article.

U.D.C. 621.395.2

Sohlberg, C O: *30-Line Selector for Small Automatic Telephone Exchanges.* Ericsson Rev. *30* (1953) No. 2 pp. 50—53.

The development of the automatic systems type ALD 10—20 required a selector with a larger capacity than that of the rotary step-by-step 25-line selectors earlier used in the L M Ericsson small automatic telephone exchanges. The new type of selector, briefly described in the article, is based on the same principle as that of the 25-line selector but with 30 contact positions, better contact properties, less power consumption and considerably longer life.

U.D.C. 621.315.67

Wiberg, E A: *New Coupling Components.* Ericsson Rev. *30* (1953) No. 2 pp. 54—55.

The interconnection of the various teletechnical apparatus requires an increasing amount of multi-point coupling components of high quality but inexpensive in production. In the article a description is given of the two new L M Ericsson 20-point elements, the fork jack RNV 2101 and the pin plug RPV 2051.

U.D.C. 621.314.26:656.259.12

Ahlberg, C: *Static Frequency Converters for Track Circuits.* Ericsson Rev. *30* (1953) No. 2 pp. 56—58.

To meet the need for A. C. sources for feeding track circuits on electrified railways with $16^{2}/_{3}$-cycle traction current L M Ericsson's Signalaktiebolag has designed special frequency converters without moving parts which convert 50-cycle energy into 75- or 125-cycles. Short description of principles and design.

U.D.C. 621.316.923

Henckel, A: *A Heavy Duty Protector for Outdoor Installation.* Ericsson Rev. *30* (1953) No. 2 pp. 59—60.

In an article on binding wire lightning arresters which appeared in the Ericsson Review No. 1, 1950, a single method of protecting open wire telephone lines against atmospheric discharges with the help of a spark gap was described. For use in poor earthing conditions Telefonaktiebolaget L M Ericsson has designed a protector with three-pole spark gap, NFA 2011-NFA 2014, which is described in the article.

The Ericsson Group

ASSOCIATED AND CO-OPERATING ENTERPRISES

EUROPE

Danmark

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Telefon Fabrik Automatic A/S *København K*, Amaliegade 7, tel: C 5188, tgm: automatic-københavn
Dansk Signal Industri A/S *København-Vanløse*, Skalbakken 10, tel: DA 6346, tgm: signaler-københavn

Deutschland

Ericsson Verkaufsgesellschaft m. b. H. *Frankfurt am Main S*, Holbeinstrasse 41, tel: 65783, tgm: erictel-frankfurtmain

España

Cía Española Ericsson, S. A. *Madrid*, Conde de Xiquena 13, tel: 31 53 03, tgm: ericsson-madrid

France

Société des Téléphones Ericsson *Colombes (Seine)*, Boulevard de la Finlande, tel: CHA 35-00, tgm: ericsson-colombes-seine
Paris 17e, 147 Rue de Courcelles, tel: Carnot 95-30, tgm: eric-paris
Société Cinéric *Paris 20e*, 111 Rue Villiers de l'Isle Adam, tel: Ménilmontant 87-51, tgm: cinéricsson-paris

Great Britain

Swedish Ericsson Company Ltd. *London, W. C. I*, 329 High Holborn, tel: Holborn 1092, tgm: teleric-london
Production Control (Ericsson) Ltd. *London, W. C. I*, 329 High Holborn, tel: Holborn 1092, tgm: productrol holb-london

Italia

Setemer, Soc. per Az. *Milano*, Via dei Giardini 7, tel: 6 22 41, tgm: setemer-milano
SIELTE, Soc. per Az. — Società Impianti Elettrici e Telefonici Sistema Ericsson *Roma*, C. P. 4024 A, tel: 78 02 21, tgm: sielte-roma
F. A. T. M. E. Soc. per Az. — Fabbrica Apparecchi Telefonici e Materiale Elettrico »Brevetti Ericsson» *Roma*, C. P. 4025 A, tel: 780 021, tgm: fatme-roma
S.E.T. Soc. per Az. — Società Esercizi Telefonici *Napoli*, C. P. C. 20833, tel: 50 000, tgm: set-napoli

Nederland

Ericsson Telefoon-Maatschappij, N.V. *Rijen (N. Br.)*, tel: 344, tgm: erictel-rijen
den Haag—Scheveningen, Gevers Deynootplein 30, tel: 55 74 70, tgm: erictel-haag

Norge

A/S Elektrisk Bureau *Oslo*, P. B. Mj 2214, tel: Centralbord 46 18 20, tgm: elektriken-oslo
A/S Industrikontroll *Oslo*, Teatergaten 12, tel: 33 50 85, tgm: indtroll-oslo
A/S Norsk Kabelfabrik *Drammen*, P. B. 48, tel: 12 85, tgm: kabel-drammen

Portugal

Sociedade Ericsson de Portugal, Ltda. *Lisboa*, 7 Rua Filipe Folque

Suomi

O/Y L M Ericsson A/B *Helsinki*, Fabianinkatu 6, tel: 201 41, tgm: ericssons-helsinki

Sverige

Telefonaktiebolaget L M Ericsson *Stockholm 32*, tel: 19 00 00, tgm: telefonbolaget
AB Alpha *Sundbyberg*, tel: 28 26 00, tgm: aktiealpha
AB Ermex *Solna*, tel: 27 27 25, tgm: elock
AB Rifa *Ulvsunda*, tel: 26 26 10, tgm: elrifa
AB Svenska Elektronrör *Stockholm 20*, tel: 44 03 05, tgm: electronics
L M Ericssons Driftkontrollaktiebolag *Solna*, tel: 27 27 25, tgm: powers
L M Ericssons Svenska Försäljningsaktiebolag *Stockholm*, Kungsgatan 33, tel: 22 31 00, tgm: ellem
L M Ericssons Mätinstrumentaktiebolag *Ulvsunda*, tel: 26 26 00, tgm: elmix
L M Ericssons Signalaktiebolag *Stockholm 9*, tel: 19 01 20, tgm: signalbolaget
Mexikanska Telefonaktiebolaget Ericsson *Stockholm 32*, tel: 19 00 00, tgm: mexikan
Sieverts Kabelverk *Sundbyberg*, tel: 28 28 60, tgm: sievertsfabrik
Svenska Radioaktiebolaget *Stockholm*, Alströmergatan 12, tel: 22 31 40, tgm: svenskradio

ASIA

India

Ericsson Telephone Sales Corporation AB *Calcutta*, P. O. B. 2324, reg. mail: *Calcutta 22*, 5 Commissariat Road, P. O. Hastings, tel: South 2165, tgm: inderic-calcutta

Indonesia

Ericsson Telephone Sales Corporation AB *Bandung*, Djalan Dago 151, tel: S 707, tgm: javeric-bandung

Türkiye

Ericsson Türk Ltd Şirketi *Ankara*, Ziyah Gökalp cad. 5/2

AMERICA

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Cía Sudamericana de Teléfonos L M Ericsson S. A. *Buenos Aires*, Belgrano 894, tel: 332071, tgm: ericsson-buenosaires
Corp. Sudamericana de Teléfonos y Telégrafos S. A. *Buenos Aires*, Belgrano 894, tel: 332071, tgm: cartefe-buenosaires
Cía Argentina de Teléfonos S. A. *Buenos Aires*, Perú 263, tel: 305011, tgm: cecea-buenosaires
Cía Entrerriana de Teléfonos S. A. *Buenos Aires*, Perú 263, tel: 305011, tgm: cecea-buenosaires
Cía Comercial de Administración S. A. *Buenos Aires*, Perú 263, tel: 305011, tgm: cecea-buenosaires
Industrias Eléctricas de Quilmes S. A. *Quilmes FCNGR*, Eva Perón 1090, tel: 203-2775, tgm: indelqui-buenosaires

Brasil

Ericsson do Brasil Comércio e Indústria S. A. *Rio de Janeiro*, C. P. 3601, tel: 43-0990, tgm: ericsson-riodejaneiro
São Paulo C. P. 5677, tgm: ericsson-saopaulo
Empresa Sul Americana de Telefones S. A. *Rio de Janeiro*, C. P. 4684, tel: 43-0990, tgm: emsulatel-riodejaneiro

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Ericsson Telephone Sales Corporation *Montreal 25, P. Q.*, 1320 Sherbrooke St. W., tel: HArbour 3504, tgm: caneric-montreal

Chile

Cía Ericsson de Chile S. A. *Santiago*, Casilla 2118, tel: 86025, tgm: ericsson-santiagodechile

Colombia

Cía Ericsson Ltda. *Bogotá*, Apartado Aéreo 4052, tel: 11-100, tgm: ericsson-bogotá

México

Cía Comercial Ericsson S. A. *México D. F.*, Apartado 9958, tel: 18-12-14, tgm: coeric-mexicocity
Teléfonos de México S.A. *México D.F.*, Paseo de la Reforma 107 bis, tel: 21-91-00, tgm: telmex-mexicocity

Perú

Cía Ericsson S. A. *Lima*, Apartado 2982, tel: 34941, tgm: ericsson-lima
Soc. Telefónica del Perú, S. A. *Arequipa*, Casilla de Correo 112, tgm: telefonica-arequipa

United States of America

Ericsson Telephone Sales Corporation *New York 17, N. Y.*, 100 Park Avenue, tel: Murray Hill 5-4030, tgm: erictel-newyork
The North Electric Mfg. Co. *Galion, Ohio*, tel: 24201, tgm: northphone-galionohio

Uruguay

Cía Ericsson S. A. *Montevideo*, Uruguay 1258, tel: 8 44 33, tgm: ericsson-montevideo

Venezuela

Cía Anónima Ericsson *Caracas*, Apartado 3548, tel: 57467, tgm: ericsson-caracas

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Grèce

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Ireland

E. C. Handcock, Ltd. *Dublin, C 5*, Handcock House, 17 Fleet Street, tel: 76 534, tgm: forward-dublin

Island

Johan Rönning H/F *Reykjavik*, P. O. B. 883, tel: 4320, tgm: rönning-reykjavik

Schweiz

RIBAG — L M Ericsson Generalvertretung *Basel 9*, Türkheimerstrasse 48, tel: (061) 38925, tgm: ribag-basel

ASIA

Burma

Vulcan Trading Co. Ltd. *Rangoon*, P. O. B. 581, tel: S. 878, tgm: suecia-rangoon

China

The Ekman Foreign Agencies Ltd. *Shanghai*, P. O. B. 855, tel: 16242-3, tgm: ekmans-shanghai

Hongkong

The Swedish Trading Co. Ltd. *Hongkong*, Prince's Building, Ice House Street, tgm: swedetrade-hongkong

Indochine (Viet-Nam)

Compagnie Internationale de Commerce *Saigon*, P. O. B. 204, tel: 20 253, tgm: intercom-saigon

Iraq

Swedish Oriental Company AB *Bagdad*, Mustansir Street, 5 A/38, tel: 8 48 19, tgm: swedeorient-bagdad

Iran

Irano Swedish Company AB *Teheran*, Khiabané Sevomé Esfand No. 201, tel: 36761, tgm: iranoswede-teheran

Israel

Jos. Muller, A. & M. *Haifa*, P. O. B. 243, tel: 3160, tgm: mullerson-haifa

Japan

Gadelius Co. Ltd. *Tokyo*, Shiba Park 7, SKF-Building, Minato-ku, tgm: goticus-tokyo

Jordan

H. L. Larsson & Sons Ltd. Levant *Amman*, P. O. B. 647, tgm: larson-hus-amman

Liban

Swedish Levant Trading *Beyrouth*, P. O. B. 931, tel: 61-42, tgm: skefko-beyrouth

Malaya

Thoresen & Co. (Malaya) Ltd. *Singapore*, P.O.B. 653, tel. 6818, tgm: thoresenco-singapore

North Borneo

Thoresen & Co. (Borneo) Ltd. *Sandakan*, P. O. B. 44, tgm: thoresen-sandakan

Pakistan

Vulcan Trading Co. (Pakistan) Ltd. *Karachi* City, P. O. B. 4776, tel: 2506, tgm: vulcan-karachi

Philippines

Koppel (Philippines) Inc. *Manila*, P. O. B. 125, tel: 3-37-53, tgm: koppelrail-manila

Saudi Arabia

Mohamed Fazil Abdullah Arab *Jeddah*, P.O.B. 39, tgm: arab-jeddah

Syrie

Georgiades, Moussa & Cie *Damas*, Rue Ghassan, Harika, tel: 10289

Thailand

Thoresen & Co. (Bangkok) Ltd. *Bangkok*, (Radio and Electric Appliances Dept.) Wat Yanawa, tel: 30730, tgm: thoresen-bangkok

Türkiye

Genel Sanayi Techizati T. A. O. *Istanbul*, P. K. Galata 1455, tel: 44510, tgm: telotomat-istanbul

AFRICA

British East Africa

R. W. Ketchley Engineering Ltd. *Nairobi, Kenya*, P. O. B. 5182, tel: 3230, tgm: bonzl-nairobi

Egypt

Swedish Industries *Cairo*, P. O. B. 1722, tel: 51408, tgm: ecoproduct-cairo

Ethiopia

Swedish Ethiopian Company *Addis Abeba*, P. O. B. 264, tel: 1447, tgm: etiocomp-addisabeba

Moçambique

J. Martins Marques *Lourenço Marques*, P. O. B. 456, tel: 5953, tgm: tinsmarques-lourençomarques

Tangier

Elcor S.A. *Tangier*, Francisco Vitoria 4, tel: 2220, tgm: elcor-tangier

Union of South Africa and Rhodesia

Reunert & Lenz, Ltd. *Johannesburg*, P. O. B. 92, tel: 33-5201, tgm: rockdrill-johannesburg

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Bolivia

Johansson & Cía, S. A. *La Paz*, Casilla 678, tel: 2700, tgm: johansson-lapaz

Costa Rica

Tropical Commission Co. *San José*, Apartado 661, tel: 3432, tgm: troco-sanjose

Curaçao N. W. I.

S. E. L. Maduro & Sons, Inc. *Curaçao*, P. O. B. 172, tel: 1200, tgm: madurosons-curaçao hato

Ecuador

Ivan Bohman & Co. *Guayaquil*, Casilla 1317, tel boman-guayaqu

Guatemala

Nils Pira, *Guatemala City*, Apartado 36, tel. 3311, tgm: nilspira-guatemala

Haïti

F. Georges Naudé *Port au Prince*, P. O. B. A 147

Honduras

Cía de Comisiones Inter-Americana, S. A. *Tegucigalpa D. C.*, P. O. B. 114, tel: 15-63, tgm: inter-tegucigalpa

Nicaragua

J. R. E. Tefel & Co. Ltd. *Managua*, Apartado 24, tel: 387-11 69, tgm: tefelto-managua

Panama

Productos Mundiales, S. A. *Panama, R. P.*, P. O. B. 2017, tel: 2 2003, tgm: mundi-panama

Paraguay

H. Petersen S. R. L. *Asunción*, Casilla 592, tel: 268, tgm: pargtrade-asunción. (Agent of Cía Sudamericana de Teléfonos L M Ericsson S. A. *Buenos Aires*)

El Salvador

Dada-Dada & Co. *San Salvador*, Apartado 274, tel: 48 60, tgm: dada-sansalvador

Surinam

C. Kersten & Co. N. V. *Paramaribo*, P. O. B. 216, tel: 125, tgm: kersten-paramaribo

Venezuela

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