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On cover: Interior of a modern automatic exchange for railway telephone system

Automatic Operation of Swedish Railway Telephone Systems

MR. M LINDEROTH, SWEDISH ROYAL BOARD OF RAILWAYS, STOCKHOLM

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The importance of the telephone for the railway traffic is increasing progressively. The Swedish State Railways have telephone networks of their own and operate the construction, service and maintenance entirely in their own management. Although the railway telephone systems are not commercially »self supporting», the railway administration must take advantage of the modern telephone developments. The rational utilization of the expensive network, high reliability of the systems, *staff reduction and low maintenance* are, therefore, objectives which coincide with those of commercial telephony. The conversion of the railway telephone systems to automatic operation, which will be outlined below, is an important part in the process of rationalization.

Introduction

The problems of railway telephony are naturally in many respects similar to those of the telephone administrations but there are also definite differences. Railway telephone systems are—although important and nowadays indispensible —only auxiliaries, with the object of making the *railway service* efficient and profitable. The telephone equipment must, therefore, first of all be adapted for the efficient operation of the railways. This qualification gives the railway telephone systems several distinctive features.

A consideration which should be born in mind is that telephone exchanges and other equipment in a telephone network cannot be characterized as isolated installations but are very much interdependent. This dependence is more pronounced for automatic equipment, e.g., automatic exchanges, than for manual equipment. This fact makes it essential to rely upon a centrally produced and coordinated scheme for the automatic operation of the entire system as otherwise chaotic conditions would arise in subsequent extensions and additions. During 1940—1943 general directions were drawn up for the Swedish State Railways regarding among other items the planning of the conversion to automatic operation of the telephone system. These directions were given by a committee consisting of experts from the Swedish State Railways, the Swedish Board of Telegraphs and the Stockholm Technical University. An expert from the telephone industry was also included in the committee. The resulting report proved to be of great value and served as a coordinating factor in the revision of the telephone system for the Swedish railways. The committee devoted an important and positive interest to the question of automatic operation.

Definitions and General Considerations

A complete railway telephone network may be divided into the following groups: *sectional systems, local systems* and *long distance systems.*

The term *sectional telephone system* is used for railway systems where a number of telephone sets in separate places are connected to the same line. An example of such lines is the track telephone line which in the first place is a service line for the track officials. Such party lines run along the permanent way and are usually available at a great number of service posts where telephone sets are or can be connected. As sectional telephone systems are, however, also understood party lines which are not arranged as special service lines but are used for general service purposes.

A conversion of a sectional system to automatic operation implies the introduction of selective calling equipment and coincidently a sectioning and grouping of the lines with reference to a rational utilization of the lines and the purpose of the communications. Such conversion work, however, often involves a radical and general revision of all telephone equipment for the railway lines with special reference to the equipment, required at the railway stations.

The conversion of the local systems to automatic operation means that the manual switchboards are replaced by automatic exchanges or a combination of automatic and manual exchanges. The committee mentioned above recommended with reference to automatic exchanges that those with a capacity of more than 100 lines should have facilities for *cooperation with the public telephone system.* In this way the railway telephone exchanges will take the character of private automatic branch exchanges (PABX). The junction lines between the PABX and the public telephone exchange are termed *exchange lines.* In positions where such cooperation is considered advisable, manual handling of the incoming traffic from the public exchange is required.

The long *distance telephone network* includes all junction lines between exchanges in different places. *A conversion of a long distance telephone system to automatic operation* involves the introduction of automatic long distance telephone exchanges capable of connecting long distance calls automatically. The railway telephone exchanges will, therefore, also resemble a type of rural automatic exchanges.

When planning telephone exchanges for a railway telephone network all traffic possibilities relating to the systems mentioned above must generally be taken into consideration. In the main the following cases are, therefore, possible: *local traffic and sectional traffic, cooperation between local, sectional and long distance systems* and restrictive *cooperation with the public telephone system* (= exchange line traffic).

The automatic long distance traffic facility is a requirement which, in particular, makes the normal PABX switchboards unsuitable for railway telephone purposes. With a long-term policy the requirements for the long distance traffic must, therefore, be born in mind particularly with regard to the technical lay-out of the equipment, although such traffic does not effect the initial building stage. This judicious procedure involves a remarkably small increase in the capital cost in the first stage as the long distance equipment proper, i.e., repeaters, long distance selectors, trunk registers &c. naturally are not required until the automatic long distance operation is to be introduced.

But in addition to this the cooperation between the sectional systems and other systems imposes special conditions on the design of the automatic exchanges. If, for instance, the register is to control the operation of the selectors on the line for a call from the exchange to a sectional line, the register must on the one hand be capable of storing the digits of the selector number and on the other hand direct the impulsing to the selectors. Such functions are not included in the PABX exchanges of normal type but they are very important for railway telephone purposes.

A revision of a railway telephone system, of a substantial magnitude, must necessarily be carried out in successive stages. This applies to the technical side as well as to economics. With regard to the automatic operation it is advisable to commence with a successive conversion of the principal local systems to automatic operation. At the same time the sectional lines radiating from the principal centres are provided with selective calling equipment. A regrouping of these lines is then usually required in order to increase the utilization of the lines by increased coordination of the traffic in the available

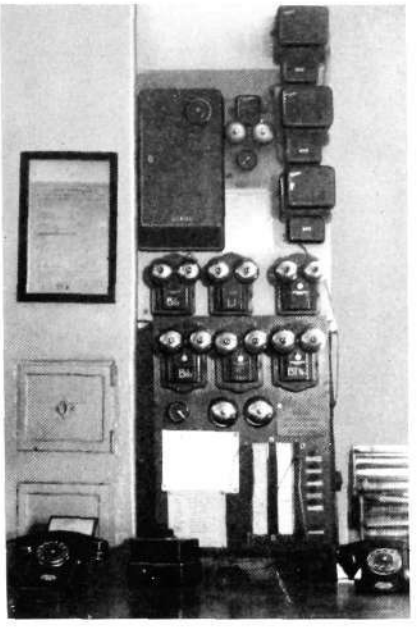


Fig. 1 X 4837

Old installation at sectional line station (train dispatching)

Fig. 2 X 4838

Modern installation at sectional line station (train dispatching)

Complete automatic operation of the sectional lines.

groups of lines. The long distance connection of the exchanges is effected in a separate stage which can be carried out when suitable. This method of getting the benefit from the automatic operation at an early stage by converting the local and sectional systems is very natural for the following reason. In a railway telephone network there is very often a pronounced shortage of long distance lines, a shortage which perhaps cannot be remedied before the electrification of a railway line, the introduction of a carrier frequency installation &c. A successive conversion requires, however, a *carefully prepared planning* and a strict coordination of the technical functions in order to avoid waste of material.

With reference to the conversion from manual to automatic operation of long distance calls it should be mentioned that *semi-automatic operation* is a natural transition stage, when the equipment for the automatic operation has been installed. This means that the operator at the calling exchange effects connection to the called station by means of the automatic equipment. The connection is thus established by *one operator* only. The same ordering procedure as used for manual operation may be applied. The line utilization is then approximately equal to that of manual operation.

General Views on Automatic Railway Telephone Systems

As a matter of interest a summary will be made of the considerations which justify automatic railway telephone systems. In the first place automatic operation is a natural requirement in modern life in accordance with well known development tendencies. For a more detailed analysis a division of the railway telephone network should be made into local, sectional and long distance systems as described above, each system being discussed separately.

Automatic operation of the local systems is as a rule clearly justified with a wide margin as far as large and medium sized railway telephone exchanges are concerned on account of the elimination of the labour required for the manual operation. Normally an automatic system will, therefore, show a tangible commercial profit. To this should be added, however, that the railway personnel in their work very much appreciate the round the clock service, the speed and flexibility which puts the automatic operation a class above the manual.

The motive of *conversion to automatic operation of sectional systems*, where lines with a number of instruments connected in parallel are used, is the replacement of antiquated and unsuitable equipment used for magneto calls with code signals with a modern *selective calling system*, rationally arranged, fig. 2.

The disadvantages and limitations of the code ringing system will appear clearly on sectional lines carrying extensive traffic, i.e., with a number of parallel party lines and otherwise when a great number of code signals are required. Apart from considerable disadvantages in the actual use, an inherent fault of the code system is the poor utilization of the lines. The selective calling system used by the Swedish railways (the LM Ericsson system) offers on the other hand excellent facilities for *equivalent lay-out* of the lines in the sectional line via, meeting the basic requirements for coordination of the telephone traffic and for a *high line efficiency*. With regard to utilization the perfect arrangement would be to make all lines in a via equally available for all telephone posts along the track and for the traffic from cooperating exchanges. For practical reasons a certain division into different types of lines has to be carried out and it may be necessary to allot one or more self-contained lines to a certain service department. In addition it is necessary to restrict certain telephone posts to one or a few lines in the group of lines in order to limit the installation cost.

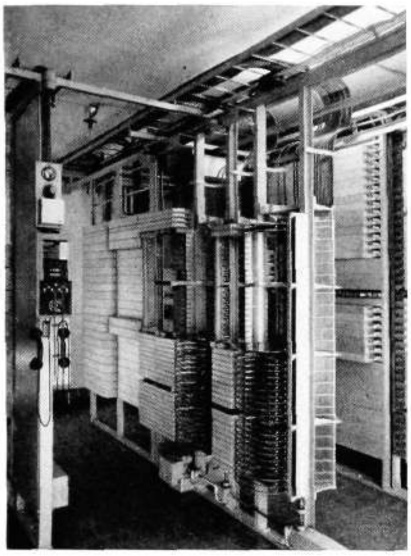


Fig. 3 X 4839

Interior view of modern automatic exchange for railway telephone system (local part)

3-digit numbering scheme for local stations

An important technical and economic factor is the fact that the selective calling system is based on the same impulsing element—the dial—as that used in normal automatic telephone systems. This means that the arrangements required for cooperation with other automatic systems will be comparatively simple.

What are finally the justifications for *automatic long distance systems* for railways? The answer would in first place be, that in order to make the most efficient use of the telephone in the service of the railways, it is desirable to utilize the advantages of automatic operation also for long distance calls. Balancing against the capital cost a reduction will, furthermore, be obtained in the costs arising from the personnel required for the manual switching. As there seems to be a steady increase in the use of the railway telephone it is not sufficient to calculate with the initial saving in personnel but the elimination of future increases should also be born in mind. For *small exchanges* it is, of course, particularly important that all traffic is automatic in order to eliminate the manual operation altogether.

The higher class of service for an automatic system, is, at least for a railway network, of particular importance during slack hours. The manual handling has a tendency to deteriorate during these hours whereas for automatic traffic the grade of service is particularly good and quite satisfactory even on a limited junction group.

The amount of available lines is a very important factor when considering conversion of long distance traffic to automatic operation. It is a fact that in a railway telephone network the number of junctions per via generally is comparatively small and in case of automatic operation this results in an unfavourable utilization. This unfavourable effect is well known and is due to the fact that for automatic traffic the number of lost calls, *the congestion*, has to be kept at a low value. In case of manual operation, order traffic is generally applied. The long distance calls are ordered and are recorded by the operator who connects the calls in rotation. The callers have to wait, sometimes a long time. The line can, however, be kept occupied up to 40—45 mins. during the busy hour, at least theoretically. Equal utilization of the lines is only attained when the traffic intensity reaches about 650 call minutes per busy hour or about 10.8 Erlang (E), which requires 15 lines at a loss of 5—6 %, which is a usual value. As mentioned above the junction groups of railway telephone networks in general are comparatively modest and may—at least as far as the Swedish railways go—amount to the order of 15 lines for certain main traffic routes only. It should be clear, however, that this simple calculation and reading from the Erlang loss tables by no means is

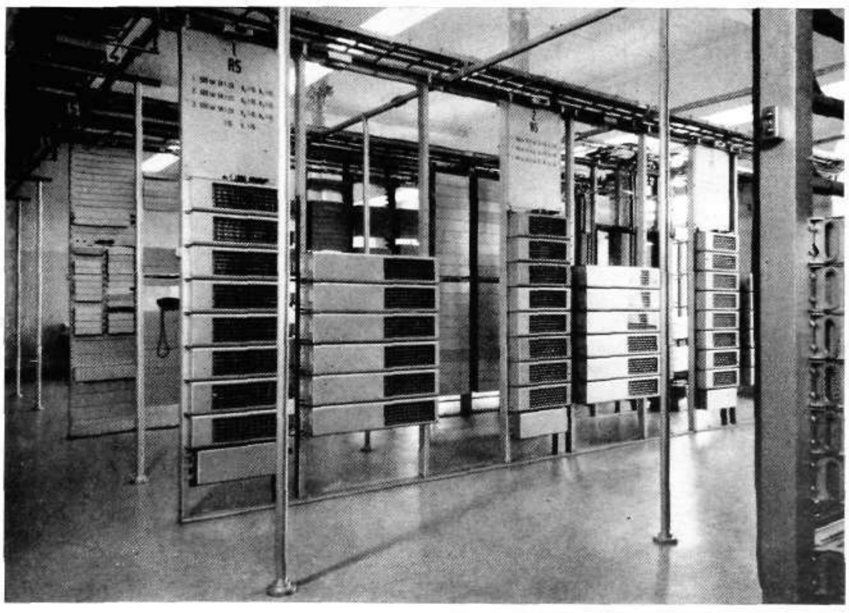


Fig. 4 X 6718

Interior view of modern automatic exchange for railway telephone system (local part)

4-digit numbering scheme for local stations

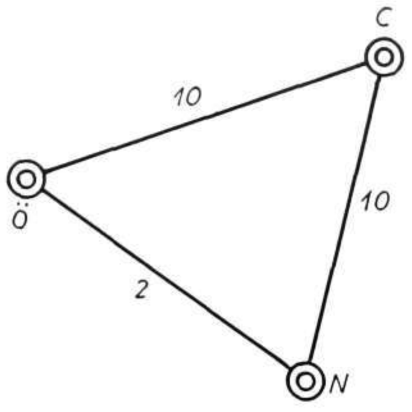


Fig. 5 X 4844
Detail of junction centre network

sufficient for a decision as to when long distance automatic operation is justified. In order to arrive at a good utilization of the lines in case of manual operation good supervision is required and thus in turn requires among other things a considerable number of operators. If these requirements cannot be met, the assumed good utilization of the lines for manual operation will be fictitious.

For automatic long distance traffic it is, however, evident that a good utilization of the lines should be a primary aim. It will be found that the *lattice shaped* manual network lay-out can be simplified—and has to be simplified for technical reasons arising out of the automatic operation—to a *star shaped* lay-out, which means that the lines are assembled into a few routes provided with a greater number of lines. The grade of utilization is, therefore, increased in accordance with the coordination principle.

At the conversion to automatic operation of *larger* networks consisting of junction centres as well as terminal exchanges and where the junction centres form a lattice shaped network, the automatic operation enables the arrangement of *automatic alternative routing*, which has the same effect as the collection of small routes into large ones. The new Swedish railway telephone system (L M Ericsson) is designed for automatic alternative routing. In order to illustrate the importance of such routing a simple example will be analysed with reference to the network lay-out in fig. 5.

The required traffic intensity between N and $\ddot{O}$ corresponds to 85 call minutes per busy hour, i.e., 1.4 E. With the available 2 lines, which is considered sufficient for a manual order traffic, a loss of as high as about 30 % can be expected for automatic traffic without alternative routing. If a loss of not more than about 6 % can be tolerated, automatic operation is not feasible as the two lines with this condition cannot carry more than 25 call minutes per busy hour. The utilization would then not be more than 12.5 mins. per line compared with 42.5 mins. for manual operation.

If we now assume alternative routing over the main routes $N \rightleftarrows C \rightleftarrows \ddot{O}$, which may as an example contain 10 lines each and be subject to a traffic of 372 call minutes per busy hour corresponding to 6.2 E. The loss on these lines will then be about 5 % if the surplus traffic from the small route $N \rightleftarrows \ddot{O}$ is excluded. The automatic equipment now diverts the surplus traffic from the latter route to the main routes $N \rightleftarrows C \rightleftarrows \ddot{O}$. In the example we are approximately right in adding $\frac{30 \times 1.4}{100} \cong 0.4$ E to the above mentioned 6.2 E and will then obtain 6.6 E for the main route. The original loss (5 %) is increased by the traffic addition to 6 % only.

The small route $N \rightleftarrows \ddot{O}$ carries a traffic corresponding to $\frac{70 \times 1.4}{100} \cong 1$ E or 60 call minutes per busy hour. The utilization of these lines has, therefore, increased to 30 mins. per line. By means of alternative routing normal traffic loss has thus been attained over connection N—$\ddot{O}$ without increasing the number of direct lines in the connection. The loss for traffic $N \rightleftarrows \ddot{O}$ will be of the order $\frac{30}{100} \cdot 2 \cdot \frac{6}{100} = 3.6$ % including the loss in the two vias constituting the alternative route. Without the alternative routing the utilization of these lines would be 12.5 mins. per line only at a required loss of 6 %, but only a small part (25 call minutes) of the required traffic (85 call minutes) assumed in the example would be transmitted. If the same amount of traffic should be transmitted with the same loss (about 6 %), *the via N—Ö would have to be increased from 2 to 4 lines.* The utilization would then, however, only be about 20 mins. per line and busy hour.

The above gives an indication of the considerable importance of automatic alternative routing as a means of increasing the line utilization for automatic long distance traffic. The long distance lines must, therefore, be arranged with this object in view. One of the things to be born in mind is that the lines between the junction centres are arranged in such a way that they with regard to transmission obtain the stability required for the alternative routing.

The nature of a railway telephone system necessitates a high degree of reliability. An inferior reliability also results in higher maintenance costs and thus in a reduction of the profit gained by automatic switching with regard to savings in operator personnel. With these views in mind the automatic long distance telephone system for the Swedish railways has been constructed throughout with crossbar switches for all selector functions. The experiences of this type of selector has proved to be extremely good with regard to reliability and maintenance. Also for other connection devices considerable attention has been paid to the selection of elements with high reliability and low maintenance cost. The automatic operation may require a service personnel higher in quality but hardly in quantity as compared with that required for manual equipment.

The capital cost for the automatic long distance exchanges cannot be specified here, but it may be mentioned that the cost of the automatic equipment in a junction centre (generally a principal railway station) often is of the order of 30 % of the complete cost of the automatic exchange equipment. The automatic long distance equipment for a terminal exchange (generally a large or a medium sized railway junction) is remarkably simple and amounts to approximately 15 % of the full capital cost of the exchange, not including the local network and the telephone instruments. These figures, although approximate, give an indication that the apparatus cost for automatic long distance operation is not of a dominating order.

The views above summarize the essential guiding principles which have been followed by the Swedish Railways when deciding to obtain and install equipment for automatic operation of the long distance telephone systems in two districts. The results and experiences from these installations will, of course, give a more definite basis as to what can be gained by the introduction of automatic operation.

Automatization of the Swedish Railway Telephone Networks over a Ten Year Period

It may be of a certain interest also to mention something about the extent of past automatization work for the Swedish railways. The centrally and uniformly planned conversion started 1942 and an analysis can, therefore, be made of the past ten year period.

Fig. 6 X 4842

Development diagram indicating connection possibilities in the automatic exchanges of the Swedish Railways. Number of line relays = LR.

At the end of 1940 automatic exchanges were installed by the Swedish Railways with an available capacity of about 3000 line relays.

The development diagram, fig. 6, gives an indication of the growth of *automatic extensions* from 1940 to 1952 (1953). The diagram represents the number of actually fitted line relays *(LR)* and also indicates the increase in percentage compared with the 1940 figures. The difference between the number of installed *LR* and actual extensions *(»subscribers»)* is small, as the automatic exchanges are designed with plug-jack system both with regard to *LR* as well as the connecting circuits, which enables successive extensions according to line and traffic requirements. These extensions can be carried out at short notice and without difficulties. In other words, the capacity can be adjusted according to the actual requirements. A judicious estimation of the final capacity for the switchboards is, however, very important.

During the first part of the period covered by the diagram accelerated planning, development and ordering took place, which naturally required a certain amount of time. As shown by the diagram in fig. 6 noticeable results in the shape of more important exchanges in operation did not materialize until 1945 and 1946. The subsequent construction was carried out at a faster rate. Finally it should be mentioned that the diagram represents an increase of some 50 automatic exchanges of varying sizes from 50 up to 1 800 extensions *(LR)*.

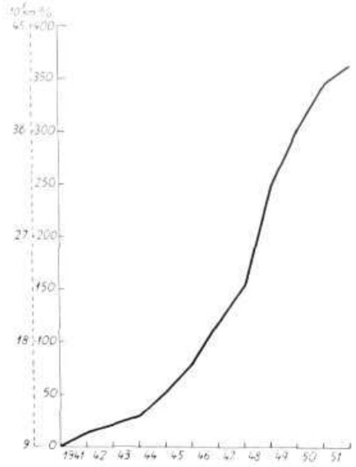


Fig. 7 X 4843

Development diagram indicating the growth of the automatic sectional line network in the Swedish Railways' telephone system

The diagram refers to length of lines equipped with L M Ericsson selective calling sets. At the end of 1940 about 9000 km of lines were provided with L M Ericsson equipment.

The diagram in fig. 7 illustrates the development of the automatic sectional network during the same period. To this may be added that the approximate number of selectors was 2 000 at the end of 1940 and that the number had increased to 10 000 at the end of 1951. In this connection it should be remembered that the number of selective calling telephone instruments is considerably smaller than the number of selectors as usually one instrument is connected to several lines, all of which are provided with individual selectors at each station.

System of Numbering and Types of Automatic Exchanges

The table below lists the capacity and numbering system for the automatic exchanges which can be considered as normal types for the Swedish automatic railway telephone system.

Types of automatic exchanges for railway telephone systems.

Type	Max. capacity		Proposed position in the long distance telephone system
	local lines	select. lines	
I. 4-digit LME 500 selector	3000	300	Junction centre
II. 3-digit » » »	300	100	Junction centre, terminal or satellite exchange
III. 2-digit LME crossbar switch	80-n	n	Terminal or satellite exchange
IV. 3-digit » » »	200	40	» » » »

Number series		To satellite exchange	To operator	Long distance calls	Public telephone system
local	selector				
I. 1000—3999	400—699	7	8	9	0
II. 200—499, 50—69	100—199	7	8	9	0
III. 10—79, 81—89 or 11—89	Out of the local series	—	80 or 10	9	0
IV. 200—399	100—139	4, 5, 6, 7	8	9	0

It follows immediately that the numbering system and the dialling procedure for automatic switching must be arranged logically and expediently both in view of equipment design and with regard to the users. The numbers will in the first place be dependent of the size of the telephone installation. With reference to the one-digit numbers, the code digits, it should of course be remembered that these cannot be used as first digits in multi-digit numbers. The first-digit numbers available for 3 and 4-digit exchanges according to types I and II are 1, 2, 3, 4, 5 and 6, for 2-digit exchanges 1—8 and for 3-digit exchanges according to type IV 1, 2 and 3.

The local equipment and the selectors for incoming long distance traffic for exchanges types I and II are provided with L M Ericsson 500-line selectors and are operated with registers and revertive impulses. The local registers are built up of crossbar switches and relays. They can store up to 9 digits, i. e., code digit, 2-digit long distance exchange number, 3 or 4-digit local number and 3 or 2-digit selector number. The junction centres in the network are provided with trunk selectors and trunk registers. For these devices no mechanical selectors are used, only crossbar switches with relays. The purpose of the trunk registers is to store the 2-digit exchange numbers and to direct the connection to the required exchange directly or on an alternative route in accordance with the number stored.

Exchange types III and IV are entirely based on crossbar switches and relays. These exchanges are also provided with registers but with the application of by-path and marker system.

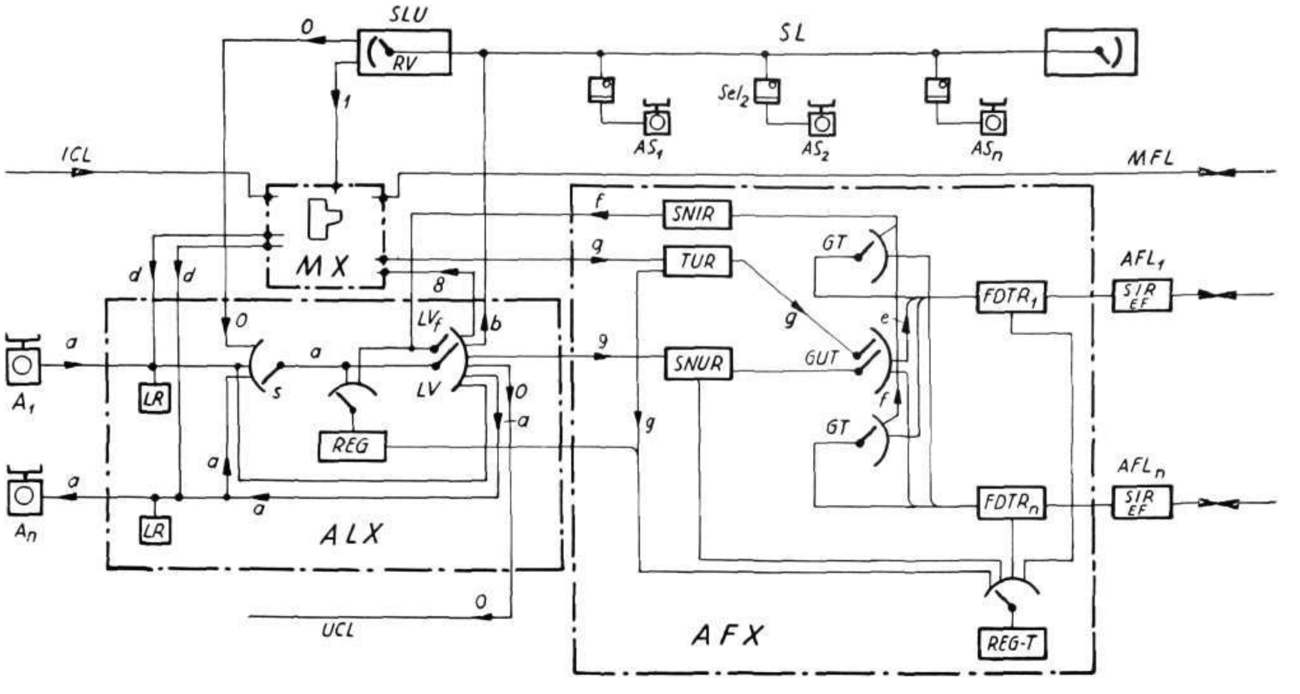


Fig. 8 X 7637

Simplified traffic route diagram for a medium sized railway telephone installation of junction centre type

ALX	automatic local exchange
A	station
LR	line relay
S	line finder
LV	connector
REG	local register
ICL	incoming exchange line
UCL	outgoing exchange line
MX	manual switchboard
MFL	manual long distance line
SL	sectional line
AS	selector set
SU	selector equipment
RV	direction selector
Sel	selector
AFX	automatic long distance exchange
SNUR	outgoing long distance connecting circuit
REG-T	trunk register
SNIR	incoming long distance connecting circuit
TUR	outgoing cord circuit for operator
GT, GUT	group or trunk selector for long distance traffic
FDTR	relay repeater for long distance line
AFL	automatic long distance line, junction line
SIR	signal repeater
EF	terminal amplifier

System of Signalling for Switching over Junction Lines

For the switching over junction lines the dial and control signals are positive A.C. impulses.

Dependent on the type of line low frequency—about 70 c/s—or voice frequency —1 500 c/s—is used for the signals.

For short lines without amplifiers, signal repeaters of the low frequency type are used as individual additions to the relay repeaters for the lines. Longer lines with amplifiers are provided with voice frequency signal repeaters. These are also made as individual additions to the relay repeaters but are mounted in conjunction with the amplifiers and are fed from a tone generator common for the station.

The release signals have a duration of 700 msecs. if they are originated by the caller and of 250 msecs. if they come from the called station. Other signals, seizing, impulsing acknowledgement &c. have a duration of 40 or 50 msecs.

Transmission Principles

The junction centres are arranged with permanent terminal amplifiers for the long distance lines of any substantial length. The transit connection takes place without addition in attenuation. The overall attenuation for the line part in the connection—in other words up to the terminal exchange—amounts to 1 Neper.

The trunk selectors in the junction centre effect a 4-wire connection both for transit traffic and for traffic over the local exchange.

Traffic Routes in the New Railway Telephone System

Fig. 8 shows a traffic route diagram representing, in a very much simplified form, an exchange system of type II applied to a terminal exchange. The symbols in the diagram indicate apart from the exchange equipment also local, section and long distance lines as well as exchange lines to and from the public telephone system.

1. *Call: A_1 to A_n. Purely local call*

When the handset A_1 is lifted, A_1 is connected over *a*, finder *S*, connecting circuit *a* to local register *REG*. When the 3-(2-)digit local number to A_n has been dialled and stored, *REG* directs selector *LV* to the position corresponding to line *a* to A_n.

2. *Call: A_1 to sectional line set AS_1*

Connection to *REG* as above. The 3-digit number for the sectional line in the exchange is dialled (series 100—199) and consecutively the 2-digit local selector number for AS_1. *REG* directs *LV* to *b* and then transmits the impulse train of the 2-digit number on the sectional line.

3. *Call: A_1 to the manual switchboard*

Connection to *REG* as above. Number 8 is dialled. Register *REG* directs *LV* to the position corresponding to line 8 to the manual switchboard.

4. *Call: A_1 to the public telephone system*

Connection to *REG* as above. Number 0 is dialled. The register directs selector *LV* to the position corresponding to number 0 which contains the outgoing exchange lines. After receipt of dialling tone the public telephone number is dialled. (Calls from the public telephone system are connected manually over multiple lines *d*.)

5. *Call: AS_1 to the automatic exchange*

When the handset on AS_1 is lifted and the instrument is connected to the selector line, dialling tone is transmitted from the selector equipment. On the dialling of connection digit (generally 0) to the automatic exchange the direction selector *RV* is operated to position 0 to the automatic exchange. After this AS_1 can, in the main, be considered as a calling local station. AS_1, AS_2 ... AS_n are equivalent.

6. *Call: AS_1 to the manual switchboard*

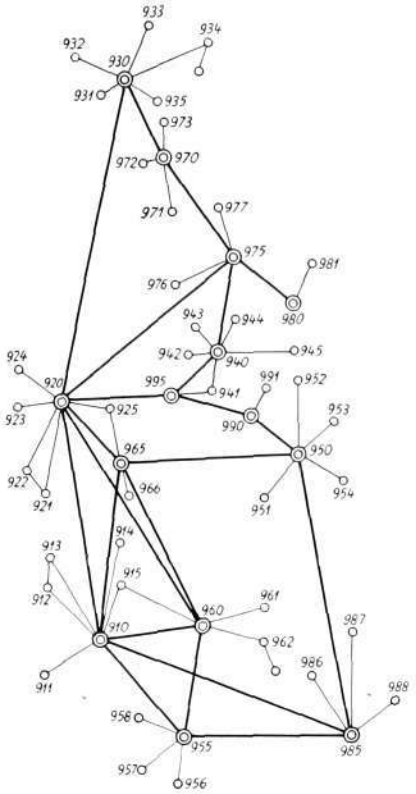
As above under 5. Code digit is often 1. The operator can establish connection to the required line.

7. *Call: AS_1 to AS_2*

After the dialling of the local 2-digit number of AS_2 selector Sel_2 has reached ringing position. The exchange is not effected by the call.

8. *Call: A_1 to A_n in remote exchange*

Assume automatic long distance traffic (= traffic over junctions) and as a simplification that the remote exchange is of the same type as the calling exchange. As mentioned above code number 9 applies as general number for long distance calls and as explained below the exchanges have 2-digit identification numbers (= exchange numbers) in the long distance system. After the lifting of A_1 and receipt of dialling tone from *REG 9XX* is dialled immediately followed by the 3-digit local number or in other words the caller dials *9XXXXX* without intermediate dialling tone. *REG* stores the impulse trains and directs *LV* to level 9 where a free outgoing long distance connecting circuit *SNUR* is seized. A trunk register *REG-T* is connected which receives from *REG* and stores the two digits following number 9 (= the exchange number). *REG-T* directs the group selector *GUT* to the position corresponding to the position where the long distance lines are available which are leading towards the called exchange. Assuming that *GUT* seizes a free line AFL_1 and effects connection to this over *c*. Seizing and acknowledgment signals are now transmitted over AFL_1 (usually voice frequency signals). *REG-T* then transmits the



X 4841
X 9123

Fig. 9

Lay-out for automatic long distance network for railway telephone system

◎ junction centre

○ terminal or sub-exchange

impulsing code for the called exchange by means of similar signals and the connection is established with or without passing junction centres on the route to the called exchange. If fig. 8 also is illustrating the called exchange, we assume that the call is coming in, for instance, on long distance line AFL_n. The relay repeater $FDTR_n$ for this line receives the incoming impulsing code over AFL_n and repeats the impulses to group selector GV, which in this way is operated to connection f. Connection is obtained over connecting circuit $SNIR$ to line selector LV and to local register REG. A signal is now returned from the called exchange to the local register in the calling exchange where as mentioned above the local 3-digit number is stored. This local register now transmits impulses over the long distance line to the REG in the called exchange. This register directs LV, in the usual way, to the position corresponding to line a to A_n. The long distance connection is then completed.

9. *Semi-automatic connection: A_1 to A_n in remote exchange*

From A_1 the manual switchboard is called by number 8 as described above. The operator receives the order for the required call. The manual switchboard has connections g equipped with cord circuits TUR with corresponding trunk selector GUT together with connections g to the trunk register. When the operator has connected TUR the exchange number and the local number for the ordered call are dialled by means of dial or key sender. The exchange number is stored in $REG\text{-}T$ but a local register REG is simultaneously connected and receives the local number. The long distance connection is then automatically established in the same way as described under 8. When A_n has answered, the connection is completed by the operator connecting line g to the multiple wires d corresponding to A_1.

From consideration of space these examples may suffice as a guidance in the traffic routes and connection principles employed for long distance calls.

Numbering System for the Long Distance Telephone System

Alternative Routing

It has been indicated above that the automatic exchanges to be included in the automatic long distance system are allotted 2-digit identification numbers usually referred to as exchange numbers. Fig. 9 illustrates the network arrangement in principle, without resembling geographically any network in existence. The diagram shows the principal types of lines, viz., terminal exchange lines and junction centre lines. The former compose star shaped network groups in relation to their junction centres. The latter, which have to possess higher transmission properties to allow tandem connection, form a network which to a great extent retains the lattice shaped character of a manual network.

The network diagram shows that the exchange number always is the same irrespective of the position of the calling exchange, a fact which is very important for the users of the system and from directory point of view.

A detail important for the telephone traffic and the line utilization should be pointed out with reference to exchanges 912 and 913. The example shows how direct connection can be arranged between two geographically adjacent exchanges. For this purpose a sub-exchange code is preferably used, for instance 7. For direct connection in one or the other direction the local number is prefaced by the figure 7. In other words the terminal exchanges will in this way constitute sub-exchanges dependent on each others.

The network diagram shows the simple sub-exchange connection at exchanges 934 and 962. For traffic towards the sub-exchange a single-digit code, e. g. 7, is added in front of the local number. For calls from the sub-exchange towards the terminal exchange a single-digit code, e. g. 0, is dialled, dialling tone is awaited and continued dialling is carried out as from a telephone set connected to the terminal exchange.

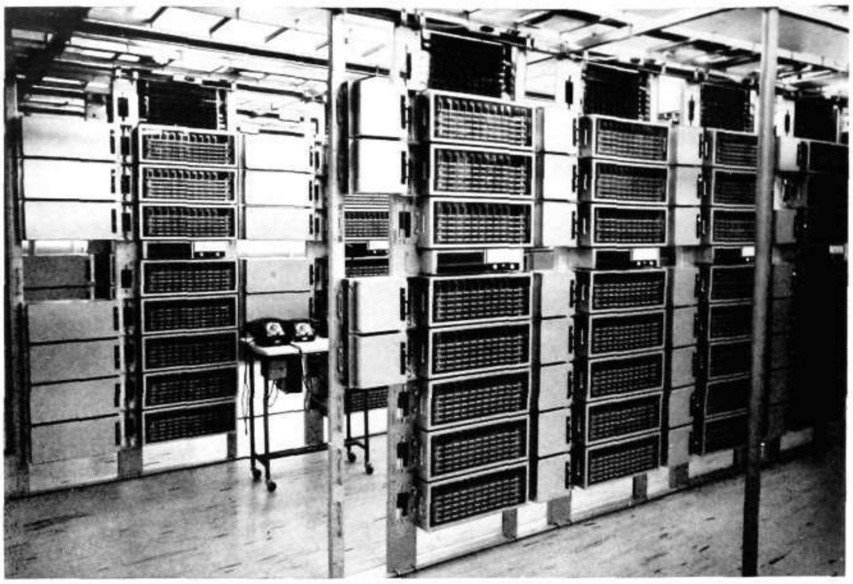


Fig. 10 X 6719

Interior view of large automatic exchange for railway telephone system. Long distance equipment of junction centre type.

The illustration shows relay repeaters with trunk selectors (crossbar switches).

The position of certain terminal exchanges is such that they, out of line considerations, have to be connected to two junction centres. As an example see terminal exchange No. 925. The automatic system allows alternative routing to, as well as from such an exchange increasing the utilization of the terminal exchange lines.

Alternative routing in a wider sense refers, however, to the junction centre network. The switching progress may be as follows. Assume that a station in exchange 911 calls a station in 932 by automatic operation. The trunk register in the junction centre 910 first directs the connection over the direct lines 910→920. If these are engaged, the route over 965 is tried and if this route is engaged the register may be so arranged that the route over 960 is automatically tried. Should this route also be engaged the caller will receive busy tone. Assuming that the connection has reached junction centre 920 by one route or another, a trunk selector in this exchange will test if the direct line 920→930 is free. If this is not the case, a trunk register is connected in exchange 920 arranging alternative routing over exchanges 975 and 970. Only if this route also is engaged or if the terminal exchange line or the called station is engaged, busy tone will be received by the caller. It should be noted that the alternative routing operations take place quite automatically. The caller will notice an alternative routing only by the fact that ringing tone will be received a few seconds later than usual.

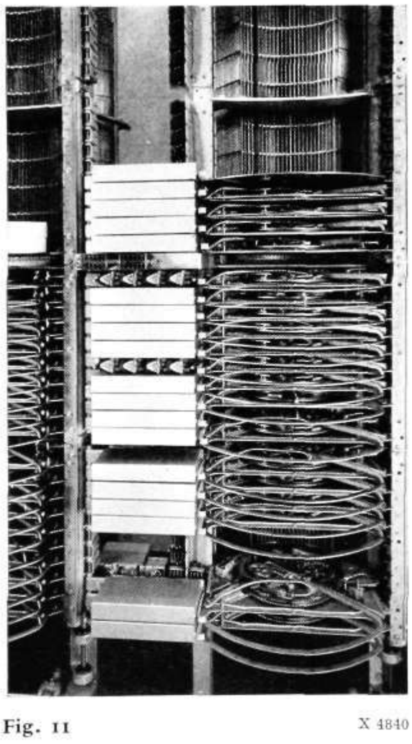


Fig. 11 X 4840

The final selector stage in a long distance connection for an exchange of type I or II is represented by 500-line selectors

Conclusion

The application of automatic operation on railway telephone systems dealt with above refers to conditions in Sweden. The first telephones for railways were introduced in Sweden already at the end of the last century. The importance and use of the railway telephone system were considerably increased after 1930. Ten years later it was found necessary to put into hand an extensive coordination, standardization and modernization of the railway telephone system and apparatus. This work has been progressing during the past ten years, the introduction of automatic operation taking a prominent part as will be evident from the above. It is natural that this work is followed by a modernization of the transmission equipment.

For a railway man the conversion to automatic operation is of considerable interest and his opinions after the starting of the new systems are almost without exception very positive. The flexibility and the saving of personnel which are the objects of the automatic operation will be more and more evident as this system is being extended. The ultimate aim is »the telephone as an efficient auxiliary for the railway management».

Modern Telephone Systems for Internal Communications

O SIEWERT, TELEFONAKTIEBOLAGET L M ERICSSON, STOCKHOLM

U.D.C. 621.395.2

In recent years a number of new telephone systems for internal communication have been introduced on the market by Telefonaktiebolaget L M Ericsson. As these telephone systems principally differ in character and offer different traffic facilities it is very important that the most suitable system is selected for each particular purpose.

In the following article a comparison is made of the traffic properties for different telephone systems which are possible in companies and organizations of a certain size and it is hoped that this will serve as a guidance in selecting a suitable system. The systems described have been classified with reference to the extension capacity. First internal telephone systems for up to about 10 extensions are described, then systems for about 20 extensions, 50 extensions and finally 100 and 200 extensions. The survey is concluded with a description of different manager's telephone systems.

There exists in all organizations a definite necessity for internal and external telephone communications. A great number of telephone systems have also been developed to meet this requirement. The systems are principally of two different kinds, viz., *private branch exchanges* where one system covers both the external and the internal traffic, and *purely internal telephone systems*. The use of both types of installations in the same organization is also very common and offers quite often the most rational solution. It is not possible to give a universal answer as to which system or combination of systems is the most satisfactory one from the subscriber's point of view, as it is dependent on the size, character and routine of the organization, the tariff policy of the telephone administration and the capital cost of the different telephone systems.

There is no doubt, however, that the purely internal telephone systems are very popular in many quarters and the demand for such systems is constantly on the increase. Quite a number of new telephone systems have also recently been developed providing improved facilities to meet the numerous varieties of telephone requirements which exist.

Telephone Systems for up to 8 or 10 Stations with One Simultaneous Connection

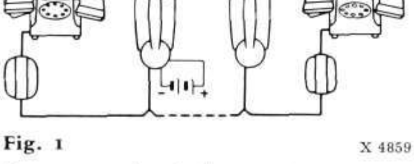


Fig. 1 X 4859

Departmental telephone system

for 8 (possibly 9) stations max. consisting of desk instruments DEK 9002 or DEK 9004 and wall instruments DEP 3201 or DEP 3202

Telephone systems of this size are intended on the one hand to cover the entire internal telephone requirements in *small companies*, on the other hand to serve as an auxiliary system for a limited number of persons, for instance, in *a department of a large organization*. A common feature for such small systems is that *one* call only can be in progress at the time. The experience has shown that these systems have a surprisingly high traffic capacity as they are mainly used for short calls. The grade of service is further improved if the system is made for non-secret calls or if one or more extensions are arranged with priority, i. e., facility to enter a call in progress and request the parties to clear the line.

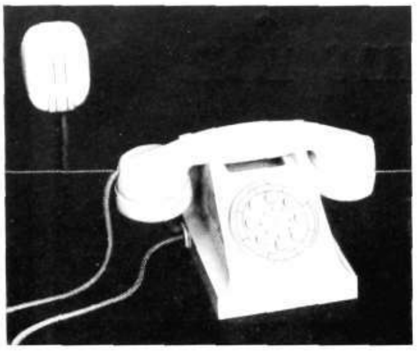


Fig. 2 X 4847

Desk instrument for departmental telephone system DEK 9004

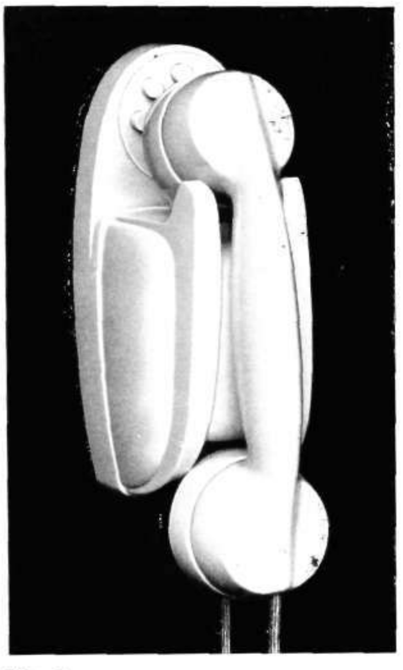


Fig. 3 X 4720

Wall instrument for departmental telephone system DEP 3202

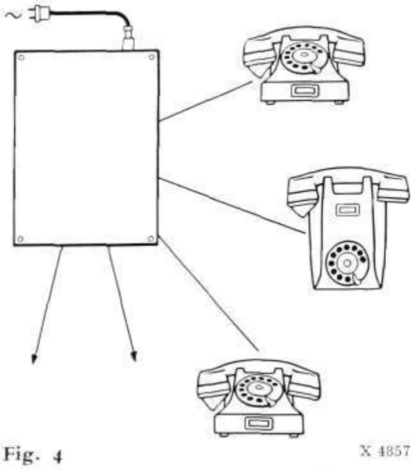


Fig. 4 X 4857

Automatic exchange system OL 15 for 10 extensions max.

Departmental Telephone System

The simplest and by far cheapest system of this kind is the *departmental telephone system*. This does not require a central switching device and consists of telephone instruments only, either desk sets or wall sets, provided with a push button set with 8 buttons. These push buttons are used to transmit individual call signals to other instruments. All stations have the same facility to call other stations. The calling operation is very fast and is carried out by pressing the appropriate call button. The call signal is transmitted as long as the call button is pressed and can be repeated any number of times. Several stations may be called at the same time when required and conferences between several persons can take place.

The instruments are moulded in black phenolics or ivory melamin plastics, figs. 2 and 3. The *system* operates on 6 V supplied from a dry cell battery or a mains connected power unit.

There is also a simplified version of the system where the push button set is omitted and the instrument is provided with one push button only. This system is referred to as a *domestic telephone system* and is used when telephone connection is required between two stations or possibly between three or four. In the latter case calling takes place by means of code signals, as the call signals are transmitted to all stations. The instruments and the properties of the system are otherwise identical with those of the departmental telephone.

Automatic Exchange OL 15

If a system with secret calls for the internal telephone traffic is considered necessary a small automatic exchange *OL 15* should be used.

The exchange is made for a maximum of 10 extensions. The instruments are ordinary dial sets. The extensions are called by one-digit numbers 1—9 and 0, dialled in the normal way.

The exchange is made in such a way that a certain station, e. g., No. 1, can have priority. This station can enter calls in progress in order to ask the parties to clear the line. This station can also call all extensions at the same time by dialling his own number. This facility is useful when in an urgent situation it is required to find a person absent from his room or when a general message to all extensions should be transmitted.

The instruments are connected to the exchange over 2-wire cables which means a cheap network easily modified in case of alteration of the premises, fig. 4.

The exchange equipment is very small and consists of two 12-line rotary selectors, a number of relays, capacitors and a power unit for connection to the electric mains. The power unit provides the necessary voltages for the transmitter supply, operation and signals. No battery is, therefore, required. The equipment is enclosed in an aluminium enamelled mild steel cover, fig. 5.

Loudspeaking Intercom

The two systems described above are provided with ordinary telephone instruments and all conversation takes place by means of handsets. This method has advantages as well as disadvantages. The advantages are that other persons in the room cannot listen to the conversation or be disturbed by a call in progress. The disadvantages are that the parties are tied to the instrument, that one hand is engaged during the conversation and that the handset has to be lifted from the cradle when initiating or answering a call which necessarily takes a certain time.

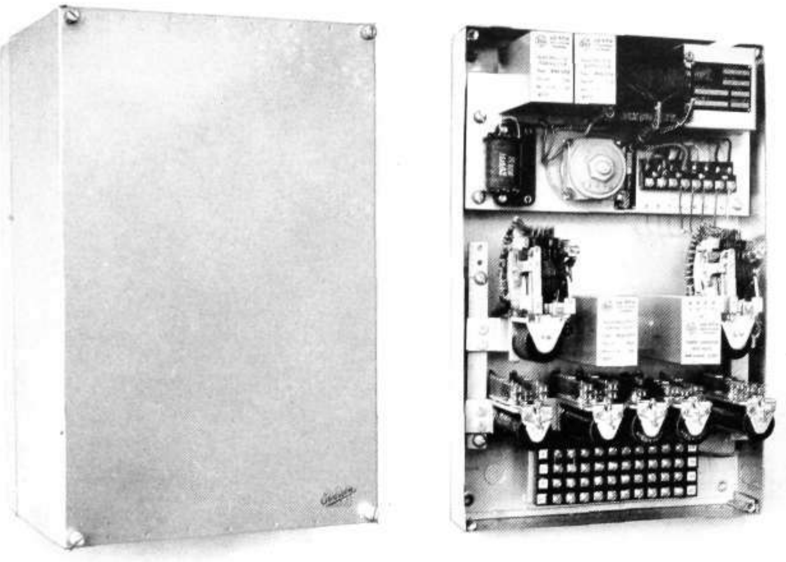


Fig. 5 X 6720

Automatic exchange OL 15

right with cover removed

When a fast connection is of importance and when loudspeaker conversation is desired or acceptable, the loudspeaking intercom is an excellent means of communication, as it is operated with push button calling and normally does not require any manipulations when a call is answered.

The system is devised in such a way that speech is transmitted in one direction at the time. The speech direction is controlled by the caller by means of a speech button and requires, therefore, a certain amount of routine. If the system is mainly used to pass or collect information the operation of the speech button hardly presents any difficulties.

A loudspeaking intercom system either consists of master sets only with all-to-all connection or is built up of master sets and sub-sets, the latter being able to call the associated master sets only. Fig. 6 shows two common combinations, but there are many other combination possibilities. If master sets only are used the capacity of the system is 10 (possibly 11) sets. If sub-sets are also used, this number can be considerably increased. One call only can, however, take place at the time and during this time the other sets are ineffective. A visual signal on each set indicates that the system is engaged. Calls in progress cannot be heard on other sets. One or more master sets can, however, be provided with priority, i. e., they can disconnect a call in progress restoring the system to disengaged condition.

As the calls normally are connected *directly* to the called set and are signalled by lamp signals only, apart from the callers announcement in the loudspeaker, each master set is provided with a secrecy switch obstructing the direct connection when so is required.

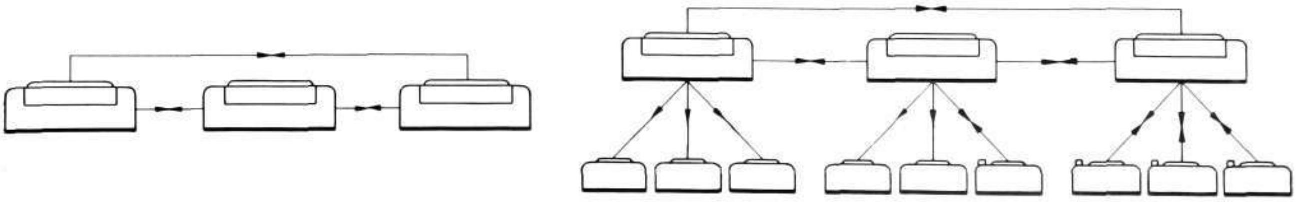
The master sets, fig. 7, contain control buttons, microphone-loudspeaker, secrecy switch, call buzzer and connecting and calling relay. The sub-sets, fig. 8, are supplied in two variations: — with or without call button. The instruments with

Fig. 6 X 7638

Loudspeaking intercom system in different combinations

A system containing master sets only (11 max.)

B system containing master sets and sub-sets; each master set can be connected to 10 master and sub-sets max.



call button can call their associated master set, whereas those without button can only receive incoming calls. For conversation between a master set and a sub-set the speech direction is always controlled from the master set.

Apart from the instruments a loudspeaking intercom system includes a common amplifier which also contains relays for the speech direction and power supply for connection to A. C. mains. All these components are mounted in an aluminium enamelled cover for wall mounting.

Fig. 7 X 4849
Master instrument for loudspeaking intercom DEL 2301

Telephone Systems for up to 20 or 22 Stations

All systems described above are made for *one* simultaneous connection and the number of stations is limited to 10. If more than one simultaneous connection is required or if it is necessary to connect more than 10 extensions to the internal telephone system, other types must be selected. It is then a question of choosing between on the one hand an intercommunicating system consisting of instruments only or an automatic exchange system where the calls are dialled. The capital cost for an intercommunicating system depends on the total length of lines between the instruments and this system should, therefore, principally be used when the stations are comparatively close together. Otherwise an automatic exchange is preferable. An automatic system has, furthermore, the advantage over an intercommunicating system that the calls are secret.

Intercommunicating System DEH 12

The telephone instruments included in the system are made for 10 or 20 lines. They are supplied as desk sets or wall sets, figs. 9 and 10, and are interconnected with multicore cable. Each instrument is provided with a line selector for 10 or 20 lines by means of which the required station is connected. The call signal is effected by means of a push button and the signal is transmitted as long as the button is pressed down. The call is answered by lifting the handset. No other operations are necessary on the part of the called party and the line selector can be in any position.

A system of this type has unlimited connection capacity, as in a 10-line system 5 calls and in a 20-line system 10 calls can take place simultaneously.

A telephone conference can also be arranged without difficulty. The conference leader calls the required conference members in turn and asks each of them to turn the line selector to his number and press the call button in order to establish conference connection.

X 4850
Fig. 8 X 4851
Sub-instrument for loudspeaking intercom
left DEL 1201 without call button and right DEL 1202 with call button

Fig. 9 X 4848
Desk instrument for intercommunication system DEH 1210

The system operates on 12 V supplied from a small centrally fitted mains connected power unit or a dry cell battery.

Any type of line material may be used. The lines are generally run from station to station. The desk sets are provided with a special junction box which also serves as wall terminal box for the instrument cord, whereas the wall sets have terminal blocks enclosed in the instruments for direct connection of the cable. For cable joints and branching points loose junction boxes are used. Ten-line systems require a 22-core cable and twenty-line systems 42-core cable. With a wire diameter of 0.5 mm (SWG 25) a maximum distance between the two extreme stations should not exceed 500 m (550 yds) cable length.

Automatic Exchange ALD 10

Automatic exchange type *ALD 10* is specially designed for use in small offices and factories and has all the properties that experience has proved to be desirable for such purposes. The exchange is normally supplied for 22 extensions and 3 or 4 simultaneous connections. All calls are secret. The instruments are connected to the exchange over 2-wire lines and are normal dial set of desk or wall type.

Fig. 10 X 4861
Wall instrument for intercommunication system DEN 1110

All connections are established by means of dialling. As soon as the number has been dialled an intermittent ringing signal is transmitted to the called extension if this is free. The caller simultaneously receives ringing tone. When the called party answers, the ringing signal is disconnected and line connection is established. If the called extension is engaged, the caller receives busy tone and should replace the handset.

In order to enable certain persons in the organization to obtain connection to engaged instruments the exchange may be provided with priority facility. When a priority extension has been connected to a call in progress a faint busy tone is transmitted which is heard by the parties in connection. This busy tone remains on the connection as long as the priority extension is connected. The priority facility should preferably be used for very short messages leaving the original call to be continued afterwards.

The exchange can also be provided with a conference unit to enable telephone conferences between up to 10 predetermined extensions. The extensions prepared for such conferences must be provided with instruments with push button for temporary earth connection of one of the line branches.

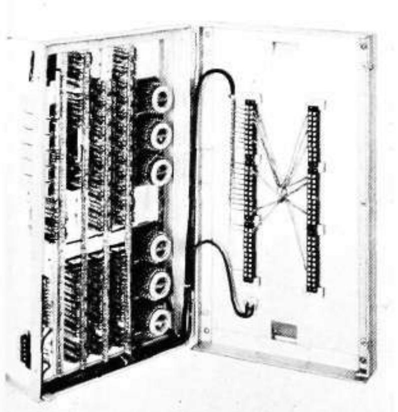


Fig. 11 X 4862
Automatic exchange ALD 10
without cover and with relay and selector gate open

Another traffic facility which can be provided on this type of exchange is *staff location*. For this purpose the exchange is provided with a staff locator unit making it possible to call 31 persons on lamp indicators fitted in different positions of the premises. To initiate a staff location signal a special number is first dialled to obtain access to the staff locator unit and then the call signal number for the wanted person. Telephone connection is obtained with the wanted person as soon as this person has dialled a special answering number and obtained connection to the staff locator unit. The staff locator facility is available for all extensions.

In certain cases it is required to arrange cooperation with another exchange and *ALD 10* can be supplemented with equipment for such traffic which is carried out entirely by automatic operation.

The mechanical lay-out is illustrated in fig 11. As shown all components are mounted on bars fixed on a hinged gate making the rear of the exchange and the base plate with main distribution frame easily accessible.

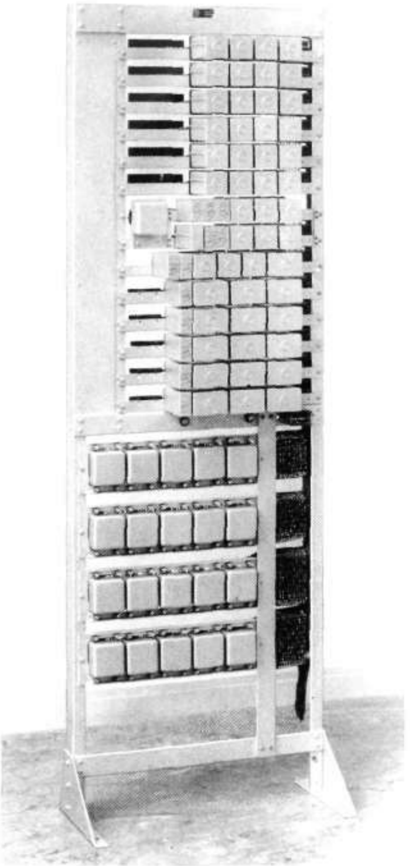


Fig. 12 X 4866
Automatic exchange OL 45
fitted with equipment for 48 extensions and 5 simultaneous connections

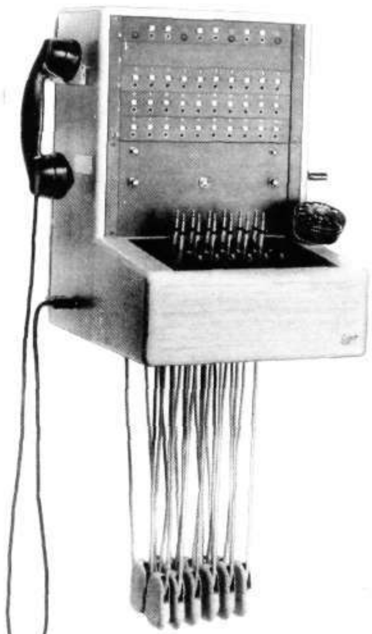


Fig. 13 X 4852
Manual switchboard ADE 1210
for max. 50 extensions

The connecting elements principally consist of rotary 25-line selectors, relays and capacitors. The relays and the selectors are permanently wired. The front of the exchange is covered by an aluminium enamelled mild steel cover protecting the components against dust and mechanical damage.

Telephone Systems for up to 48 or 50 (possibly 90) Extensions

If the actual internal telephone requirement in an organization is 20 or 30 extensions and it is estimated that this number within a comparatively short period will increase to about 50 extensions the most economical policy is to install an exchange type which is equipped for the capacity initially required but which later — as the requirements are growing — can be easily supplemented with the necessary connecting devices up to the estimated final capacity.

For this capacity only automatic or manual exchanges can be used, intercommunicating systems being out of the question for economical and practical reasons.

The capital cost for a manual exchange is lower than that for an automatic exchange. The cost for the manual operation and the disadvantages of the long connection and disconnection times as compared with the automatic exchange are, however, such that the higher capital cost of an automatic exchange very soon will be compensated. A manual exchange for *purely internal traffic* is, therefore, very rarely installed in a business organization. On the other hand manual operation of internal traffic can be justified in special cases such as in hotels where the number of internal calls between the guest rooms are very few and an operator in any case must be available for connection of the external calls. Such an exchange is, however, not an internal telephone system but a private branch exchange.

Automatic Exchange OL 45

Automatic exchange type *OL 45* is specially designed for use in medium sized offices and factories with an actual telephone requirement of 20 to 30 extensions. The exchange is designed in such a way that it can be extended in stages with equipment for 8 extensions or 1 connection facility at the time up to final capacity.

For not more than 48 extensions the exchange consists of a rack holding all necessary relays and selectors, fig 12. The number of simultaneous connections amounts to five. The line relay units as well as the link units are connected to the rack wiring over plug and jack and it is, therefore, very easy to extend the exchange. The system may, for instance, initially be equipped for 24 extensions and 3 simultaneous calls and then be extended in stages of 8 extensions or 1 call at the time up to final capacity.

If this capacity should prove insufficient, a further rack for a maximum of 42 extensions and another 5 links can be added and equipped successively. The maximum final capacity of the exchange is, therefore, 90 extensions with a total of 10 simultaneous calls.

The telephone instruments are normal dial sets connected over 2-wire lines. All calls are secret.

All calls are effected by dialling and a number of extensions may be arranged with priority. The connections of calls from ordinary and priority extensions take place in the same manner as described for *ALD 10*. As in case of the latter exchange *OL 45* may be supplemented with units for staff location and automatic connections to other automatic exchanges.

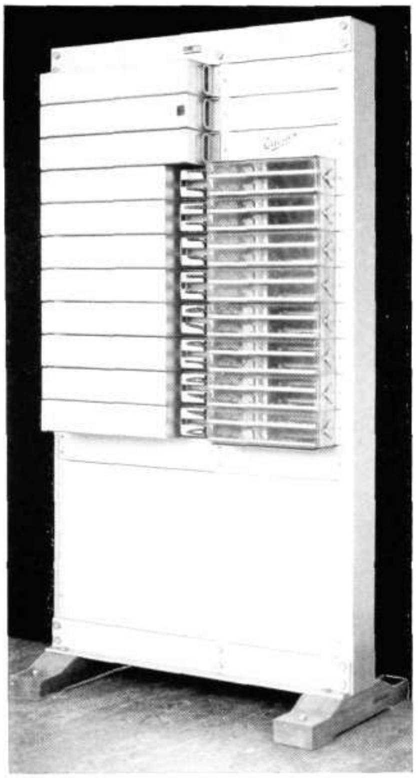


Fig. 14 X 4853

Automatic exchange AHD 90

fitted with equipment for 100 extensions and 8 simultaneous connections

The connecting elements consist mainly of rotary 25-line selectors, relays and capacitors. They are mounted on bars in a rack of section iron. The racks are always supplied wired for final capacity.

Manual CB-switchboard ADE 1210

The capacity of the switchboard is 50 extensions and 10 simultaneous calls. As in the case of the automatic exchange *OL 45* described above, the manual switchboard *ADE 1210* can be equipped with the number of line units and switching sets initially required and subsequently be extended to final capacity in stages by adding equipment for 10 extensions and 1 cord circuit at the time. This is made possible by making the line and cord circuit equipment in detachable units.

All units in the switchboard are mounted in an oak frame. The board is made for wall mounting, fig 13, but it can also be placed on a special floor stand at the side of a desk. The switchboard will in this way be better accessible for the operator than is the case when the board is mounted on the wall.

The calling and supervisory devices in the switchboard consist of lamps and relays; the connecting devices consist of cords and plugs.

The telephone instruments are connected over 2-wire lines and are either normal C.B. instruments or, if the lines are short, instruments of the domestic type.

The switchboard is called by lifting the handset. The operator answers the call by plugging up an answering cord in the caller's jack and — after receiving the wanted number — the calling cord in the jack for the required extension. Ringing signal is transmitted by means of a handgenerator or a pole changer. When both extensions have replaced a supervisory lamp is operated and the operator releases the connection.

Telephone Systems for 50—200 Extensions

Internal telephone systems of this size are either automatic or manual. For exchanges of this capacity it is for economical reasons even more important than in the case of smaller exchanges, that they are designed in such a way that considerable additions can be made to the initial requirements both with reference to the number of extensions and to the number of simultaneous calls. A few types of exchanges both automatic and manual will be described below.

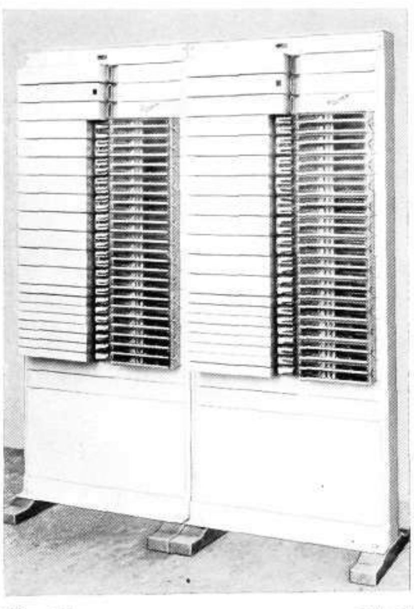


Fig. 15 X 4854

Automatic exchange AHD 94

fitted with equipment for 200 extensions and 2 × 9 simultaneous connections

Automatic Exchanges AHD 90, AHD 94 and AHD 96

Exchange type *AHD 90* has a maximum capacity of 100 extensions and 8 simultaneous calls and is specially suitable, when the initial requirement is 50 to 60 extensions, fig 14. Exchange types *AHD 94* and *AHD 96* both consist of two identical 100-line racks and can, therefore, be extended to 200 lines, fig. 15. Type *AHD 94* is intended for normal telephone traffic corresponding to 9 simultaneous calls per 100 extensions, whereas *AHD 96* is intended for high traffic intensity corresponding to 13 simultaneous connections per 100-group. These two types of exchanges are economically favourable when the initial requirements are 90 to 100 extensions. The capacity of the systems can subsequently be doubled. The capital cost for the initial installation is, however, effected only to a very small extent by the provisions for this extension reserve.

All these types of exchanges are with regard to mechanical construction and circuits based on the use of the L M Ericsson 100-line XY-selectors, fig 16, which enables a very simple and comprehensive lay-out of the exchanges.

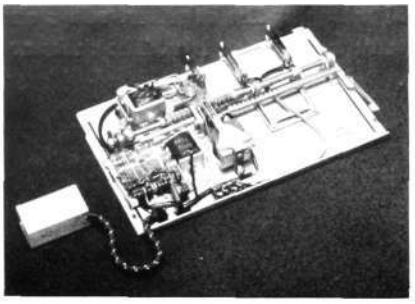


Fig. 16 X 4846

XY selector or 100-line selector

The telephone instruments are normal dial sets and are connected to the exchange over 2-wire lines. All calls are secret.

The traffic facilities are identical with those for the automatic exchanges of types *ALD 10* and *OL 45*. All connections are established automatically and intermittent ringing signal is transmitted if the wanted extension is free. Certain extensions may be arranged with priority enabling them to obtain connection to the wanted extension even if this should be engaged on a call in progress. The exchanges can be provided with equipment for automatic staff locator calls of up to 31 persons. They can also be supplemented with equipment enabling conference calls between a maximum of 10 extensions. For this purpose the telephone instruments for the effected extensions must be provided with a push button for temporary earth connection of one of the line branches. Automatic junction lines to other automatic exchanges may be arranged.

Finally certain extension lines can be called by a common number referred to as a group number. This facility which is not included in exchanges with 25-line selectors, can be used for such purposes as when a number of persons are employed on similar work each person having a separate extension. When a group number is dialled the first free extension in the group is called. All extensions in the group can, however, be called by individual numbers, in which case the extension with the dialled number only receives the call.

Fig. 17 X 4865

Manual switchboard ADF 1413

for 100 extensions max.

The connecting elements consist of relay sets, connected over plugs to corresponding jacks in the frame, and XY-selectors, which are connected over a flexible cord to a jack in a corresponding relay set, fig 16. It is, therefore, initially not necessary to equip the exchange with more elements than are actually required. As the extension and traffic requirements increase the exchange can be successively extended up to full capacity.

Manual C.B. Switchboards ADF 1413 and ADF 1422

The manual C.B. switchboard *ADF 1413* has a maximum capacity of 100 internal extensions and 20 cord circuits, fig 17, whereas switchboard *ADF 1422* has a capacity of 200 internal extensions and 20 cord circuits. The switchboards are similar and differ only with regard to the jack field which is higher on *ADF 1422* doubling the extension capacity.

These switchboards are, as in the case of switchboard *ADE 1210*, designed in such a way that the actually required number of line units and cord circuits only need to be fitted initially. They can later be extended up to final capacity by adding further line units and cord circuits. This successive extension possibility makes it an economical proposition for organizations to install types of switchboards with a final capacity twice as big as that initially required, if it is estimated that they later on will have to extend their system.

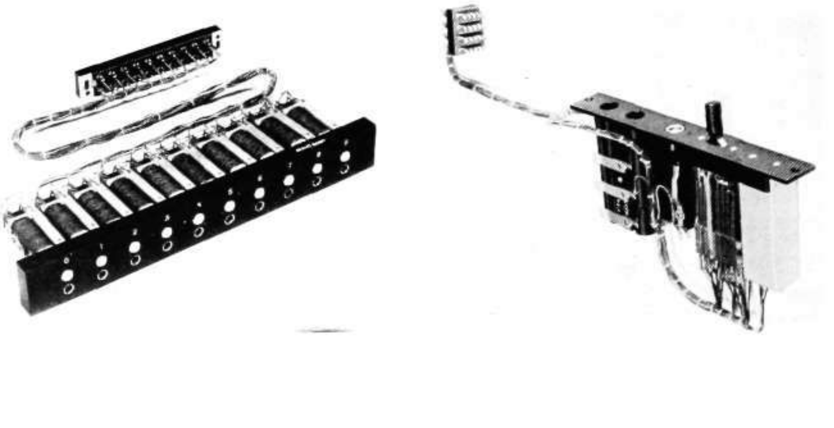


Fig. 18 X 4855 X 4856

Connecting elements for manual switchboards ADE and ADF

left line unit, right switching set

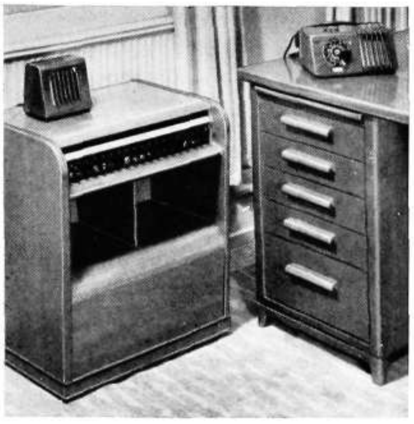


Fig. 19 X 4858

Master station for conference telephone system type AEC

consisting of manager's desk AEC, telephone instrument with enclosed microphone DBF and loudspeaker RLE

The types of switchboards described above are provided with a frame of oak veneered laminated wood. The boards employ relays and lamps as calling signals and cord pairs with plugs as connecting devices. 10 lamps and 10 relays are assembled into a line unit. Such a unit consists of a chassis moulded in phenolics carrying relay-jacks, lamps and lenses, fig. 18 left. The cord circuit units are also provided with a chassis moulded in phenolics which carries key, relay, supervisory lamp and terminal clips for cord connection, fig 18 right. Each board also includes a position unit, which contains the common components for the switchboard.

The switching procedure is identical with that which applies for type ADE 1210.

To the switchboard are connected normal C. B. instruments or, if the lines are short, instruments of the domestic type.

Manager's Telephone System

No summary of telephone systems for internal communications would be complete without mentioning *the manager's telephone systems* which lately have been finding an increasing use.

A manager's telephone system consists of a master instrument and a number of sub-instruments and is designed in such a way that the master instrument by a simple operation can call any of the sub-instruments individually or simultaneously, whereas the sub-instruments can call the master station only. The system is thus completely controlled by the person holding the master instrument. The advantage of a manager's telephone system is that it gives a very fast and always available communication between the manager and his nearest collaborators.

The simplest manager's telephone system supplied by LM Ericsson is based on domestic telephone instruments, the master set consisting of an instrument with push button set with 8 buttons, e. g., *DEK 9002* and the sub-sets of instruments with one push button only, e. g., *DEK 9203*. The principal can call any of the connected sub-instruments whereas the latter can call the principal's set only. The capacity of the system is 1 master instrument and 8 sub-instruments.

Another manager's system, which contrary to the system above is made for loudspeaking connection, is based on the loudspeaking intercom system, master instrument *DEL 2301* described above being used as manager's, set and instruments *DEL 1202* as sub-sets. The capacity of the system is 1 master set and 10 sub-sets.

The manager's telephone systems mostly used are, however, the two systems described below and referred to as *conference telephone systems* as they in a very conveniant manner enable conference connection between an arbitrarily number of connected stations. The conversation from the master set can take place either over an ordinary handset or over a desk microphone and loudspeaker.

Fig. 20 X 7390

Sub-instruments for conference telephone system, type AEC

left DEK 1301 for 1 line, centre DEH 2901 for 2 lines and right DEH 2902 for 3 lines

Fig. 21 X 4845

Master station for conference telephone system, type DYA

consisting of telephone instrument DBH 2502 and key base DYA 1025. The master set can be supplemented with loudspeaker RLE 1001 and microphone RLC 1001.

One of the systems which is type-coded *AEC* is provided with a manager's telephone desk as master set whereas the master set in the other system consists of a telephone instrument with a key base *DYA*. The two conference systems may be coordinated and the master sets can also be connected to a private branch exchange or to the public telephone system.

Conference Telephone Systems AEC

A conference telephone system of this type consists of a manager's telephone desk, fig. 19, with calling and answering equipment for 20 or 30 sub-sets as well as a special telephone instrument with an enclosed microphone and a separate loudspeaker to enable loudspeaking communication, and 20 or 30 sub-instruments. The sub-sets, fig 20, are made in different variations for connection to one, two or three master sets. They can also be made for one connection to the manager's desk and one to an ordinary telephone switchboard. The sub-instruments are provided with an indicator giving a remaining signal for unanswered calls from the manager. The sub-sets are connected to the master set over 2 wire lines.

The calls are secret, i.e., a station cannot listen to a conversation unless it is connected in the master set. When connection is established to a sub-set a corresponding lamp is operated in the manager's desk.

A number of stations can, however, be simultaneously connected *in conference* from the manager's desk. These stations then obtain line connection with each other and with the manager's desk.

A sub-set is called from the manager's desk by throwing the key, corresponding to the wanted station, downwards. An intermittent buzzer signal is then transmitted to the receiver in the handset of the called station. If no answer is received the principal is able to transmit a remaining visual signal on the indicator in the called set by moving the key to the upper position. The required person can then see on his return that he is wanted by the manager. The manager's desk is called from the sub-sets by the handset being lifted. A discreet signal is sounded in the manager's desk and the lamp above the corresponding key is operated. The call is answered by throwing the key downwards.

The calls from the manager's desk are normally carried out over the desk microphone and the loudspeaker. As no speech direction key is required, the caller is not tied to the instrument and has both hands free. Persons present in the room can take part in the conversation. If the principal wants to use the handset he has only to lift the handset from the cradle. The microphone as well as the loudspeaker are then automatically disconnected. Return to loudspeaking connection can also take place during the conversation.

The system includes a two-way amplifier mounted in the manager's desk. The power supply is provided from a mains connected power unit.

Conference System, type DYA

This system differs from the above mainly in the construction of the master set. In place of the refined piece of furniture, the manager's desk, the master set in this system consists of a key base with 5, 10 or 15 push buttons, carrying a telephone instrument, fig 21. The master set is generally supplemented with equipment for loudspeaking telephone, i. e., loudspeaker, desk microphone and amplifier. In addition a relay set is required which also includes a buzzer. The sub-instruments are similar to those used in conference system, type AEC, but the indicator is omitted and a button is added.

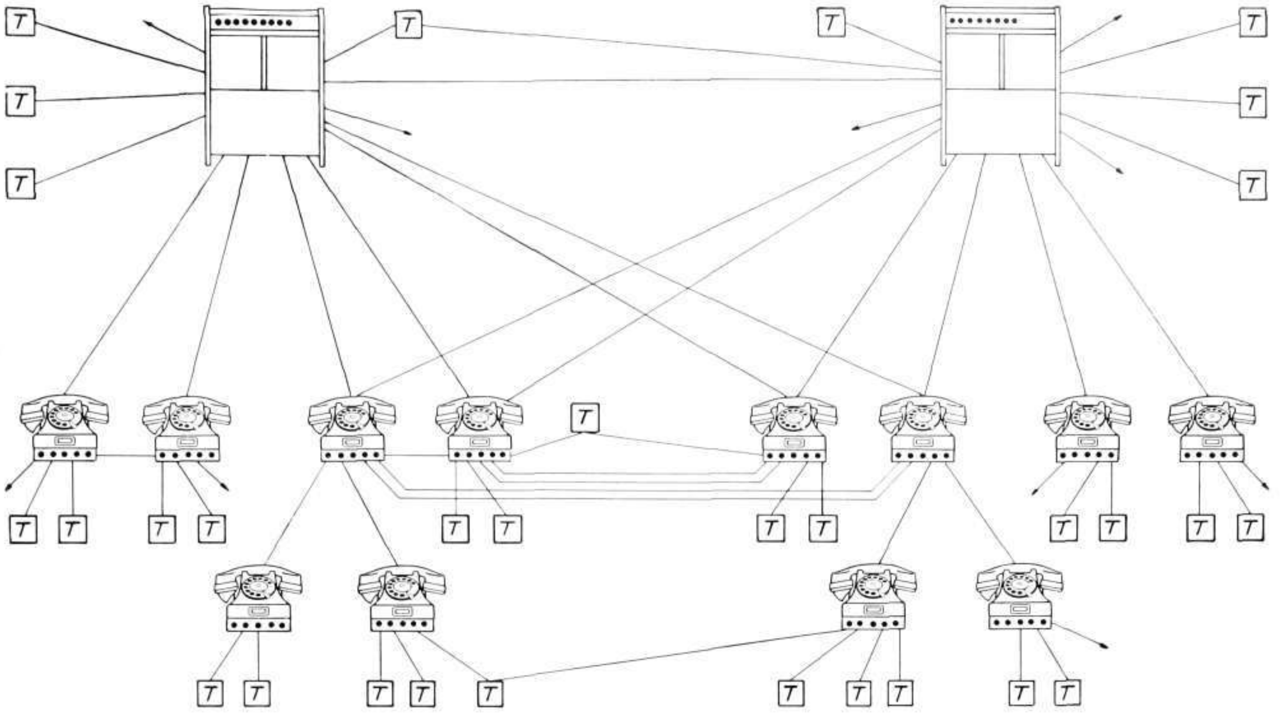


Fig. 22 X 7639

Compound conference telephone system

consisting of 2 manager's telephone desks, type AEC, 12 master sets, type DYA and a large number of various types of sub-instruments (T)

The calls are secret, i. e., a station cannot listen to a conversation unless it has been switched in in the master set. When a station is connected the corresponding lamp in the key base is operated.

A number of stations can, however, be simultaneously connected *in conference* from the master set. These stations can then speak with each other and with the master set.

A sub-set is called by pressing the push button corresponding to the required station. A continuous ringing signal is transmitted as long as the button remains pressed in bottom position. The master set is called from the sub-sets by the handset being lifted and the button on the instrument being pressed momentarily. A call lamp is operated in the master set and a buzzer is sounded. The call is answered by pressing the button in the key base corresponding to the lamp.

If the system is provided with loudspeaker and desk microphone this equipment is used as described for conference system, type AEC.

Compound Conference Telephone-Systems

A very useful form of conference telephone system is a combination of the systems described above. A considerable number of connections can be obtained in this way. The lay-out of such a telephone system often conforms to the main outlines of the organization plan of the enterprise and a typical example is illustrated in fig. *22*. The system consists of two manager's telephone desks with on the one hand immediate sub-sets and on the other hand lines connected to key base stations for the different department managers. The latter have in their turn sub-stations of their own and direct lines to the key bases for other department managers or sub-managers. Several of the sub-instruments may be connected to two manager's desks or two key bases. Conference calls can be established in a great variety of combinations and the persons taking part can be summoned in a few moments.

In view of the fast operation, loudspeaking facilities for all managers and adaptability this type of system offers considerable possibilities in the rationalization of the internal telephone communications in large organizations.

Tesla Quick Tester for Rare Gas Tubes

A HENCKEL, TELEFONAKTIEBOLAGET L M ERICSSON, STOCKHOLM

U.D.C. 621.317.39: 621.316.923

The L M Ericsson tesla quick tester is intended for testing the tightness of rare gas tubes, e.g., types NGC 30—NGC 33, which are used as voltage protectors in fuse boxes, fuse strips, etc. The by far most common faults are cracks in the glass and a tesla quick tester offers, therefore, a quick and simple method of checking the quality of rare gas tubes which is quite adequate for practical purposes.

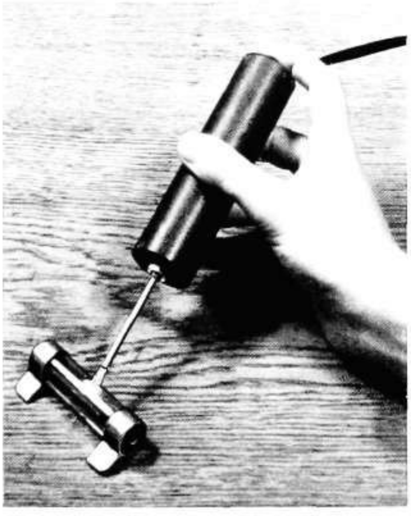


Fig. 1 X 4813
Rare gas tube
checked by tesla quick tester

Construction

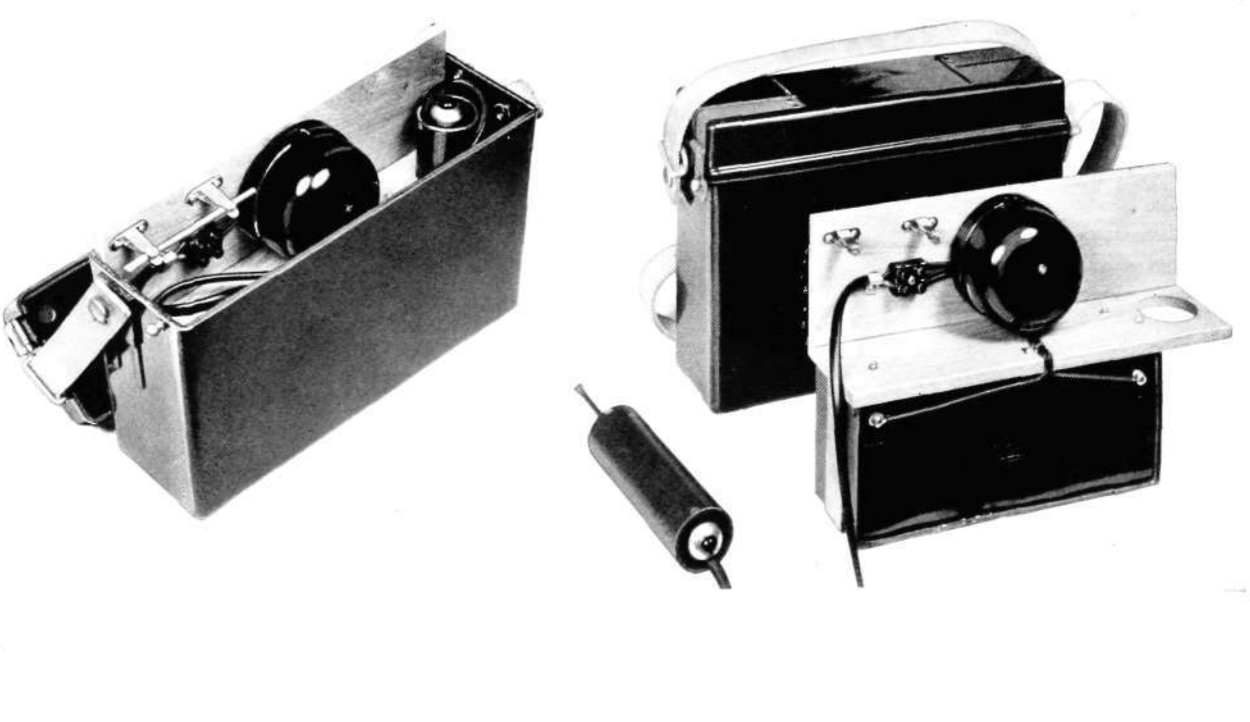
The tesla quick tester *LTP 1752* consists of a tesla transformer, vibrator and battery in a phenolic moulded box provided with shoulder straps. The tesla transformer is enclosed in a tubular case which can be held in one hand. The case is provided with push button for connection of the current and a detachable copper rod with brush electrode. A 1 metre long cable is connecting the case to a vibrator and a 90 V battery mounted on a shelf which can be readily removed from the moulded box.

When testing, the copper rod is inserted in the jack in the tubular case and the brush electrode is brought close to the tube, which is to be tested, keeping the push button pressed. Flash-over takes place at a distance of a few millimeters, fig. 1. If the tube is satisfactory, the gas in the tube becomes luminous. The brush electrode should not be brought into metallic contact with any of the electrodes on the tube, to avoid overloading of the battery.

Function

Fig. 4 shows an oscillator circuit consisting of a capacitor and a coil in parallel. The capacitor is charged from the battery (contact in position *a*) and is discharged through the coil (contact in position *b*). In this way damped oscillations are generated, see fig. 5.

Fig. 2 X 7620
Tesla quick tester LTP 1752
right with tesla transformer, vibrator and battery removed from the box



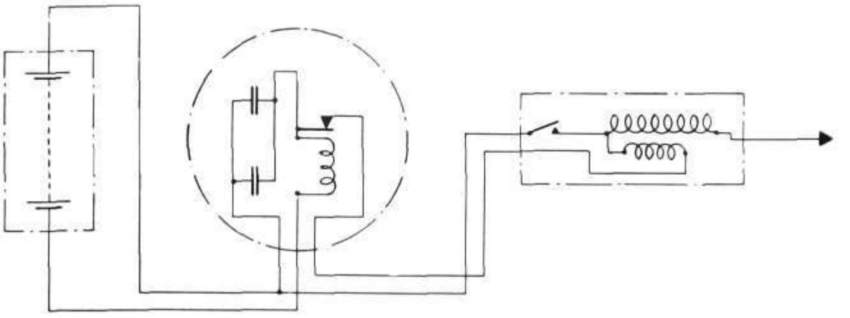


Fig. 3 X 6703

Circuit diagram for tesla quick tester LTP 1752

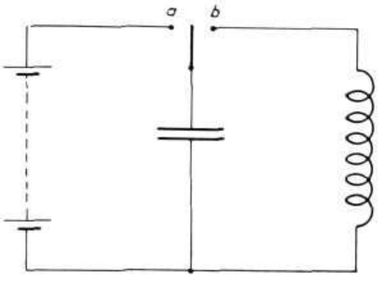


Fig. 4 X 6695

Oscillator circuit

consisting of a capacitor and a coil in parallel

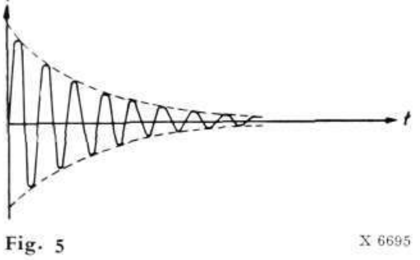


Fig. 5 X 6695

Damped oscillation

obtained by charging and discharging

If the contact is replaced by a vibrator (buzzer) the oscillator circuit can be used for the generation of high frequency oscillations when *L* and *C* have been adjusted to suitable values. The high frequency oscillations may be transferred to another circuit magnetically or electrically.

As shown in fig. 3 the secondary side in the tesla tester *LTP 1752* consists of the secondary side of the transformer the free end of which is terminated with a brush electrode. The components are adjusted in such a way that the primary circuit is tuned in resonance with the secondary side and alternating voltages are generated between the electrode rod and the surroundings sufficiently high to cause brush discharge from the electrode. When the electrode is brought close to an object a spark flashes over to this and remains ignited while the brush electrode is kept near the object. If the object is a vacuum tube the residual gas will become luminous providing the pressure of the gas is sufficiently low as specified. If the gas pressure is increased the luminescence is reduced and will cease altogether when the pressure is approaching athospheric pressure.

The vibrator has a frequency of about 400 c/s and this is the tone which is heard when the tester is in operation. The tester generates a mixed series of frequencies up to the shortwave range. The short circuit current on the output side is 10 mA approx.

It should be mentioned that the voltages generated by the tesla quick tester are of such a nature that they cannot cause injuries to the person using the tester.

New Shockproof Loudspeaker

E LINDSTRÖM, SVENSKA RADIOAKTIEBOLAGET, STOCKHOLM

U.D.C. 621.395.623.7

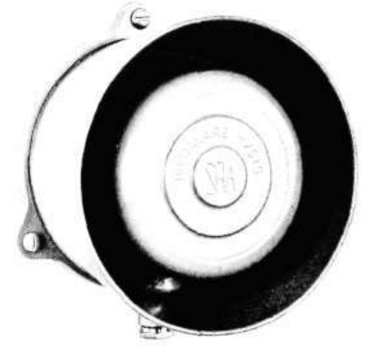


Fig. 1 X 4864
Loudspeaker M/51 S

Svenska Radioaktiebolaget is marketing a new loudspeaker, M/51 S, intended for use where ordinary loudspeakers do not meet special requirements of mechanical strength and resistance to corrosion. M/51 S is principally designed for speech reproduction and is approved by the Swedish Explosives Committee for use in premises where fire and explosion hazards exist. The loudspeaker has thus many applications and can be used, for instance, on ships, in shipyards, mines, flour-mills, munition factories, refineries, marshalling yards, on sports grounds or for military purposes.

The new loudspeaker has a reflex air column horn mounted on a baseplate, both made of a light alloy chemically inert, in particular, to salt water. Further the surface of the horn and the baseplate have a grey semi-glossy finish. The speaker is of robust design and the horn can take an arbitrarily placed load of 100 kg, and a tensile strain of 1.000 kg can be applied between the inner and outer components of the same.

The magnet system is constructed in the conventional manner with anisotropic type of magnet. All steel components are cadmium plated as a protection against corrosion.

The diaphragm is pressed out of a special fabric treated with thermosetting material which, after pressing, is coated in order to close possible pores. As the diaphragm may be exposed to violent variations in pressure, its strength must be of a very high order. The diaphragm will, without damage, withstand accelerations up to 2 000 g, which means that the loudspeaker can be placed at a distance of 4 m from the muzzle of a 15 cm gun oblique to the line of fire. A diaphragm support is fixed on the magnetic core under the diaphragm. This support is shaped similarly to the diaphragm and is placed at a distance of about 1 mm from it. The support limits the inward movement of the diaphragm, when subjected to violent pressure waves. The outward movement on the other hand is limited by the dome in the inner bell.

If the diaphragm should break due to overload, it is easy to replace. The magnet system is then detached from the horn, the old diaphragm is removed —if necessary by a screwdriver—and the new diaphragm is fitted. No soldering is necessary.

The vital parts of the loudspeakers are protected against humidity by means of synthetic rubber seals which are resistant to petrol, oil and salt water.

The speaker is designed for best intelligibility. The maximum permissible power is 15 W and the dispersion some 120°. The average range is about 500 m, but this is of course dependent on the ground and weather conditions and noise level.

Technical data:

Max. power	15 W
Impedance	16 ohms
Frequency range	400—5 000 c/s
Induction	11,000 Gauss
Total flux	54.000 maxwell
External diameter	160 mm
Depth	110 mm
Weight	2.6 kg

Fig. 2 X 4863
Magnet system with diaphragm removed

L M Ericsson Exchanges 1952

During 1952 the following exchanges on the L M Ericsson automatic telephone system with 500-line selectors have been put into service:

town	exchange		number of lines
Argentina			
Buenos Aires	4 PABX		1400
La Banda			500
San Martín			500
Brazil			
Americana			500
Blumenau		(extension)	500
Nova Friburgo			500
Colombia			
Bogotá	Centro	(extension)	3000
Bogotá	Chapinero	(extension)	2000
Bogotá	Teusaquillo	(extension)	1000
Ibagué		(extension)	500
Manizales		(extension)	500
Neiva		(extension)	1000
Denmark			
Copenhagen	1 PABX		800
Finland			
Harjavalta			350
Helsinki	1 PABX		200
Jokioinen			300
Karhula			1000
Kotka			3500
Pori		(extension)	500
Tampere		(extension)	2000
Turku		(extension)	4000
Vaasa		(extension)	1500
Island			
Reykjavik		(extension)	1000
Italy			
Abano		(extension)	100
Acireale		(extension)	260
Asti		(extension)	300
Bari		(extension)	1500
Benevento		(extension)	260
Bergamo		(extension)	1000
Brescia		(extension)	1500
Canicattì			500
Caserta			500
Cremona		(extension)	1000
Este			500
Ferrania	1 PABX	(extension)	40
Mantova		(extension)	500
Messina		(extension)	500
Modica			500
Napoli	Vomero II		3000
Novara		(extension)	1000
Novi Ligure		(extension)	300
Ovada		(extension)	100
Padova		(extension)	1500
Potenza		(extension)	260
Salerno		(extension)	500
Siracusa		(extension)	500
Venezia	Centro	(extension)	1000
Venezia	Lido	(extension)	500
Verona		(extension)	2000
Libia			
Bengasi			500
Mexico			
México D. F.	Mixcoac	(extension)	500
México D. F.	San Angel	(extension)	500
México D. F.	Victoria	(extension)	1500
Netherlands			
Rotterdam	Centrum	(extension)	3000
Rotterdam	West	(extension)	500
Rotterdam	1 CABX		460
Rotterdam	1 PABX		400
Rotterdam	2 PABX	(extension)	360
Norway			
Arendal		(extension)	1000
Kristiansand		(extension)	500
Kristiansund		(extension)	500
Larvik		(extension)	1500
Porsgrunn			2500
Skien			4000
Peru			
Cuzco			1000
Poland			
Katowice	16 PABX		5120
Sweden			
Enköping		(extension)	1000
Gothenburg	Hisingen	(extension)	4000
Gothenburg	Kålltorp	(extension)	3000
Gothenburg	Masthugget	(extension)	5000
Gothenburg	Askim	(extension)	500
Gothenburg	Tranared	(extension)	1000
Gothenburg	3 PABX		540
Gothenburg	8 PABX	(extension)	660
Gävle		(extension)	500
Hagfors		(extension)	500
Kalmar		(extension)	1500
Katrineholm			4000
Klippan			2000
Kristianstad		(extension)	1500
Ludvika			4000
Lund		(extension)	1000
Norrtälje			3000

town	exchange		number of lines
Stockholm	Högalid	(extension)	1000
Stockholm	Södra Vasa	(extension)	1000
Stockholm	Östermalm	(extension)	1000
Stockholm	Aspudden	(extension)	3000
Stockholm	Farsta		10000
Stockholm	Spånga	(extension)	1000
Stockholm	Tureberg	(extension)	1000
Stockholm	Velamsund	(extension)	500
Stockholm	Vendelsö		1000
Stockholm	Viggbyholm	(extension)	1000
Stockholm	Ängby	(extension)	5000
Stockholm	Örby	(extension)	3000
Stockholm	4 PABX		1960
Stockholm	10 PABX	(extension)	770
Trollhättan		(extension)	1500
Tumba		(extension)	400
Uddevalla		(extension)	1000
Ulricehamn			2500
Västervik		(extension)	1000
Åmål			2000
Various places	9 PABX		1890
Various places	15 PABX	(extension)	620
Turkey			
Eskişehir			2500
Istanbul	Kadiköy		3000
Union of South Africa			
Johannesburg	1 PABX		200
Cape Town	3 PABX	(extension)	140
		Total	152190

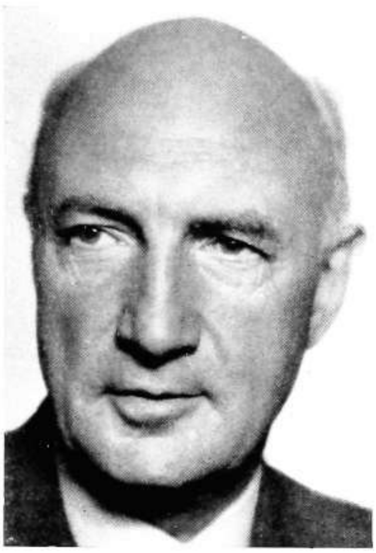
During 1952 the following exchanges and switchboards with 100-, 25- and 12-line selectors have been delivered. Extensions to existing plants are not included in the figures.

	number	number of lines
Exchanges with 100-line selectors	13	5360
Switchboards with 100-line selectors, system AHD	294	23362
Switchboards with 25- and 12-line selectors, system OL	752	18024
Total	1059	46746

NEWS *from All Quarters of the World*

Management Changes at LME

Helge Ericson, Chairman of the Board
Sven Ture Åberg, President



Helge Ericson

Sven Ture Åberg

Certain changes were made in the Board of Directors of Telefonaktiebolaget L M Ericsson at the Annual General Meeting this year. Mr. Waldemar Borgquist resigned from his chairmanship of the Board, in which position he has been succeeded by Mr. Helge Ericson. Mr. Sven Ture Åberg was appointed President of the Company. Mr. Åberg has previously held the position of Vice-President in charge of Sales.

At this meeting Mr. Hemming Johansson resigned from the Board, of which he has been a member since 1903.

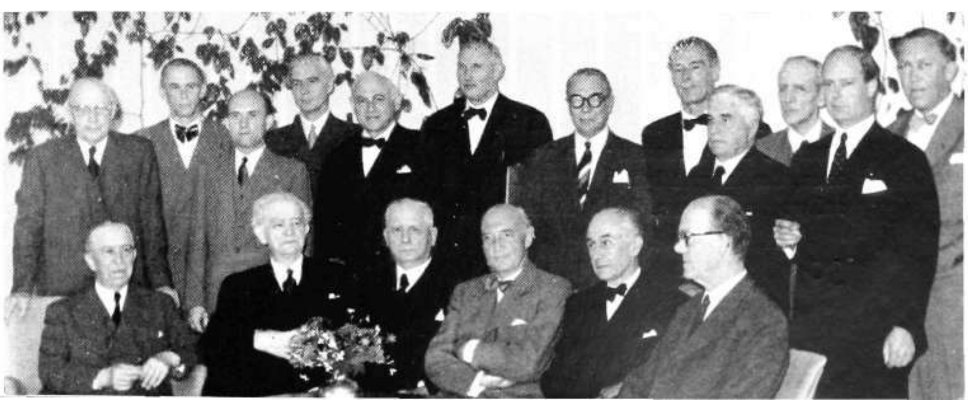
Mr. Nils Sterner, Senior Vice-President, will continue to manage the Company's interests in the Western Hemisphere, and Mr. Hans Thorelli, Senior Vice-President, will, as previously, be in charge of the industrial activities of the Parent Company.

Mr. Waldemar Borgquist proposed a vote of thanks to Mr. Hemming Johansson for his long and valued services as President of the Company and subsequently Member of the Board during a period of fifty years. Mr. Borgquist furthermore thanked Mr. Helge Ericson for his admirable management of the Company during the last ten years. Mr. Marcus Wallenberg, Senior Vice-Chairman of the Board, expressed the gratitude of the Board and of the Company to Mr. Borgquist for his able and unifying leadership manifested during his twenty years as Chairman.

The retiring Head of L M Ericsson has exercised the management of the entire Group since 1942. Mr. Ericson's great experience and insight will remain at the service of the Company when he now becomes Chairman of the Board of Directors.

The new President, Mr. Sven Ture Åberg, was born in 1903. He graduated at the Institute of Technology in 1927 and has been associated with LM Ericsson since that time. For many years he worked with LME enterprises abroad — in Europe, Asia and South America. From 1936—1940 Mr. Åberg represented L M Ericsson in U. S. A., and from 1940—1946 he acted as President of Ericsson Telephone Sales Corporation in New York and Vice-President of Teleric Inc. From 1946 onwards he has been stationed in Sweden as Vice-President of Sales for the LME Group.

In the upper photograph Mr. Helge Ericson is seen presenting the Company's Gold Plaque to Mr. Marcus Wallenberg, who for 20 years has acted as Chairman of the Finance Committee of the Board. Below: the Board and Management of Telefonaktiebolaget L M Ericsson after the Annual General Meeting. Left to right, sitting: W Johnsson, H Johansson, W Borgquist, Helge Ericson (Chairman), H Thorelli (Senior Vice-President), K Kåell; standing: B Wahlqvist, S T Åberg (President), O Hult, W Söderman, S Häggberg, M Wallenberg, E Browaldh, S Salmonson, S Rudberg, C Montelius, H Ohlin, H Lindberg.



Expansion of Sales Organization in Indonesia

The growth of the Ericsson Telephone Sales Corporation AB in Bandung has taken place at a rapid rate. A year ago the staff comprised one Swede and seven Indonesians, but the workshops and office now employ some 40 persons, and this number will soon be increased.

A short time ago the L M representation in Indonesia was extended by a further office in Djakarta. Djakarta previously had 400 000 inhabitants, but since becoming the capital of the Indonesian republic its population has grown to 2½ millions. The LM Office is situated on the road to the Gunug-Sahri airfield.

Extensive telephone development is at present in progress in Djakarta. It is estimated that an automatic exchange will soon be put into service constructed specially for the benefit of Government Departments and Administrative Offices. At the same time work is being done on modernizing older LM exchanges, which are still giving good service in spite of their age. The Kota exchange, which serves the business quarter, was constructed in 1912, and the Harbour Exchange, Tandjong-Priok, was opened in the same year. The Djati-Negara exchange in the residential district was put into service in 1918. The Gambir main exchange, in the centre of the city, was completed seven years later. All these are manual exchanges and are now being modernized throughout, while the number of junction lines is at the same time being increased.

New Projects for L M Ericsson in Turkey

Important new developments are at present being undertaken by L M Ericsson in Turkey. Automatic exchanges comprising altogether 13 500 lines are being installed in eleven Anatolian towns. All exchanges are being equipped with 500-line selectors with crossbar registers. The exchanges are spread over a very large area, the largest being on the Bagdad railway at Adana. This town lies 30 miles from the mouth of the navigable Seihund river, and is the centre of the cotton trade. It will comprise 3 500 lines. In the towns of Samsun, Konya, Trabzon and Iskenderum exchanges are being built of 1 500 lines each, and at Kayseri and Mersin of 1 000 lines each. Ceykan, Antakaya, Erzerum and Tarsus will have exchanges of 500 lines each.

New Orders and Deliveries

L M Ericsson has received orders for two automatic telephone exchanges and associated networks for installation in the Brazilian town of Campos do Jordão, 90 miles north-east of São Paulo. The exchanges will be equipped with 500-line selectors. The largest of them, Aberneissia, will be constructed for 1 000 lines, the other, Emilio Ribas, for 500 lines.

A 2 500 line automatic exchange, also operating on 500-line selectors, was recently delivered by L M Ericsson to another town near São Paulo, Ribeirão Preto, which is the centre of a large coffee-growing district. An order for extension of this exchange by a further 2 000 lines has already been received.

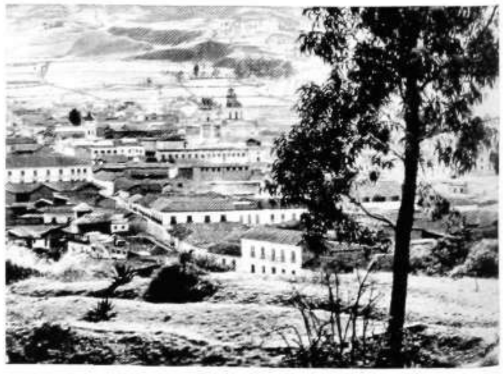
In Colombia, an L M Ericsson automatic exchange of 1 500 lines was opened at Pasto at the end of April. Pasto lies high up in the Andes, in the southern part of Colombia, at 2 600 metres above sea level. L M Ericsson was also entrusted with the installation of the town's telephone network.

At Arica, in the extreme north of Chile — and at the same time the port for Bolivia — telephone traffic has since the end of April been operated by an L M Ericsson 500-line selector automatic exchange. The exchange has a capacity of 500 lines, and L M Ericsson's installation also comprises the associated network.

The automatic exchange in Åbo, Finland, is to be extended by 2 000 lines. L M Ericsson has also received an order from Finland for crossbar exchanges.

A 1 000-line crossbar exchange is to be supplied by L M Ericsson to Zagreb in Jugoslavia.

View of Pasto.



Burglar Alarm Installation for National Bank of Belgium

Quite recently a burglar alarm plant of L M Ericsson's make has been installed at the Banque Nationale in Brussels. The plant, which serves both the Head Office and the Note Printing Establishment, comprises photoelectric cell equipment and vibration contacts, and throughout the Head Office a sound detector system has been installed which, when the bank is closed, enables the least sound to be heard over a loudspeaker. At the cash desks there are alarm contacts, for operation both by foot and hand, which enable the cashier to call for help in the event of an assault.

The photocell equipment and other alarm contacts operate in conjunction with central equipment that is connected to the police. Thus an alarm is sent automatically to the Police Station. By means of the central equipment indications are also given of the opening and closing of doors to certain rooms.

One of the first nights after the sound detector system had been installed, a leak occurred in a water pipe. The sound of the drops was picked up in the loudspeaker, and personnel were immediately sent to shut off the water supply, thus preventing damage from being done.

Swedish Exhibition in Bogotá

On the initiative of the Swedish Minister in Bogotá, Mr. B. Eng, and with the cooperation of the Swedish Institute in Stockholm, a Swedish exhibition was arranged in Bogotá in December, 1952. The exhibition included Swedish pottery, glass, furniture and textiles, and as a background to the exhibits there was a photographic display of Swedish industrial enterprise, in which L M Ericsson was represented.

The exhibition lasted a fortnight and was visited by about 12 500 people. During the whole period of the exhibition the Radio National devoted ten minutes a day to talks on the Swedish enterprises represented and their production. A number of Swedish films were also shown.

The L M Ericsson stand at the Bogotá exhibition. A photographic display was shown of different L M workshops. The exhibition was visited by about 12 500 persons.

L M E in Canada

In Sherbrooke Street, the main thoroughfare of Montreal, L M Ericsson have opened a new office in an old merchant house. Before the move the building was rebuilt and modernized to make better use of the available accommodation. The head of the Canadian Office is Mr. Eric Kühn, and his second-in-command is Mr. Eilert Sundt, previously of Elektrisk Bureau in Oslo.

The office is located in the building seen in the centre of the photograph above.

Help to Dutch Flood Victims from L M Companies and their Staffs

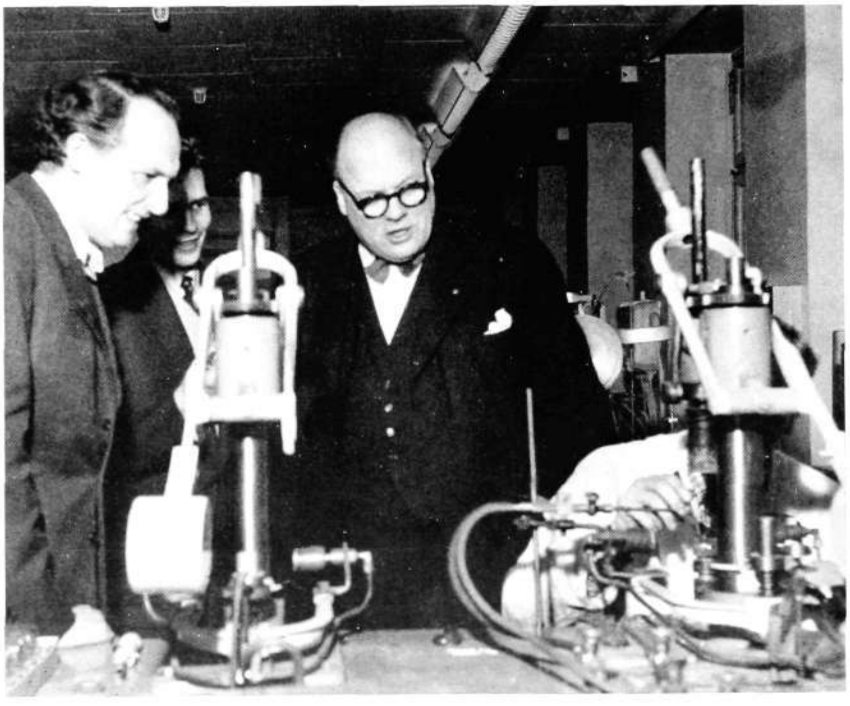
At the time of the disastrous floods in Holland at the beginning of February, collections were arranged at the various L M enterprises to help the Dutch people in their distress. Clothes collection centres were organized, and at the Midsommarkransen Factory alone several lorry loads of garments were sent to the Swedish Red Cross for distribution to the flood victims.

Above: The telephone exchange in Stellendam, one wall of which was destroyed by the floods. Right: Some of the clothes parcels collected at L M Ericsson.

In addition, an amount of over 65 000 kronor was presented by Ericsson companies and their staffs.

Hospital Installation in Brazil

Orders have been received for L M Ericsson telephone and telesignalling plants to be installed at the Instituto de Aposentadoria e Pensoes dos Comerciários. The hospital, which possesses 300 beds, is being equipped with a centralized radio system with *headset and programme selector* at each bed. Patients have the choice of three different programmes. Secondary clocks are also being installed in every corridor and office, and a private automatic exchange for 50 extensions is being used for internal communication.



Visit to L M Ericsson by Technicians of Swedish Board of Telegraphs

Representatives of the Technical Bureau of the Swedish Board of Telegraphs, with Mr. Sven Nordström at their head, recently paid a visit to the Development Department at L M Ericsson's Head Factory, where they were given the opportunity of studying a number of new devices. Mr. Nordström is here seen with two Ericsson engineers—Mr. Malte Patricks (left) and Mr. Olaf Sternbeck (rear)—studying the manufacture of tube bases for trochotrones in the Electron Tube Laboratory.

U.D.C. 656.254.155.4(485): 621.395.34

LINDEROTH, M: *Automatic Operation of Swedish Railway Telephone Systems*. Ericsson Rev. 30 (1953) No. 1 pp. 2—12.

In the process of rationalization of the railway telephone the conversion to automatic operation is an important part. In the article some general considerations on the automatization of the railway telephone traffic are given together with an account of the automatic telephone systems used by the Swedish State Railways.

U.D.C. 621.395.2

SIEWERT, O: *Modern Telephone Systems for Internal Communications*. Ericsson Rev. 30 (1953) No. 1 pp. 13—23.

In recent years a number of new telephone systems for internal communication have been introduced on the market by Telefonaktiebolaget L M Ericsson. In the article a comparison is made of the different telephone systems and their traffic properties in order to facilitate the selection of a suitable system.

U.D.C. 621.317.39:621.316.923

HENCKEL. A: *Tesla Quick Tester for Rare Gas Tubes*. Ericsson Rev. 30 (1953) No. 1 pp. 24—25.

Brief description of the L M Ericsson tesla quick tester intended for a quick and simple checking of rare gas tubes, types NGC 30 — NGC 33, which are used as voltage protectors in fuse boxes, fuse strips, etc.

U.D.C. 621.395.623.7

LINDSTRÖM, E: *New Shockproof Loudspeaker*. Ericsson Rev. 30 (1953) No. 1 p. 26.

Svenska Radioaktiebolaget is marketing a new loudspeaker, M/51 S, intended for use where ordinary loudspeakers do not meet special requirements of mechanical strength and resistance to corrosion. A brief description of the new loudspeaker, which can be used, for instance, on ships, in shipyards, mines, marshalling yards, sports grounds or for military purposes.

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CONTENTS

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.

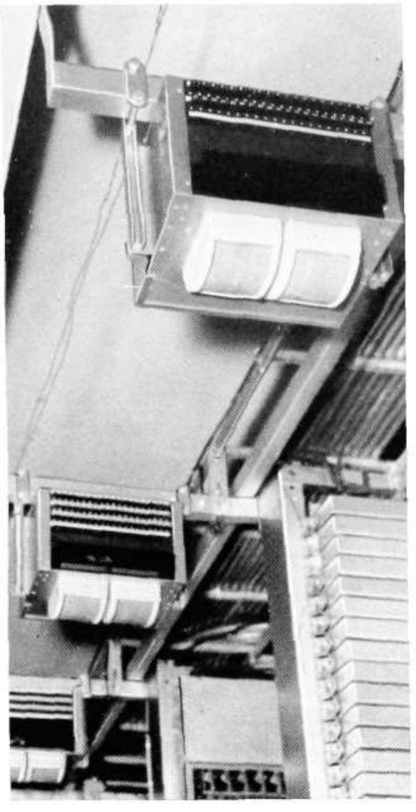


Fig. 1 X 6734

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.

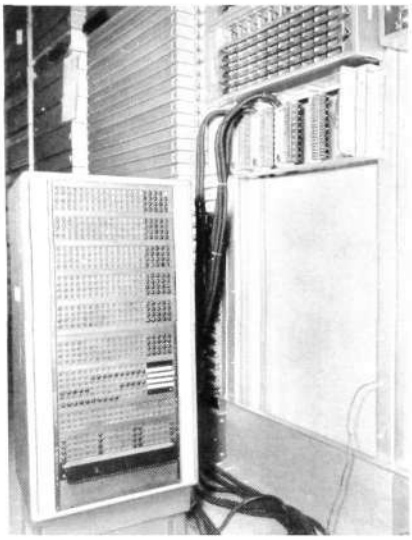


Fig. 4 X 4886
Lamp panel
connected to a subscriber stage group

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.

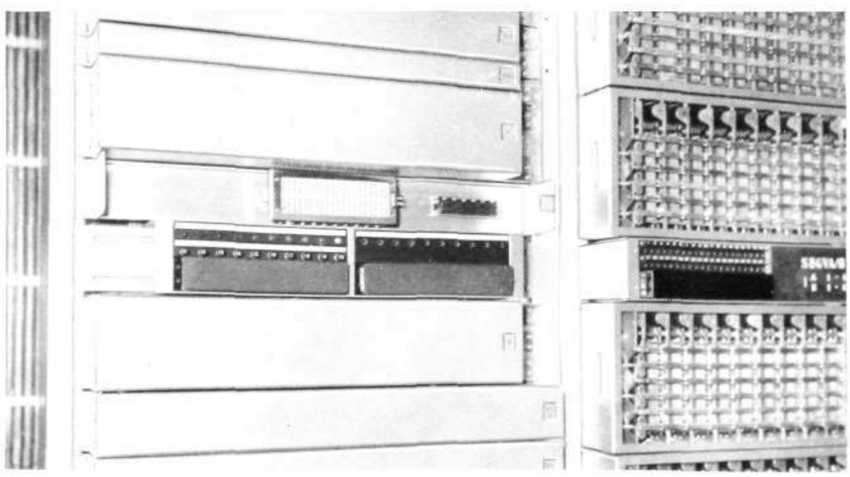


Fig. 5 X 6730
Occupation indicator
connected to a first group selector rack

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.

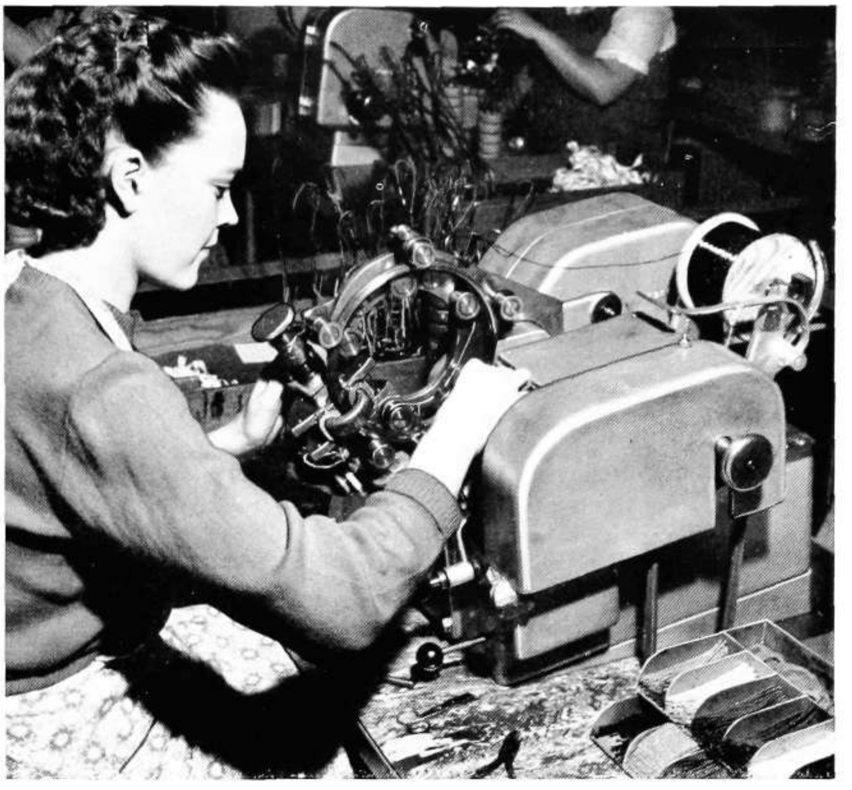


Fig. 2 X 6733
Toroidal winding machine for loading coils

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.

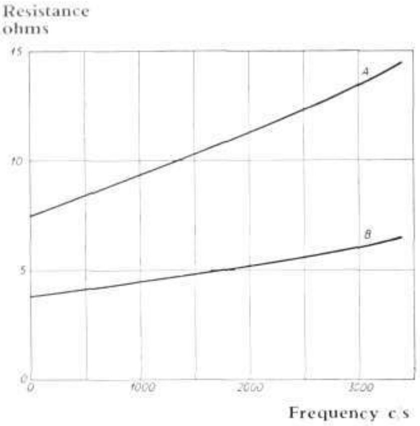


Fig. 3 X 4867

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

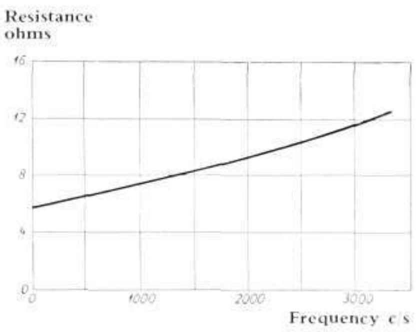


Fig. 4 X 4868

Resistance/frequency characteristic for a side circuit coil grade 2

Inductance	132 mH
Measuring current	1 mA

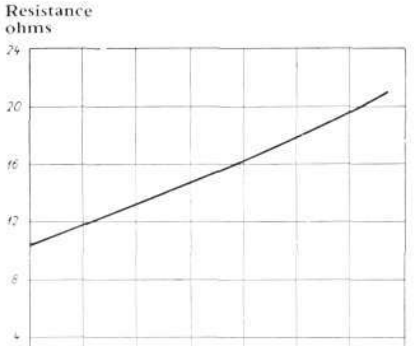


Fig. 5 X 4869

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.

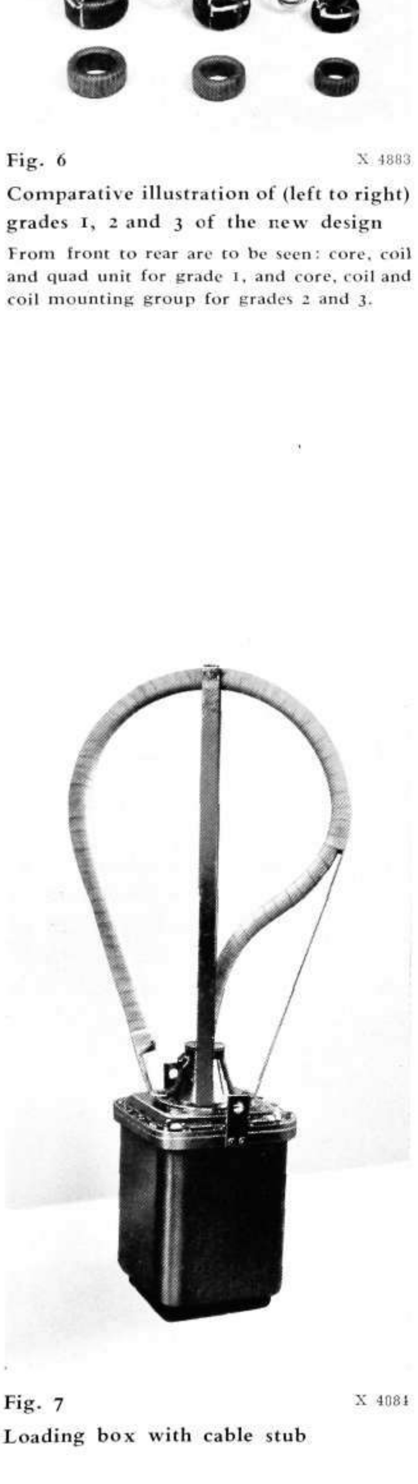


Fig. 7 X 4084

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.

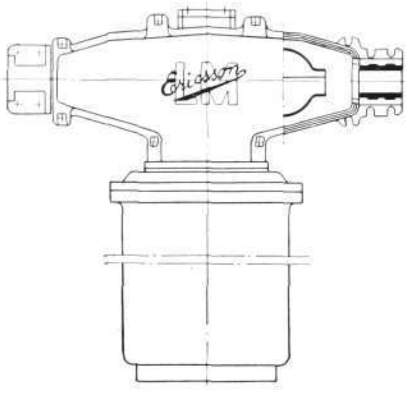


Fig. 8 X 4872

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, crosstalk 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.

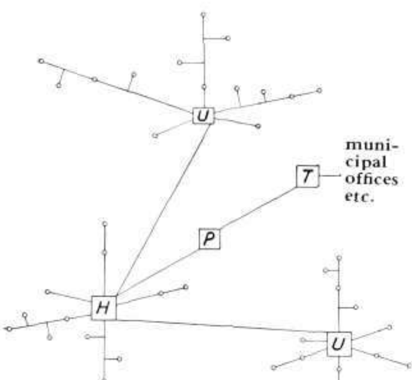


Fig. 1 X 4887

Layout of emergency telephone system

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

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.

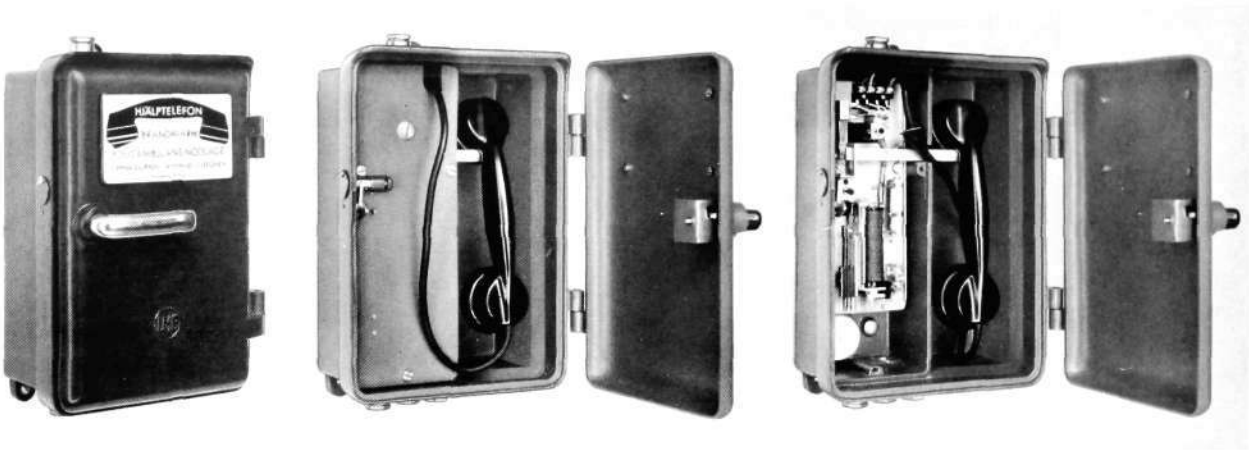


Fig. 2 X 7641

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.

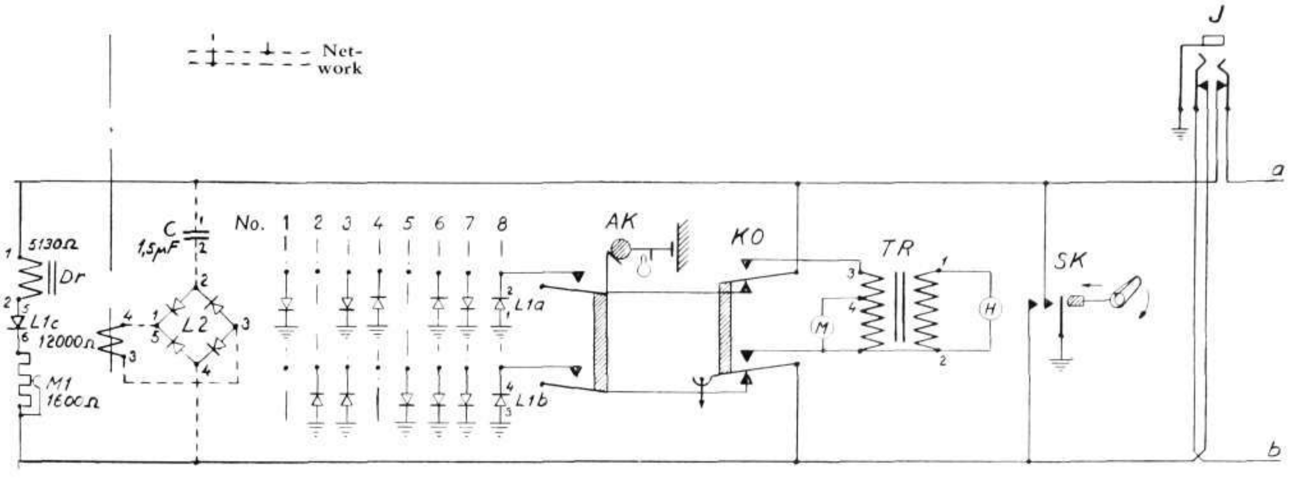


Fig. 3 X 7640

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

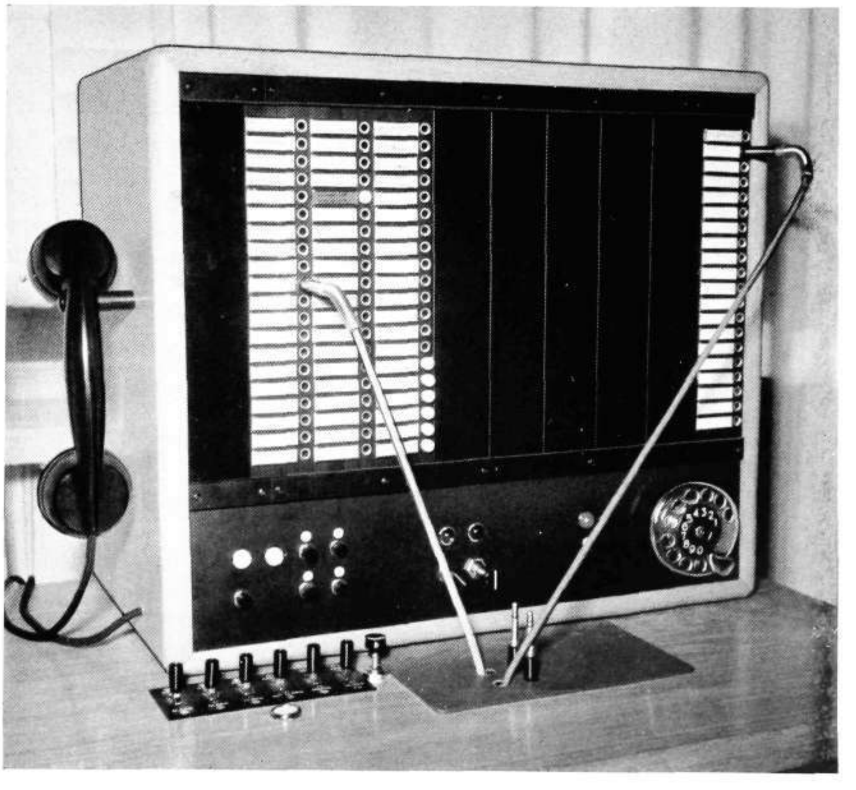


Fig. 4 X 6735

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.

Fig. 5 X 4888
Time recorder

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.

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.

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.

Fig. 6 X 4889
Tape recorder

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

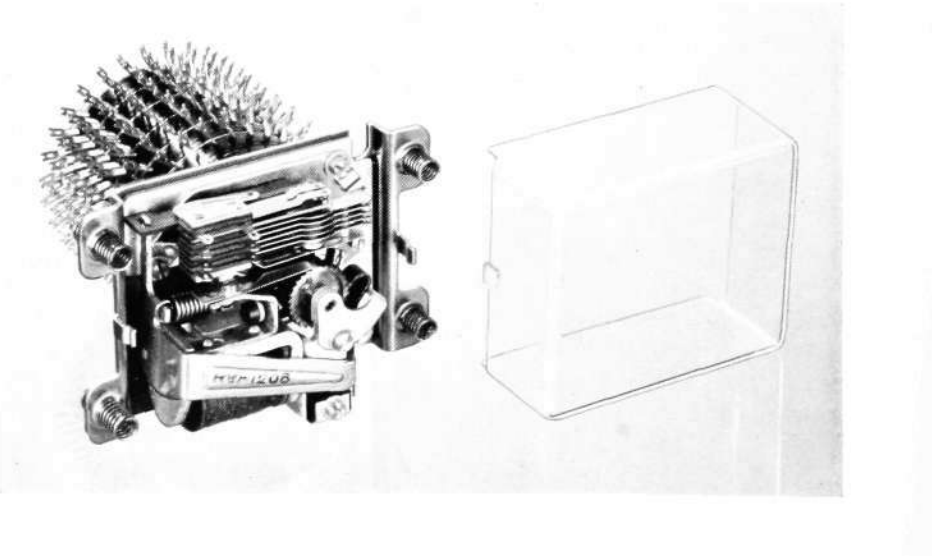


Fig. 1 X 6725

30-line selector, viewed from the mechanism end

Right plastic cover

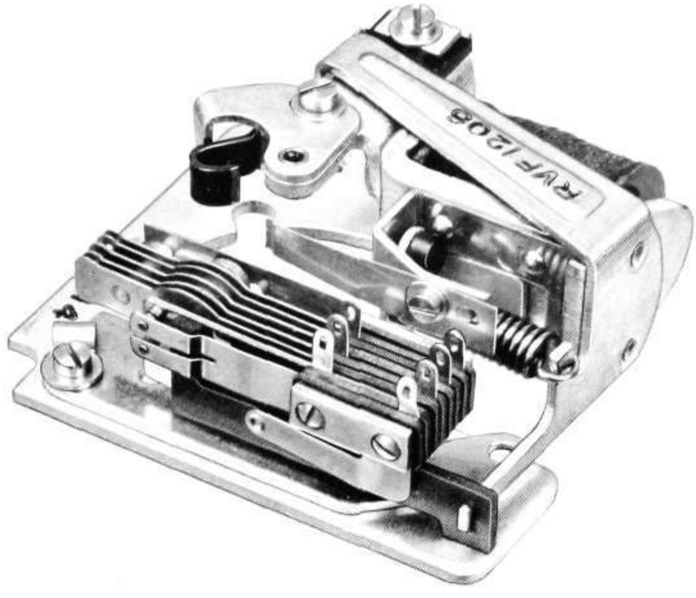


Fig. 2 X 6726

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.

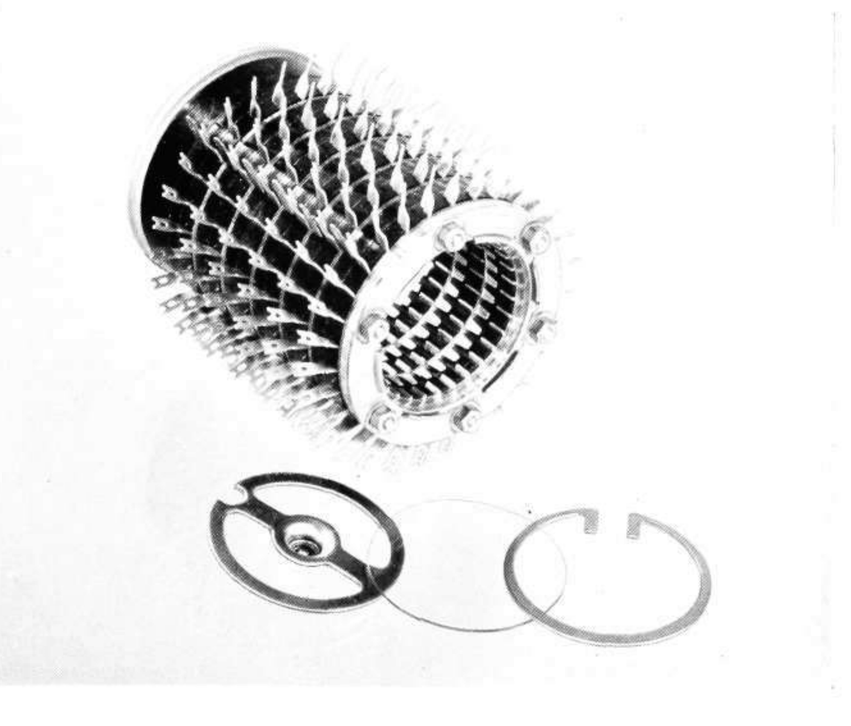


Fig. 3 X 6727

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

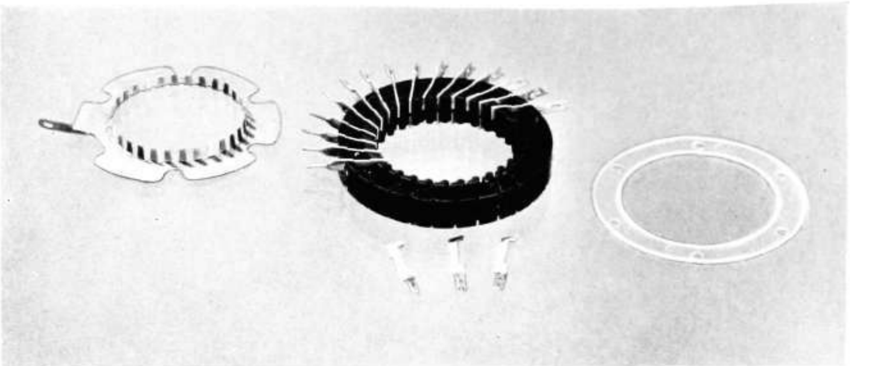


Fig. 4 X 6728

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

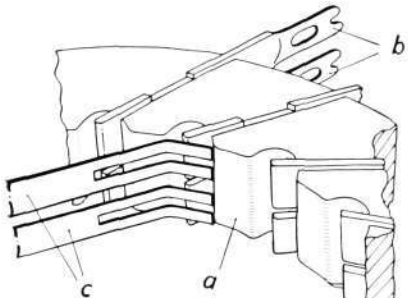


Fig. 5 X 4871

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

a multiple ring
b contact plate
c wiper spring

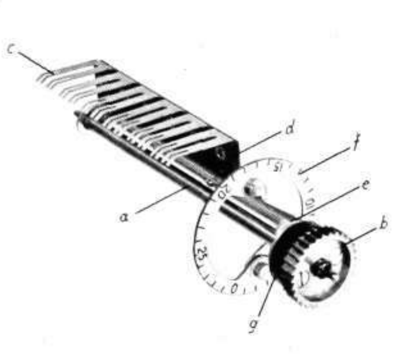


Fig. 6 X 4879

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

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.

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.

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.

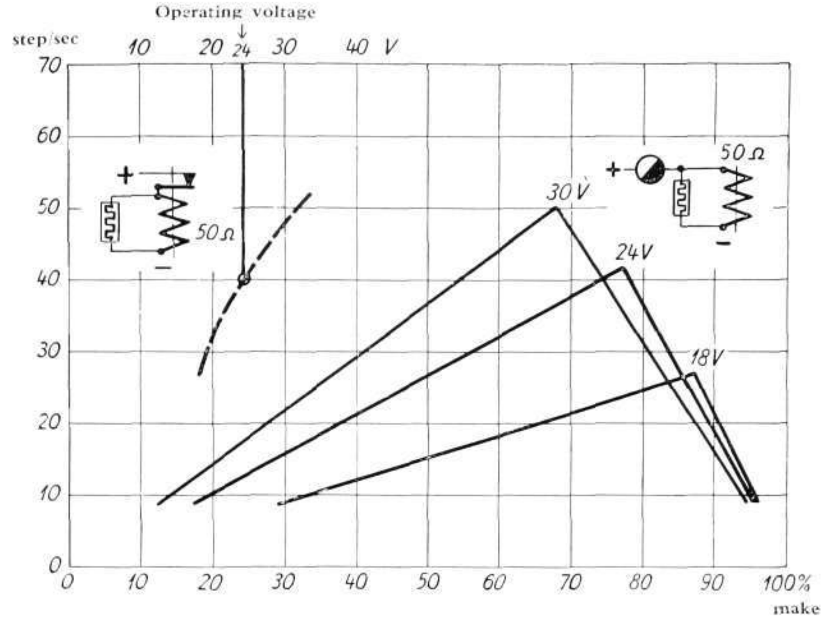


Fig. 7 X 6731

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

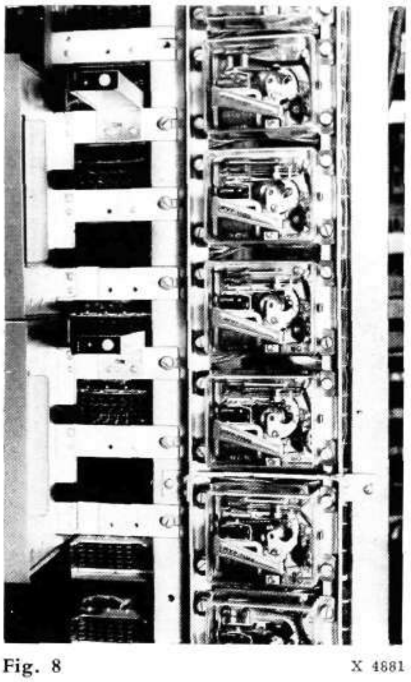


Fig. 8 X 4881

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.

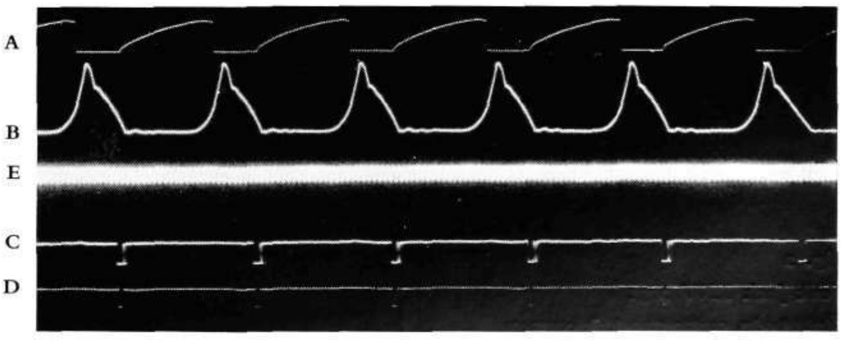


Fig. 9 X 6722

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.

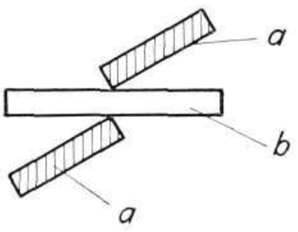


Fig. 1 X 4870

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

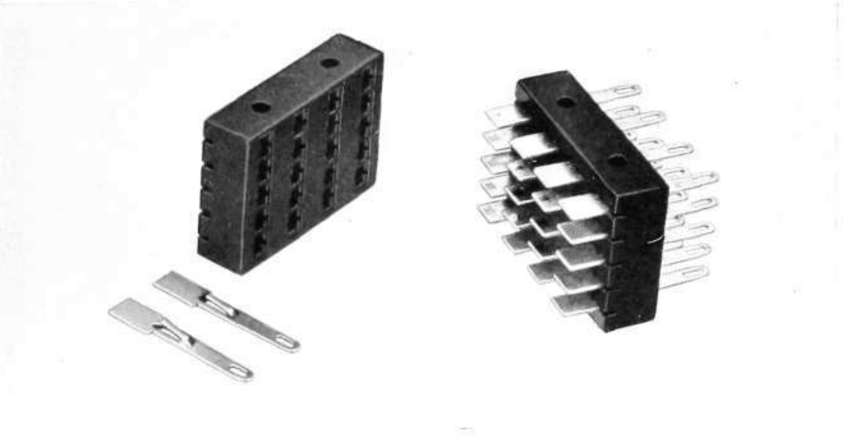


Fig. 3 X 6724

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.

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.

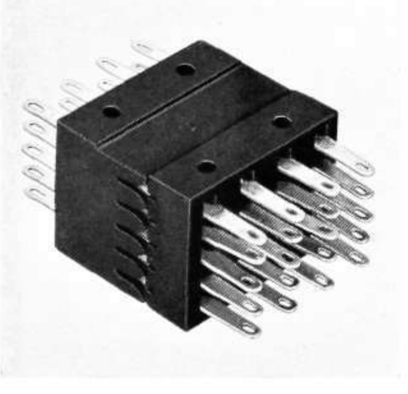


Fig. 4 X 4875

Coupled plug and jack

Left fork jack RNV 2051, right pin plug RPV 2051

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.

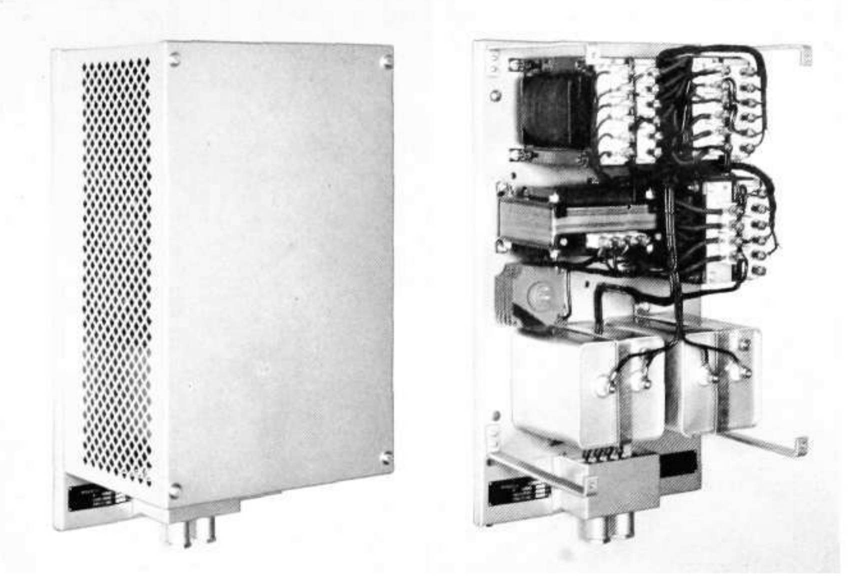
On electrified railways the rails are used as common conductors both for the signalling current and the traction current. The signal-receiving relay, which is known as the track relay, must be constructed or connected in such a way that it is not actuated by the traction current but by the signalling 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 16²/₃ 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



X 6721

Fig. 1
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 $^5/_3$, $^7/_2$, $^9/_3$, $^{11}/_3$, $^{13}/_3$, $^{15}/_3$, $^{17}/_3$, $^{19}/_3$, $^{21}/_3$, 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.

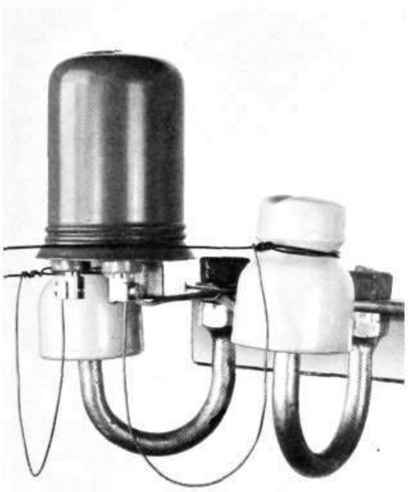


Fig. 1 X 4876
Protector NFA 2012

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

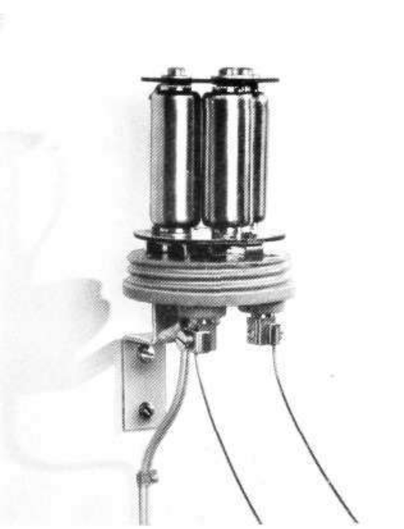


Fig. 2 X 4877
Protector NFA 2013
with hood removed

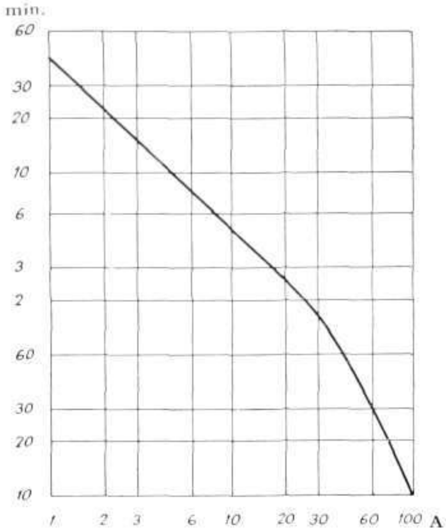


Fig. 3 X 4874

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

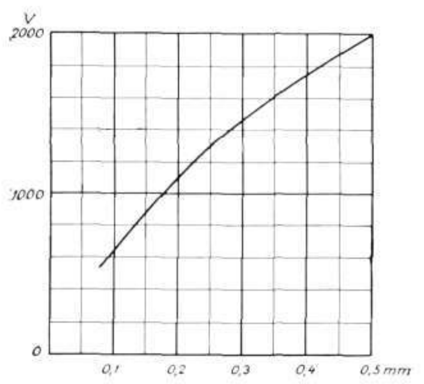


Fig. 4 X 4873

Operating voltage as a function of the electrode spacing

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.

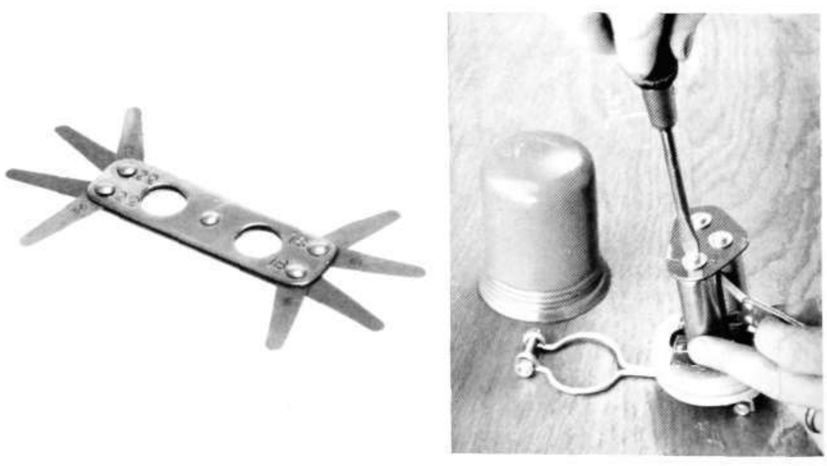


Fig. 5 X 6736

Feeler gauge LMT 1011

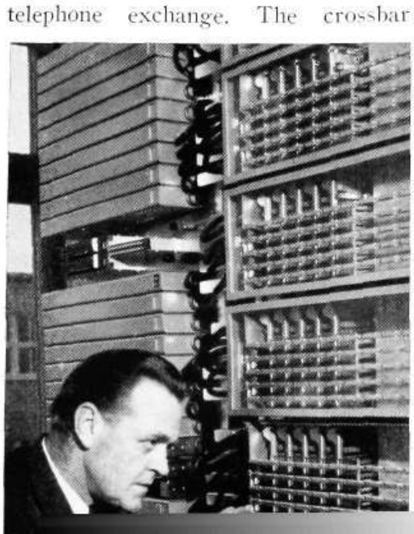
left: with all 8 blades extended; right: in use for adjusting the spark gap in protector NFA 2014

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.

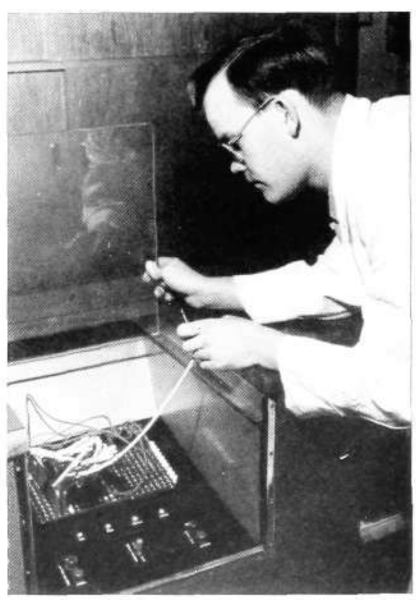
Left: The crossbar switch panel of the calculating punch. Right: the coupling panel in the sensing and punching register.

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

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.

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.

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.

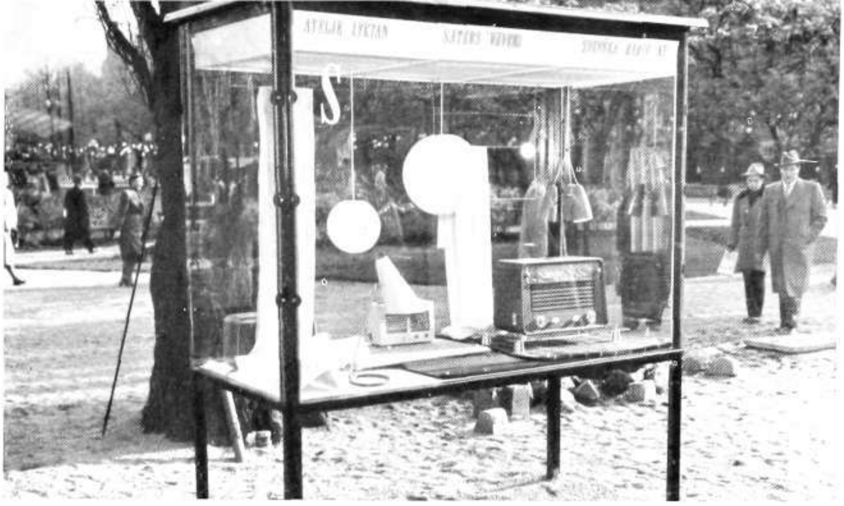
Colombia is primarily an agricultural country and is at present at a stage of rapid development. The interest of the government in various kinds of improvement is seen in their extensive planning policy in the spheres of culture and industry alike. A number of factories have grown up and given work to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

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

Stockholm's 700th Anniversary

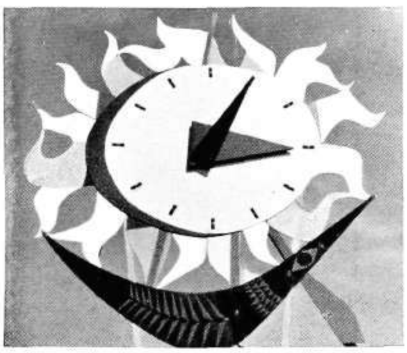
SRA at Jubilee Exhibition



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

L M Ericsson A/S *København V*, Trommesalen 5, tel: C 3438, tgm: ericsson-københavn

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

Argentina

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

Canada

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

AUSTRALIA & OCEANIA

Australia

L M Ericsson Telephone Co. Pty. Ltd. *Melbourne C 1 (Victoria)*, Kelvin Hall 55 Collins Place, tel: Cen. 5646, tgm: ericmel-melbourne

AGENCIES

EUROPE

Belgique

Électricité et Mécanique Suédoises *Bruxelles*, 56 Rue de Stassart, tel: 11 14 16, tgm: electrosuede-bruxelles

Grèce

»ETEP», S. A. Commerciale & Technique *Athènes*, 41 Rue W. Churchill, tel: 31 211, tgm: aeter-athenes

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

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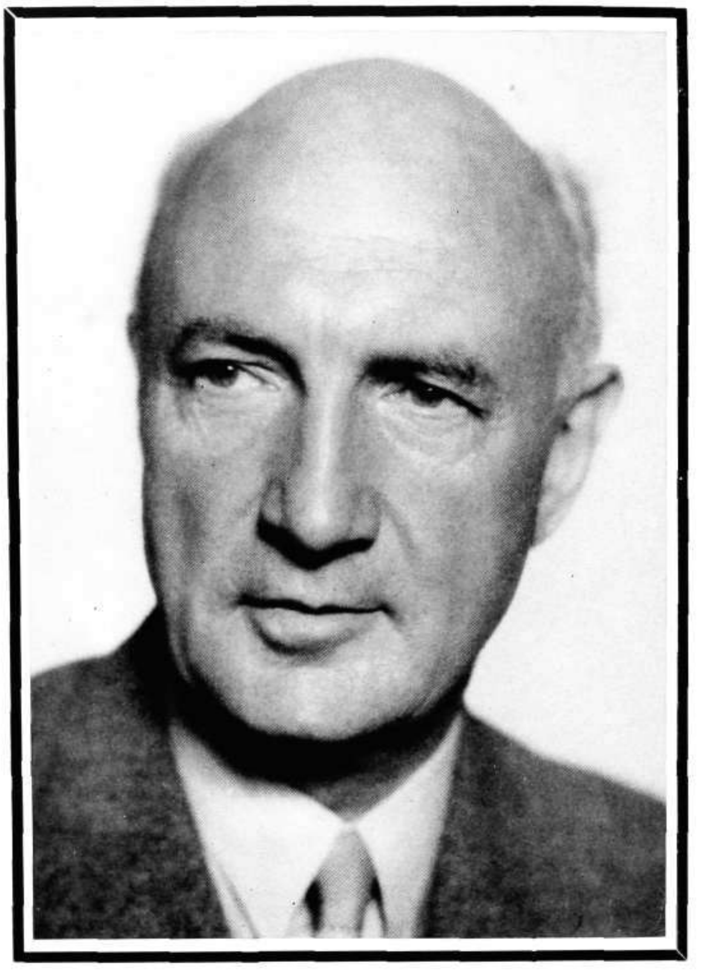
On cover: The new Ericsson table radio receiver Klockett automatically connects a desired program at the proper time.



HELGE ERICSON

** 16/3 1890 † 14/8 1953*

The Chairman of the Board of Directors of Telefonaktiebolaget L M Ericsson, Helge Ericson, died on August 14, 1953, in Stockholm.

Helge Ericson graduated from the Stockholm College of Technology in 1912 and in the following year entered the Swedish Telegraphs. In 1918 he was promoted to Superintending Lines Engineer and in 1920 to First Engineer of Division in the Board of Telegraphs. In 1928 he moved to Telefonaktiebolaget L M Ericsson as head of its Concessions Department. On July 1, 1930, he returned to the Swedish Telegraphs and was appointed Director of the Nynäshamn Workshops. As from January 1, 1939, he took over the leadership of the Swedish Telegraphs in the capacity of Director General. On October 1, 1942, he was nominated President of Telefonaktiebolaget L M Ericsson and held that office until June 9, 1953, when he was appointed Chairman of the Board.

IN MEMORIAM

When Helge Ericson passed away on August 14 this year, he left behind him—from the human standpoint all too prematurely—a sphere of work to which he had made a notable contribution.

At the time of his taking over the presidency of Telefonaktiebolaget L M Ericsson on October 1, 1942, Helge Ericson could look back over 30 years of successful work devoted exclusively to different branches of telephony. The rich experience he had gained during that period, combined with his outstanding qualities of leadership, seemed to predestine him to the task of heading the great Ericsson concern. And those who had that expectation of him were not to be disappointed. Helge Ericson, like his predecessor, succeeded in keeping the great industrial complex well under way despite the hard storms that raged over the world during the war; despite, too, the post-war dislocation of the economic structure and the restrictions imposed on industrial production and on trading relationships.

Yet greater difficulties were to follow. The demand for Ericsson materials both in Sweden and abroad was continually growing; the gap between productive capacity and volume of orders began to become disproportionate. Increased production was an imperative need. By his initiative, energy and indefatigable work, and ably supported by his colleagues, Helge Ericson overcame the many obstacles that stood in the way and successfully carried through the expansion that was needed. The existing factories were enlarged and new modernly equipped plants were built in different parts of Sweden. To provide efficient and expert service for the growing number of customers, branch sales offices were opened, at times combined with small workshops in remote parts of the world. Helge Ericson sought by every available means to strengthen the company's ties with foreign countries. Despite his heavy burden of work at the centre of the group in Stockholm, he did not hesitate to undertake long and arduous journeys abroad to effect personal contact with customers and personnel in the field.

Helge Ericson experienced the happiness of seeing his labours on the company's behalf crowned with prosperity; during the ten years of his leadership the activities of the parent company alone were doubled.

His apprenticeship in the field of telephony was served at a time when the fine pioneering traditions of Lars Magnus Ericsson and Henrik Cedergren were still alive in all their youth and vigour; and, as far as modern times would allow, he sought to uphold the inheritance passed on to him. This in no way prevented him from devoting great interest to the many new developments that arose, and he encouraged his staff to work out ideas and suggestions which would help to maintain the position that L M Ericsson had won among the great international concerns in the field of telecommunications.

Helge Ericson was popular with his staff. He took immense trouble on their behalf and showed great interest in their various associations and leisure occupations; and his interest was a genuine one. He was on a friendly footing with his employees and had a knack of winning their confidence. He always sought to be fair in his judgements and decisions, and he acknowledged the merits of others unreservedly.

Helge Ericson's memory will be faithfully preserved by his many fellow-workers.

September 1953

Hemming Johansson

Cut-over to Crossbar Systems in Aarhus

C BERGLUND, TELEFONAKTIEBOLAGET L M ERICSSON, STOCKHOLM

U.D.C. 621.395.344
621.395.722(489.47)

On the 1st of May 1953 six automatic telephone exchanges were put into operation at Aarhus covering a total of 31,800 lines as well as a large automatic trunk exchange. The cut-over was without comparison the most extensive and complicated one in the history of L M Ericsson and is briefly described below.

The Scope of the Operation

Danish newspapers reported on May 1st that »the largest telephone conversion in the world» had taken place that morning in less than half an hour. At half past three in the morning the telephone system of Aarhus, Denmark's second city, was changed over from a manual magneto system to 6 automatic exchanges covering 31,800 lines. At the same time a large automatic trunk exchange was opened with 100 operators' positions. It is true that the number of subscribers at the cut-over was only about 21,000 and that one of the exchanges with about 1,800 subscribers was already operating on an automatic system, but the conversion to an extremely modern automatic system was combined with the introduction of very advanced forms of operation both with regard to the local traffic and the trunk traffic.

The local exchanges are made according to a new form of the L M Ericsson by-path crossbar system. The system differs on essential points from that

Fig. 1 X 6758
The main exchange premises with the trunk exchange

Fig. 2 X 6755

The inaugural call between the chairman of the board of the Jydsk Telefon-Aktieselskab, Mr P Schack Eyber and the managing director Mr P Draminsky

earlier introduced in the capital of Finland (see Ericsson Review No. 4, 1950), as the latter system was specially adapted for extension of existing exchanges of Strowger type.

Also the trunk exchange with crossbar switches differs considerably on account of different operating conditions from the large similar installation which partly has been in operation in Rotterdam for about a year.

The subscribers dial trunk calls directly to some 100 places in Denmark. The exchanges at these places are equipped with key sets or dials for automatic switching to the Aarhus subscribers and for transit traffic over Aarhus. The key set operations are translated to voice-frequency signals combined out of 5 different frequencies and line signals with voice-frequency or 50 c/s A.C. have been introduced. This means that the operation at all these exchanges has been radically changed and this has necessitated new and sometimes complicated equipment.

In connection with the automatic conversion a complete revision of the tariffs has also been made, a new system of time counting on meters being introduced for local as well as trunk traffic with direct dialling.

Preparations

As the system was new many problems arose during the planning and new ideas for improvements were proposed and accepted. All this left less time at the disposal for the final testing of the system than was originally intended. Therefore, a considerably greater number of hard working specialists, than on any earlier L M Ericsson installation was employed in the accelerated tests and the cut-over of the exchanges. The Danish telephone administration made in addition a very large personnel available for the cut-over and planned this in detail.

A person present at the cut-over compared the organization with that of a military invasion operation. The operation was also executed with accurate precision and was as mentioned above completed in less than half an hour. After that followed, however, as in case of an invasion operation an intensive struggle against difficulties during a few days before the »bridgehead» was completely secured.

The Local Exchanges

The subscribers had been requested to pull out the plug for the old instrument and plug in the new one during the night. It was not unexpected that about 5 % omitted to change instruments but a considerable number of persons had to be diverted to the blocking of these subscribers and to make sure that the change was made when the subscribers were waking up in the morning.

Faults were of course detected in the new line network but not more than expected. The biggest trouble was faulty junction lines to suburban exchanges which, however, were quickly corrected, although some had to be blocked, which later added to the congestion in the traffic.

It was, of course, also expected that certain adjustments of the exchange equipment would be necessary after the cut-over. Although it had been possible to carry out tests for a considerable time before the start, the artificial traffic could not take place at the same load level as that resulting from actual traffic. Especially in new systems inadequacies which do not show up on test are, therefore, always anticipated.

The change-over was originally planned to take place at the Easter holidays when offices were closed down for five days in succession. In order to allow more time for testing the start was, however, postponed until half past two, Friday the 1st of May, which was a holiday and which was followed by a Saturday, when the offices close early, and then a Sunday. It was expected that three days of moderate telephone traffic would follow the change-over. The subscribers interest in the conversion was, however, already very keen and the newspapers gave it an unusually great publicity. By an indiscretion it had furthermore got to the knowledge of the subscribers that the telephone administration did not intend to charge the calls during the first days after the cut-over.

These and other reasons resulted in a traffic during the starting day which was far in excess of that expected and this caused a considerable overload. As the exchanges could not handle all this traffic the waiting times for dial tone increased and busy tone was received to a very large extent as no free connecting device were available to establish the required connections. As a result many subscribers—unaccustomed to the dial—started to dial before receiving dial tone and those who received busy tone immediately made a new attempt. This increased the load further still especially with regard to the registers which were occupied longer than usual as many subscribers were dialling very slowly or dialled the wrong number of digits.

As a result of the technical faults, which did not show up during the test, faulty connections and blocking of connecting devices also took place and reduced the traffic handling capacity of the system. It is, however, significant that the suburban exchange, which previously had dial instruments, did not suffer from congestion or overload owing to the subscribers having previous experience with the dial which to them was no novelty. During the enormous traffic on the opening day the fault tracing was very much obstructed, but in the evening and during the night the experts worked incessantly to repair faults and endeavoured to limit the results of the overload. The next day's operation was, however, awaited with keen interest, as the offices were then open half day. Also this day showed a very large overload but a certain improvement in the traffic handling was noticeable.

After another night of hectic work on the exchanges and since the telephone administration with the help of the press had succeeded in reducing the far too intensive inclination of the public to try out the new telephones, a quiet Sunday followed during which the traffic handling capacity of the system was not overloaded.

Fig. 3 X 4916
The cut-over to the new exchange

Fig. 4 X 6756

Mr Draminsky taking leave of the old exchange and dismissing the operators

From this day the local telephone traffic has in the main been satisfactory without waiting times, and the occasional disturbances have daily been reduced.

The Trunk Traffic

As mentioned above the subscribers had found out that trunk calls could be established without charge and this naturally resulted in a very large number of additional trunk calls, but in spite of this the trunk traffic during the first days caused no great trouble. One of the reasons for this might have been the difficulty to get local connections to the trunk records and this caused many people to postpone their trunk calls from the Saturday to the following Monday. On that day the trunk system received a very hard trial indeed.

In order to meet the expected traffic rush all operators positions were manned in Aarhus. All these operators as well as operators in other places endeavoured with praiseworthy energy to connect the never ending stream of trunk calls. Owing to the large number of calls a considerable overload occurred in certain narrow sections. All registers were engaged and often released without establishing connection as they could not find a connection route through the narrow sections. The more engergetically the operators were working the larger number of calls failed to be connected. It was pointed out that in these circumstances a reduction of operators would result in an increase of actually established connections. The number of operators were, therefore, temporarily reduced and this led to a considerable improvement of the traffic handling.

After calculations and investigations of the narrow sections it was found that rearrangements had to be made in order to increase the capacity. This rearrangement was made after careful preparations and since then the exchange has been working without any congestion to speak of. Later a similar rearrangement has taken place which has increased the traffic handling capacity further still and a considerable future traffic increase can, therefore, be met. Investigations are being made to establish if other suitable measures can be taken to the same end.

The fairly high congestion encountered before the rearrangement was made, was at times harassing for the operators and the effects of even small technical disturbances were in this way aggravated. The situation was, therefore, very nerve-racking for those responsible for the trunk operations and the technical equipment. In spite of the congestions the Aarhus operators could every day clear all incoming trunk orders but this was unfortunately not always the case with the important traffic from Copenhagen to Aarhus.

The technical work was during this time divided, the L M Ericsson personnel carrying the main part of the burden with regard to the work at the exchanges in Aarhus whereas the telephone administration were responsible for the line network and the equipment at the administration's exchanges outside Aarhus. This equipment, supplied by L M Ericsson, had also been fitted by the personnel of the telephone administration. Owing to the overload, certain disturbances and faults of inexperienced operators, the personnel of the administration travelling by car from exchange to exchange had an extremely strenuous task but succeeded with astonishing speed in getting over the difficulties.

In a change-over of this kind it is extremely difficult to organize a continual supervision from a central point (in this case Aarhus) of how the traffic from other exchanges is handled in order to get sufficient facts to locate faults and narrow sections and on this basis take the necessary steps. For this reason it was difficult to establish to what extent disturbances which occurred were attributable to the lines, carrier equipment and other equipment outside the exchanges, to the exchange equipment or to faults by operators. The effects of the troubles would no doubt have been less severe if it had been possible to arrange service lines from the different exchanges to Aarhus but this was not considered expedient on account of the scarcity of lines that existed at the time of the cut-over.

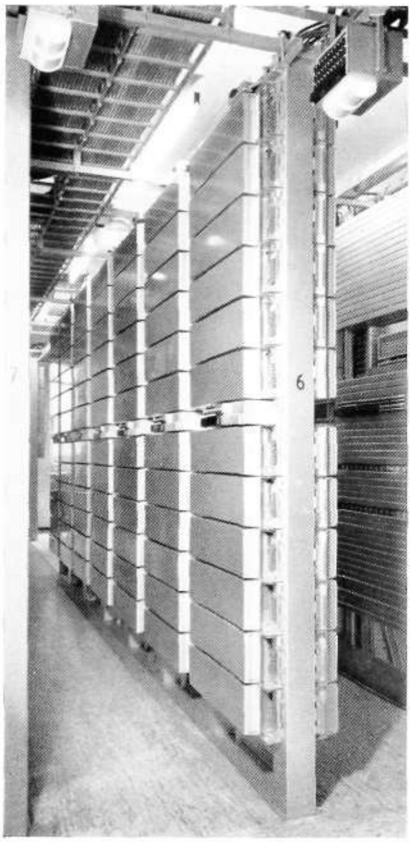


Fig. 5 X 4917
Interior of the new main exchange

Operating Results

Having got over the initial overload in the local as well as the trunk exchanges a systematical trimming of the equipment has taken place perfecting the function day by day. The following report is quoted from the August issue of an internal publication of the telephone administration.

»About 3 months after the conversion day the new system now functions perfectly both with regard to local and trunk traffic and gives a far better service than the old manual system. The Aarhus people are also on all hands very satisfied with their new telephones particularly with the fast trunk connections with direct dialling. This is certified not only by the statements given to the representatives of the telephone adminstration when they are in contact with the subscribers but also by the reduced number of complaints now reaching the administration.»

During the first time after the cut-over L M Ericsson retained the full complement of experts at Aarhus in order to carry out tests and supplementary work assist the administration in the maintenance. Now a few men only are remaining in the local exchanges and the trunk exchange for supplementary work and to assist the administration in training the maintenance staff. For the time being the telephone administration has allocated 10 men for the maintenance of the local exchanges and 7 men for the trunk exchange. This staff is considerably less than that common in automatic exchanges of other types. In spite of this it is, however, probable that the number of maintenance men can be reduced when the trimming of the exchanges and the training of the men has been completed.

*—300003

The operating time of the exchanges has been too short to allow the publishing of figures for reliability and maintenance cost but the information so far seems to justify very high expectations on excellent operating results.

Conclusion

In a discussion with experts from the American Telephone and Telegraph Company, the biggest telephone administration in the world, the cut-over at Aarhus was described. The statement of the Danish press that this operation was the biggest in the world was also mentioned to which the American experts commented that they would never attempt cut-overs on such a big and complicated scale. Irrespective of the Danish newspaper statement being correct or somewhate exaggerated, the cut-over was nevertheless a very big operation and without comparison the biggest in the history of L M Ericsson.

Why, then, was this system put in service in one operation and why was the cut-over not carried out in stages avoiding the concentrated effect of so many problems? The telephone administration had found that a cut-over in stages would require expensive temporary interwork equipment and that the development of this would have delayed the conversion to automatic operation which was calculated to reduce operating costs to the tune of several million Danish Crowns per year. A prolonged building programme would also have meant a longer transition period, not desirable for the subscribers, with a comparatively high fault rate and with a number of temporary instructions for traffic in different directions.

Now when the cut-over has taken place and the system offers a satisfactory telephone service one must no doubt agree that events have confirmed the correct planning of the administration. Those who were privileged to take part in this extremely interesting and difficult work might indeed feel satisfaction and pride over the good result, which hardly had been possible without the exemplary and cordial cooperation between the telephone administration and the contractor.

Conversion of the Aarhus Telephone Exchanges

N BORREGAARD, JYDSK TELEFON-AKTIESELSKAB (JTAS)

U.D.C. 621.395.344:621.395.722(489.47)

In connection with the opening of the new telephone exchanges at Aarhus a shortened translation is published below of a paper which the author read at a telephone engineering meeting in Denmark and which has earlier been published in the Danish periodical Teleteknik. The paper gives the outlines of the structure of the modern telephone system with crossbar switches which has been used for the new local and trunk exchanges.

The conversion of Aarhus to automatic operation covers 6 local exchanges—the main exchange and five suburban exchanges—and a trunk exchange.

During the years which JTAS has spent on the project this has been considerably developed. Originally it was based on the OS system but later—first with regard to the trunk exchange but subsequently also for the local exchanges—the Administration decided to use the crossbar system which in the meantime had been developed by L M Ericsson. The original intention was also to convert the Aarhus main exchange only. It was, however, soon apparent that the great demand for telephones during the war would not be appreciably reduced. It was, therefore, decided that automatic suburban exchanges should be built at the same time as the main exchange. In this way equipment and operating cost would be saved for the interwork between the automatic and manual exchanges. Finally the trunk exchange, which originally was to handle only the JTAS own traffic, was now dimensioned to take also the trunk traffic handled by the P.T.T. Administration.

Fig. 1 X 6753

The exchanges in the Aarhus network

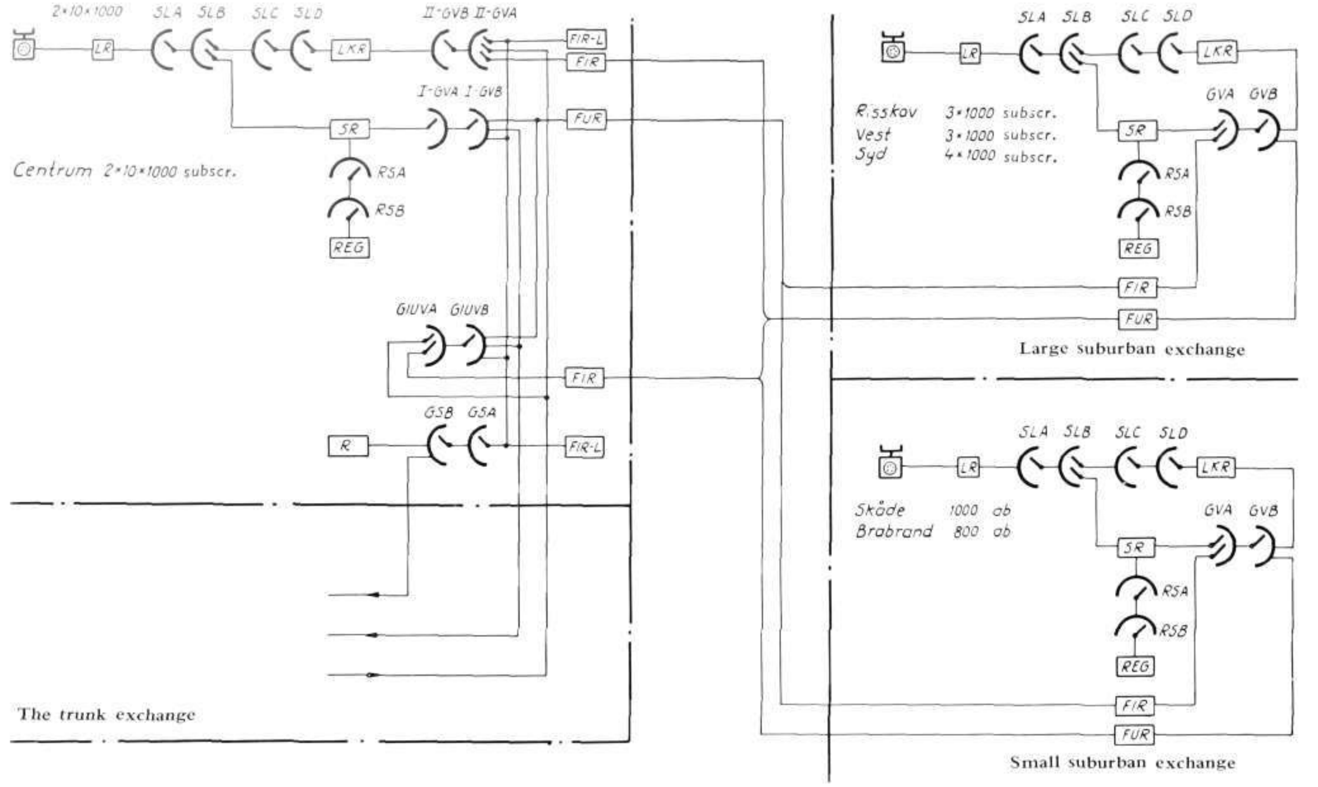


Fig. 2 X 7649

Traffic route diagram for the local exchange

An outgoing connection is established over the crossbar verticals of the subscribers' stage SLA and SLB, outgoing cord circuit SR and first group selector IGVA and IGVB. At Centrum outlets are arranged to second group selectors IIGV, suburban group selectors GV, group selector GS for special lines and the trunk exchange. From the last group selector connection is established over an incoming cord circuit LKR, the four selectors SLD–SLA in the subscribers' stage to the subscriber. Traffic in a suburban exchange passes one group selector stage only. Calls from the suburbs to the main exchange and other suburbs are connected over incoming group selector GIUV in the main exchange.

The Local Exchanges

The 6 local exchanges cover 31,800 numbers, distributed with 20,000 for Centrum, 4,000 for Syd, 3,000 for Vest, 3,000 for Risskov, 1,000 for Skåde and 800 for Brabrand, fig. 1. In addition a future exchange Nord is projected.

The 90,000 5-digit numbers which are available (before a future conversion to 6-digit numbers) are intended to be allocated with 30,000 for the main exchange, 40,000 for suburban exchanges and 20,000 for rural exchanges. The buildings for the suburban exchanges are on the average dimensioned for about twice the initial capacity. The new building for the main exchange will hardly take more than 20,000 numbers, but when the old exchange is pulled down satisfactory extension possibilities will be obtained.

In the main exchange the 20,000 subscribers are divided into two 10,000-groups, see traffic route diagram, fig. 2. All traffic between the suburbs runs through the main exchange. Direct traffic routes can, however, be arranged between them without difficulties if so should be required.

The exchanges can take up to 60 PBX-subscribers with a total of 200 lines in each of the 1,000-groups, as it is considered that the most satisfactory safeguard against traffic peaks is obtained by dispersing the PBX-subscribers. The number of subscribers that can be connected for absent subscribers' service is limited only by the traffic, which can be handled in the operators' positions of this service. A call to an absent subscriber's number is signalled in the position on a lamp panel indicating the called number. The same positions also take calls to vacant numbers. The operator can differentiate between these two cathegories by the filing cards having different colours.

Otherwise special positions are arranged of different types: testing boards, service observation board, traffic recording equipment &c.

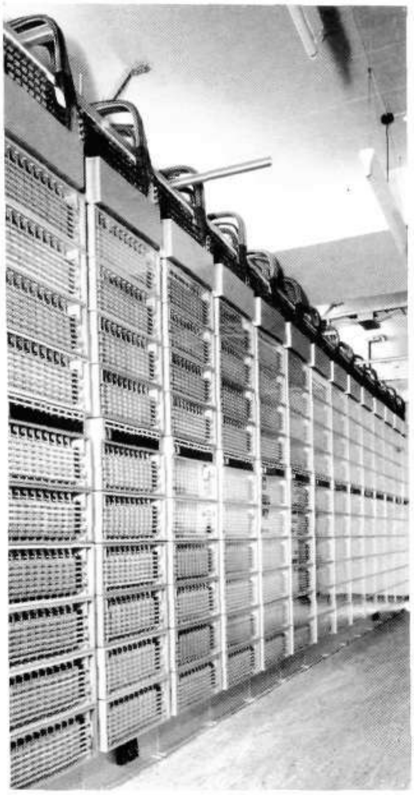


Fig. 3 X 4912
Row of selectors

The Trunk Exchange

When it became obvious that the division between the P.T.T. and the JTAS trunk exchanges could not be maintained a committee was set up from both parties. This committee found that the ideal solution was a complete fusion of the exchanges. P.T.T. considered, however, that it could not abandon the handling of calls to other concession areas, some of the reasons being personnel policy and the desirability of retaining universal handling of the traffic to the islands and abroad from all exchanges on Jutland. It is, therefore, only the automatic equipment which is used in common whereas the operators' positions are divided in two separate groups.

All exchanges (also outside Jutland) with lines to Aarhus are provided with dials or key-sets enabling the calling exchange to dial direct to the wanted Aarhus subscriber, and no incoming calls are, therefore, normally received.

The handling of outgoing calls are on the other hand different in the P.T.T. and the JTAS trunk exchanges. Normally a sufficient number of trunks are available and a large portion of the traffic can be disposed of without waiting time. Therefore, JTAS allows the subscribers to dial the required exchange directly.

When all lines in a required direction are engaged, the connection is automatically directed to an operator in Aarhus who records the call and effects connection when a line becomes free. If congestion occurs, the trunk in question can be blocked for direct dialling, all calls being directed to the records and connected with waiting time.

P.T.T. however, considered this procedure too radical at this stage, on charging reason and because a better service may be given if an operator connects the calls. (In case of direct dialling the fee for a call is recorded on the meter and the calls can, therefore, not be charged individually.) This Administration, therefore, preferred a CLR system whereby the subscriber obtains connection to a record operator (by dialling 009) who if possible establishes connection without ringing back.

The transit traffic over Aarhus is handled automatically as far as lines are available. If all lines are engaged the call is automatically directed to an operator which later connects the call.

Fig. 4 X 4913
Operators' positions for special services

Operators' Positions

The operators' positions, fig. 5, are identical in the two sections in spite of the difference in the connecting procedure. Excepted from this are the special positions and the international trunk positions which are provided with special auxiliary equipment. The positions are made as combined record and outgoing positions with 5 to 6 cord circuits and a position circuit and are arranged for 4-wire connection. In addition a number of positions are equipped for handling incoming traffic. All positions are provided with various refinements such as facilities for an operator to queue up on an engaged trunk and for selection of an individual line in a trunk. Service calls can, of course, be established between the positions and a record call can be transferred to another position.

Fig. 5 X 6754

The JTAS combined record and outgoing positions

Mechanically the boards are made as double faced wooden boards with space in the centre for cables and conveyor belt. The cord circuits as well as the position equipment are connected over plug and jack enabling quick replacements. All relays are mounted in the switch hall.

The boards are arranged in a row and the separating partition between the two sections is movable. JTAS estimate that the need for manual connection will be gradually diminished with the improvements in the direct dialling facilities and no additions in the number of boards is, therefore, anticipated even if P.T.T. will need more operators' positions.

The Automatic Equipment of the Trunk Exchange

The selectors consist as in the case of the local exchanges of link connected crossbar verticals. The traffic route diagram, fig. 6, is simplified as there are actually 2 selector groups for *GDY*, *GDN* and *GDO* and in addition a selector group not shown for service lines. *GIO* is a selector group for special positions. Incoming lines from the Aarhus local exchanges are arranged with 4-wire connection over one of the selector groups *GIH* whereas the lines from other exchanges in the network are arranged for 2-wire connection over the other group. Outgoing calls to all exchanges in the Aarhus' network are 2-wire connected by the selector group *GUH*. (After the cut-over this switching stage has been partly by-passed.)

A subscriber controlled outgoing call may be directed over *GIH* and *GDN* to the required trunk; if this is engaged a calling lamp is operated in all positions and a free operator can take the call over *GDO* by throwing the answering key a short moment to listening position and then to speaking position. The operator records the call and can then establish connection by ringing back to the caller over *GDO* and *GUH* whereas the required exchange is called over *GDO* and *GDN*.

For a P.T.T. trunk call 009 should be dialled and the call is connected in a similar manner over *GIH* and *GDO* to an operator who connects the call over *GDO* and *GDY*. If busy tone is received the call has to be recorded.

Incoming calls are connected over *GDY* and *GUH* to the local exchanges when the operator on the calling exchange is dialling the subscriber directly. Transit calls are normally received over *GDY* and transferred over *GDY*. Only in the case of a selected trunk being engaged, the connection is directed over *GDO* to an operator who records the call and establishes connection later. It will be seen that a transit call obtains 4-wire connection over the switchboard position.

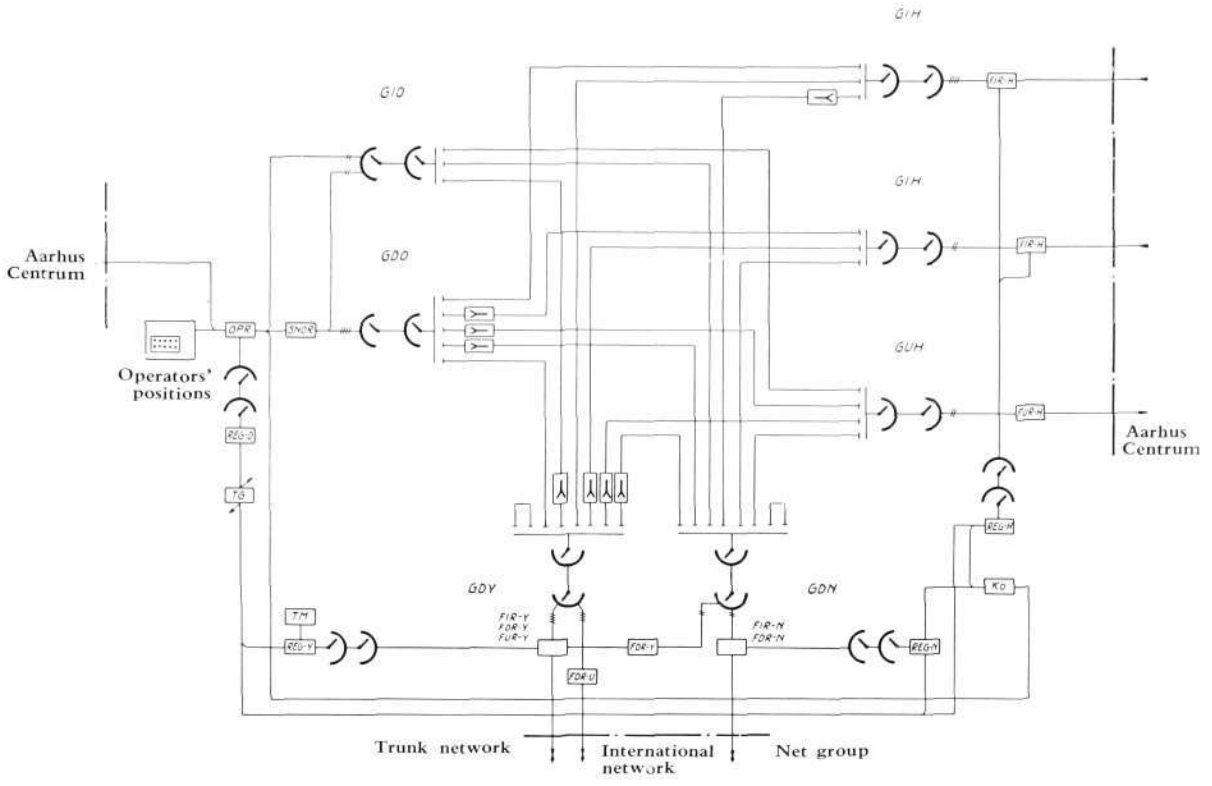


Fig. 6 X 7650

Simplified traffic route diagram for the trunk exchange

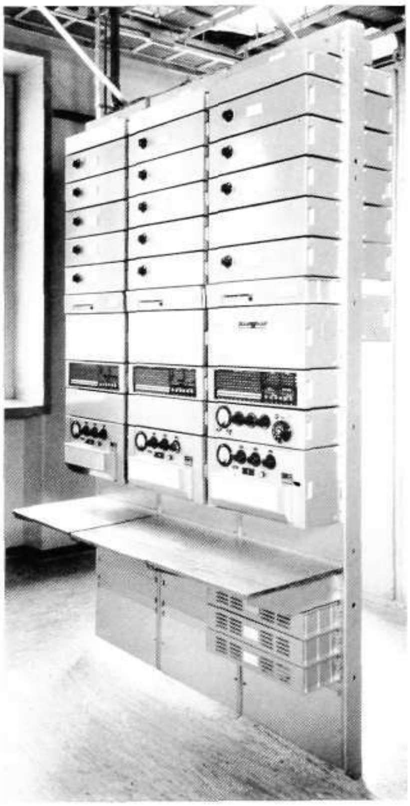


Fig. 7 X 4914

V.F. signalling rack

System of Signalling

Especially with reference to the national trunk lines the system of signalling should preferably be universal for the whole country. This matter has been extensively discussed in a Danish committee, which suggested digit transmission by means of combinations of different voice frequencies which preferably could be transmitted over carrier or loaded circuits. The line signals must be such that no part of the speech can be mistaken for a signal. A frequency was, therefore, selected which was as high as possible, *viz.*, 3,000 cycles. This frequency cannot be used on loaded cables as the attenuation is too high. A frequency of 50 cycles was chosen for such circuits although this frequency cannot be transmitted through amplifiers and has to be relayed separately by means of repeaters.

The system of signalling for net group lines need not be the same for the whole country. L M Ericsson has suggested a system based on D.C. impulses. The digit transmission takes place by means of fast polarity reversals which are received by a polarized relay with neutral position. The digit numbers are divided in groups 1—5 and 6—0 characterized by the first impulse being of different polarity in the two groups. Each digit, therefore, requires a maximum of 5 impulses and the speed will be approximately the same as that for voice frequency transmission.

This system, which will be used for the Aarhus net group when the exchanges are converted to automatic operation, is also employed for signals within the local network, *e.g.*, between registers and markers.

New Five-Digit Counter

E A WIBERG, TELEFONAKTIEBOLAGET L M ERICSSON, STOCKHOLM

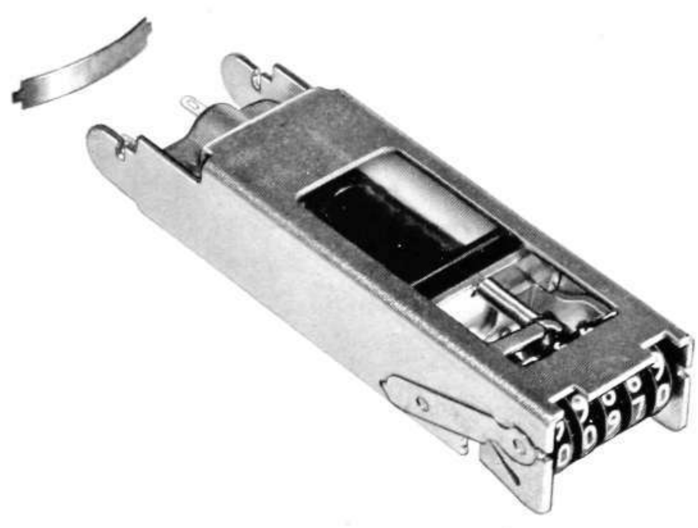
U.D.C. 621.395.663.2

In the article below an account is given of the L M Ericsson new five-digit counter coded RSA 200. The new counter is smaller and lighter than the earlier L M Ericsson four-digit counter in spite of an extended capacity. In the development of this counter high reliability and high speed have been the main considerations in order to satisfy the requirements for different methods of call charging.

The introduction of modern methods of call charging, involving multi-metering, has made the capacity of the four-digit counter so far used too small for subscribers with extensive traffic. This is especially so when local calls are charged in terms of time as suggested by Dr S Karlsson of the Helsinki Telephone Corporation. In order to reduce the reading intervals to a reasonable time the subscribers' meters should, therefore, at least for subscribers with many and lengthy calls, be of the five-digit type. In the L M Ericsson five-digit counter type coded *RSA 200* it has been possible to simplify the components for easy production at the same time as the dimensions and weight of the counter has been reduced in comparison with the earlier manufactured model despite the extended capacity.

Design

The counter RSA 200, fig. 1, consists of a frame with armature and counter wheels, magnet coil with fixing arrangement and a flat spring for the mounting of the counter. The counter wheels and the armature can be fitted in the frame and adjusted independent of the coil and can, therefore, be stocked separately. The frame of the counter is U-shaped and very robust. The front portion is provided with holes for three spindles which carry the counter wheels, transfer pinions and armature. One side of the frame is made with an adjustable lug enabling adjustment of the play between the counter wheels and the transfer pinions. The horizontal part of the frame contains an adjustable lug carrying the return spring for the armature. The rear part of the frame is cupped to ensure a satisfactory magnetic contact between the core of the coil and the frame. The sides of the frame are extended backwards



X 6751

Fig. 1
Counter RSA 200
with mounting spring

Fig. 2 X 6752
Counter RSA 200
dismantled

into lugs each of which is provided with a slot. The lugs are intended to fit in apertures on the mounting plate for the counters. The counters are fixed to this plate by means of the flat spring mentioned above, which is inserted into the two slots.

The counter mechanism, fig. 3, is driven by a pawl in a manner similar to that of a lever-escapement. The driving pawl is solidly connected to the armature and is pivoted in the frame. On operation of the armature the driving pawl moves a ratchet tooth on the unit wheel half a step and on release a further half a step. The counter wheels and the transfer pinions are made in synthetic resin and are carried on two separate spindles. Owing to the great amount of wear nylon is used on the unit wheel whereas diakon is used on the remaining wheels and the transfer pinions. The latter are provided with flanges guiding between the counter wheels and ensuring a proper engagement between the counter wheels and the pinions.

The setting of the lateral play of the counter wheels takes place by bending the lug arranged in the frame. In this way it is quite easy to adjust the total play of the five counter wheels and to ensure sufficient space for the flanges of the transfer pinions. The combination of an adjustable lug for the lateral play and the flanges on the transfer pinions results in a very reliable counter mechanism which cannot jam or get out of mesh without narrow tolerances on the width of the wheels or pinions having to be resorted to. The spindles which carry the counter wheels, pinions and driving pawl are pushed into holes in both sides of the frame and are prevented from dropping out by means of cover plates on the outer sides of the frame.

The *magnet coil* has a straight core without threads which is moulded into a phenolic bobbin. The moulding includes a terminal block holding two tags for the coil. The coil is fixed by means of a clip and two screws clamping the core end against the rear cupped portion of the frame. The clip with the two holes and the two screws are the only tapped or threaded parts in the whole counter.

Fig. 3 X 4911
The driving principle of the counter

Before tightening up the screws for the clip the armature travel is adjusted. A feeler gauge is inserted between the armature and the core face, and the armature is operated manually pressing the driving pawl against the unit

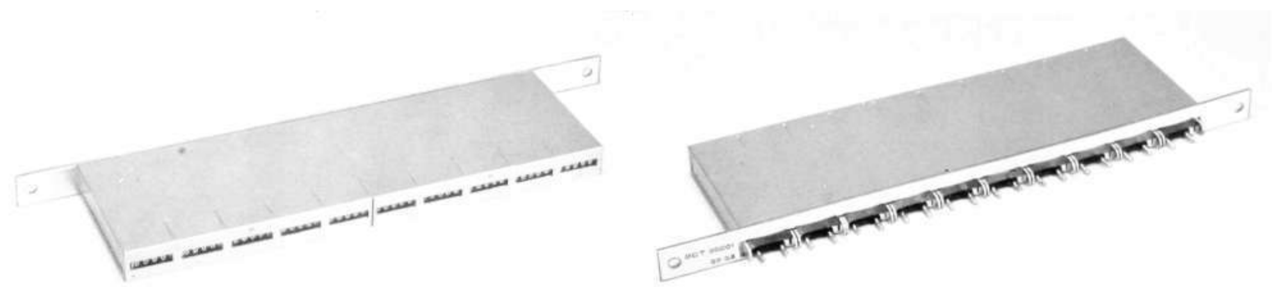


Fig. 4
Counter set BCT 950
right rear view

X 7648

wheel. The coil is pushed against the armature and the clip screws are tightened up. The armature travel will be completely controlled by the engagement of the driving pawl with the unit wheel ensuring a reliable stepping motion. The armature has no residental stud. On operation the surplus pull of the magnet coil will be transferred over the driving pawl to the unit wheel. This wheel is as mentioned above made of nylon and can well stand up to this additional stress. A spiral spring is fitted between the armature and the adjustable lug in the frame and returns the armature to home position when the coil is de-energized.

Test

After assembly and mechanical inspection the counters are tested at an impulse rate of 20 imp/sec. They are run just over 100,000 steps making the 10,000-digit wheel complete a full revolution. After the running test the counters are re-checked in order to ascertain that no excessive wear has taken place.

Counter Set BCT 950

In earlier designs with individually mounted counters it has proved difficult to obtain proper alignment of the counters. This effects the appearance and with modern photographic methods of reading the meters it is also of importance that the counters are in alignment as this facilitates the subsequent check of the records. L M Ericsson has solved this problem simply by mounting ten of the new counters side by side on a strip and providing the counters with one common cover. This cover has a guiding hole for each counter and as the flat mounting spring allows a certain amount of movement the cover effects the necessary alignment without further action being required. A counter set containing 10 counters is coded *BCT 950*, fig. 4.

The covers for the counter sets are made with or without individual designation labels. In the latter case the top row of each set of 100 counters is provided with a flag carrying the 100-digit number.

Separate counters, type RSA 200, may be provided with individual covers if requested on the order.

New High Tension Protection Equipments for Telephone Instruments

A HENCKEL, TELEFONAKTIEBOLAGET L M ERICSSON, STOCKHOLM

U.D.C. 621.316.91:621.395.721

The Ericsson Review No. 1, 1952, contained a description of L M Ericsson's high tension protection equipment with notes on the theory of the induced voltages set up in telephone circuits laid in the vicinity of high tension lines. The present article describes a new design of the same high tension protection equipment suitable for installation both indoors and outdoors.

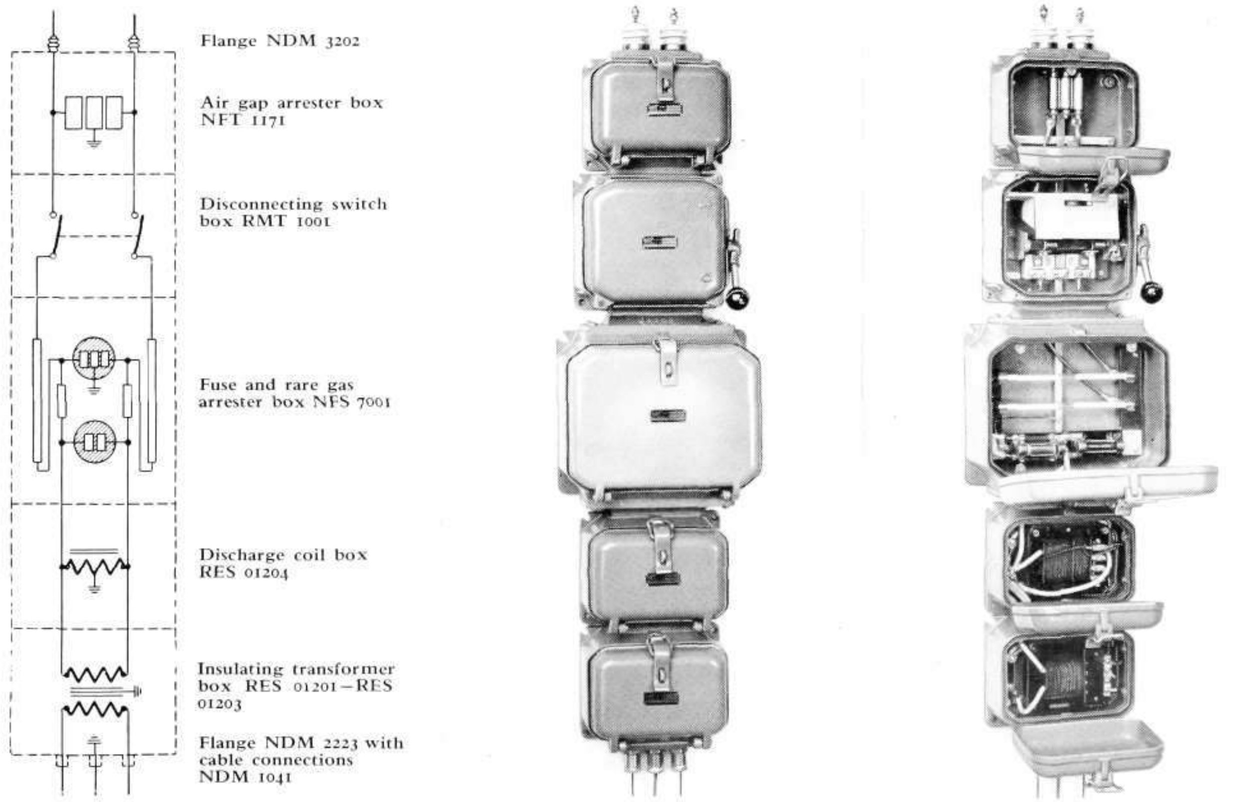
Encased High Tension Protection Equipment for A.C. Voltages

The new high tension protection equipment is so designed that all the component parts are encased in standard unit boxes which in turn are assembled to form a complete unit. The boxes are of silumin which has a specific weight about one-third of the specific weight of cast iron. All boxes can, however, also be supplied in cast iron.

The encased high tension protection equipments *NFT 1101—NFT 1103* which correspond to the »open» high tension equipments *NFT 1001—NFT 1003* consist mainly of an air gap arrester box *NFT 1171*, a disconnecting switch box *RMT 1001*, a fuse and rare gas arrester box *NFS 7001*, and a transformer box *RES 01201—RES 01203*. The high tension protection equipments *NFT 1111—NFT 1113*, which correspond to the »open» high tension equipments *NFT 1011—1013*, also includes a discharge coil box *RES 01204*.

Fig. 1 X 4892 X 6737

High tension protection equipments NFT 1111—NFT 1113



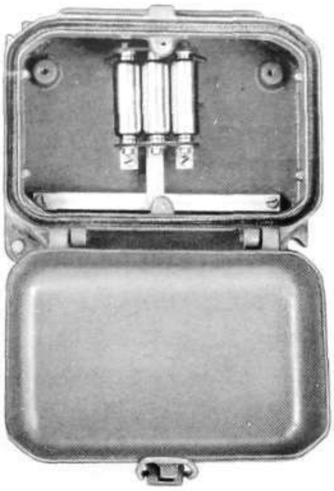


Fig. 2 X 4893
Air gap arrester box NFT 1171

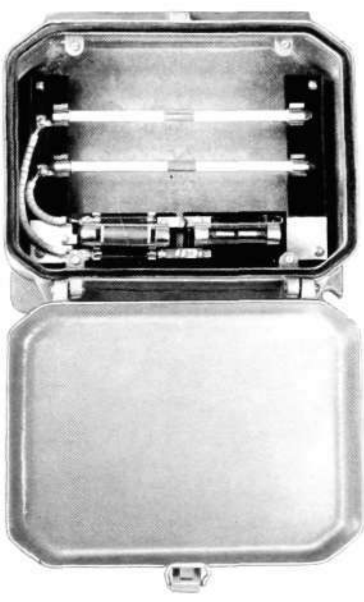


Fig. 3 X 4894
Fuse and rare gas arrester box NFS 7001

The electrical properties of the new encased equipments NFT 1101—NFT 1113 are the same as those of the old equipments NFT 1001—NFT 1013. They can withstand alternating voltages up to 66 kV with energy outputs up to 1 MVA and voltage surges transmitting quantities of electric energy up to 1 coulomb. On the other hand, the insulation properties have been appreciably improved. With a relative moisture of 95—100 % and 40° C the insulation resistance will not fall below 100 M Ω. The new equipments have also been tested by spraying them with a salt water vapour for a period of one month. In this case too, the insulation resistance did not fall below 100 M Ω. No corrosion could be observed after this treatment.

Air Gap Arrester Box

The unit NFT 1171, fig. 2, consists of a silumin box containing an air gap arrester *NFT 1071* which represents a form of protection of an entirely new design on which patent applications have been filed. The electrode system comprises 3 solid cylinders of a patented copper alloy. The shafts of the cylinders are located in parallel. The electrodes are secured in such a way that on loosening the shafts which take the form of screws the distance between the electrodes can be adjusted and the electrodes themselves can be twisted to present a new flashover surface if the previous one has been burnt out. Even where electrodes of pure copper have been used this overvoltage protection has been found to possess a longer life than the type previously employed by L M Ericsson. When the patent copper alloy mentioned above is used the length of life is increased appreciably and when in addition the possibility is available of constantly obtaining new flashover surfaces by twisting the electrodes the new protective device may be employed for practically unlimited periods without the necessity of regrinding the electrodes. Should the spark gap be overloaded owing to a power line falling onto a telephone wire for example, the electrodes become welded together and thus provide an effective earth for the telephone line.

Disconnecting Switch Box

The disconnecting switch box *RMT 1001* is a switch encased in a silumin box and is of the type employed in heavy current installations.

Fuse and Rare Gas Arrester Box

The fuse and rare gas arrester box NFS 7001, fig. 3, consists of a silumin box containing two tubular fuses *NGH 2901* as a protection against currents at high voltages, a triple-path rare gas tube *NGC 3303*, a single-path rare gas tube *NGC 3204* and two tubular fuses *NGH 2001*.

Discharge Coil and Insulating Transformer Boxes

The discharge coil box *RES 01204* and the encased insulating transformer boxes *RES 01201—RES 01203* consist of the same coil and transformers as those included in RES 01301—RES 01303, which in turn are the components in the high tension protection equipments NFT 1001—NFT 1013 but they are mounted in silumin boxes.

With regard to the electrical properties and range of use reference should be made to the article in the Ericsson Review No. 1, 1952, mentioned above.

Encased High Tension Protection Equipment for D.C. Voltages

The various components from which the high tension protection equipments NFT 1101—NFT 1113 are assembled may also be employed separately or in other combinations. For example, the air gap arrester box NFT 1171

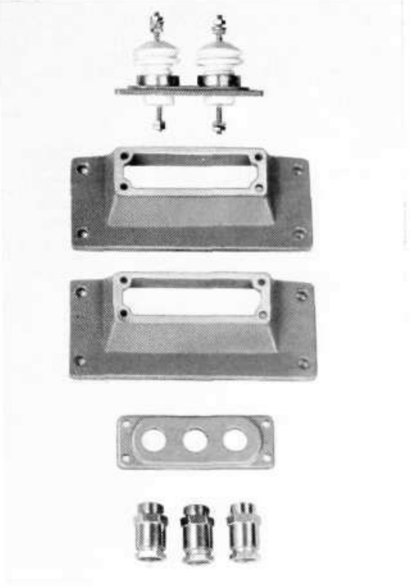


Fig. 4 X 4895

External parts for the high tension protection equipments NFT 1101—NFT 1113

may be installed when it is only necessary to protect a telephone line against atmospheric discharges. A special combination which has been used consists of the fuse and rare gas arrester box NFS 7001 and a transformer box RES 01201. This combination which bears the designation *NFT 1151* is intended as a protection against D.C. voltages up to 2000 V at outputs up to 200 kVA.

Erection

The high tension protection equipments NFT 1101—NFT 1113 may be installed both indoors and outdoors. The equipment is supplied in components which, in addition to the boxes referred to above, consists of an earthing bar, flanges with inlets, connection material, etc. Fig. 4 illustrates the external parts included in the high tension equipment NFT 1101—NFT 1113. From the top, these parts consist of: a flange with inlets *NDM 3202*, two flanges *NDM 3092*, a flange *NDM 2223*, three cable bushings *NDM 1041* with two cable packings *NDP 1011* and one cable packing *NDP 1013*. These parts are assembled on site in accordance with the instructions supplied with the material. The high tension protection equipments may be mounted directly on a wall, a pole or the like. No mounting base is required.

It is necessary to provide for an effective earthing in order that the resistance to earth is as low as possible and does not exceed 10 Ω. When difficulties are encountered in keeping the earth resistance sufficiently low, Sanick Gel *NTV 5101* should be employed.

Telecommunication Equipment on Board s/s Birger Jarl

P NORMARK, L M ERICSSON SALES COMPANY, STOCKHOLM

U.D.C. 621.391:629.12.066

S/s Birger Jarl is the latest ship of Stockholms Rederi AB Svea and has recently been put into service between Stockholm and Finnish ports. The ship was built at the Finnboda shipyard in Stockholm and has been provided with modern telecommunication equipment from L M Ericsson as described below.

The telecommunication equipment supplied by L M Ericsson to s/s Birger Jarl consists of loudspeakers, domestic telephones, ship's telephones, master communicators, service signals, fire signal and fire alarm equipment. The Svenska Radioaktiebolaget has in addition delivered material for the radio communication system.

The Loudspeaker System

The loudspeaker system is used for paging, entertainment and announcements for the passengers and crew but also for the transmission of alarm signals in case of fire or other emergency. The alarm signals are initiated from the chart house and consist of short blasts transmitted independent of the amplifiers in the radio control cabin. The alarm signals and the announcements automatically disconnect or reduce the volume of any other transmission which may be in progress, *e.g.*, from the radio, gramophone or tape recorder. Microphones for announcements are fitted in the chart house, the wireless operator's cabin and at the purser's. Information and instructions in connection with an alarm can thus be given over any of these microphones.

The loudspeakers are divided into five groups. These are connected either manually from the radio control cabin or are remotely operated from any of the microphone positions. The control sets for this purpose are also provided with a universal key and signal lamps which indicate connected lines. Separate order lines are arranged and an order is, therefore, always transmitted even if a loudspeaker is disconnected. When an alarm is transmitted all loudspeakers are automatically connected in groups.

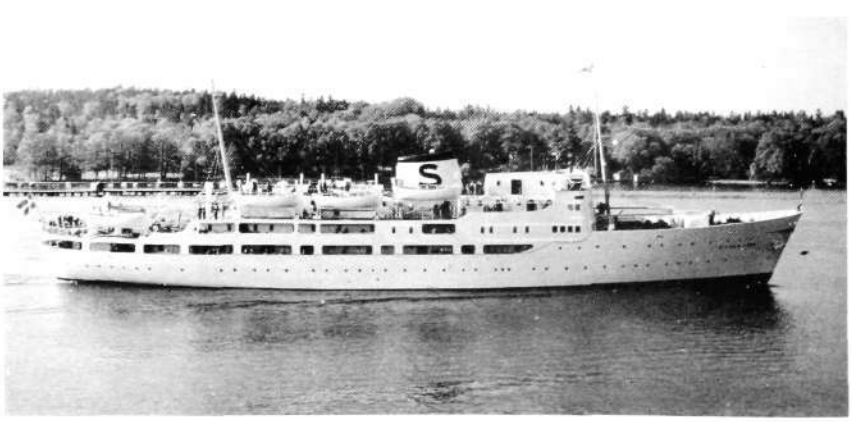


Fig. 1
S/s Birger Jarl

X 6743

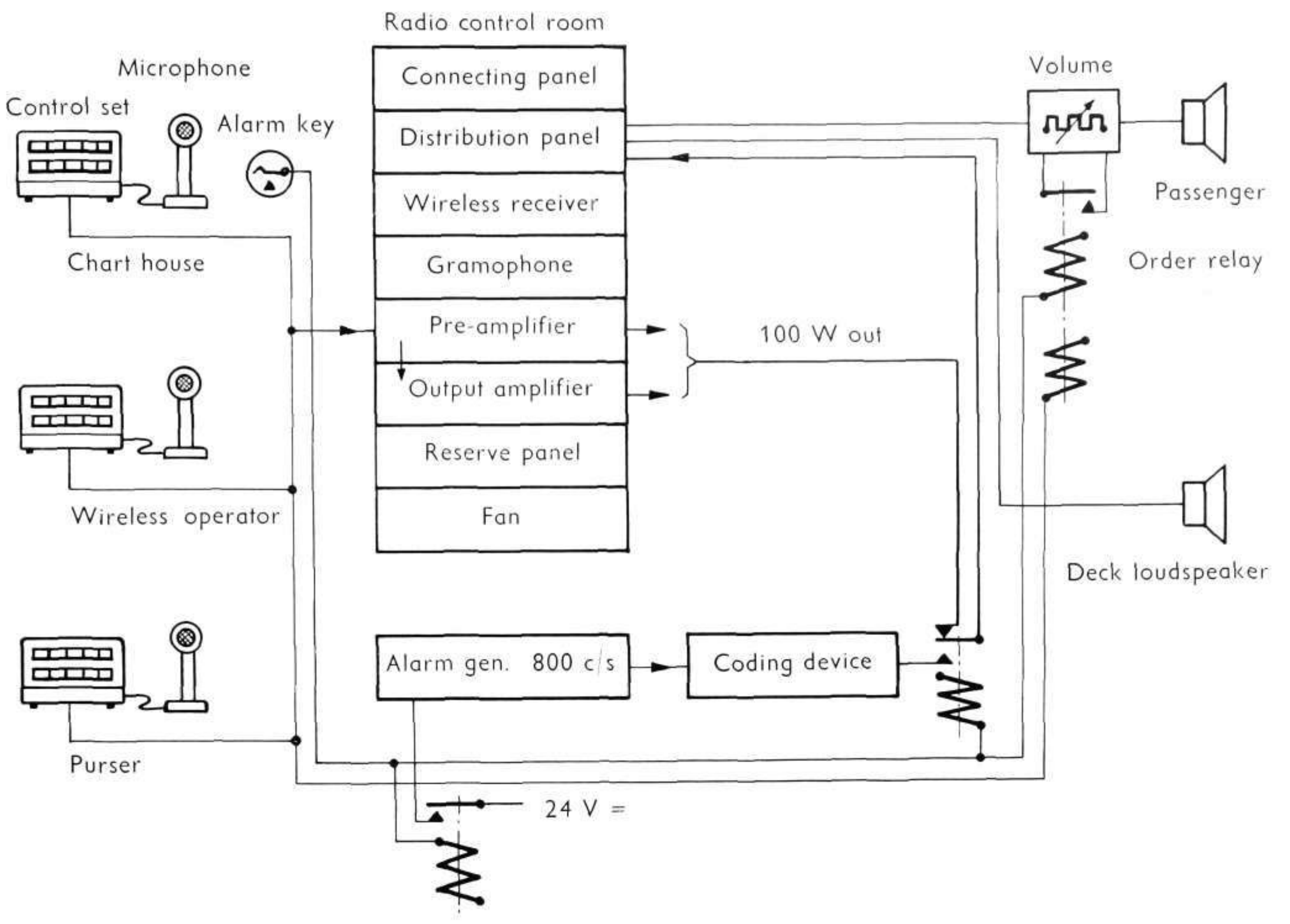


Fig. 2 X 7645

Schematic diagram over the loudspeaker system

Fig. 3 X 7642

Loudspeakers used

left marine loudspeaker RLE 709, centre pillar loudspeaker, right loudspeaker of reflex type

Various types of loudspeakers are used. On deck and other exposed positions the new shock-proof marine loudspeaker *RLE 709*, described in Ericsson Review No. 1, 1953, is used. Through the special reproduction properties of this loudspeaker satisfactory intelligibility is obtained even in noisy positions. In other quarters loaudspeakers of special design are used, *e.g.*, in dining rooms and lounges, which have been equipped with pillar loudspeakers composed of several systems. The low ceiling on board ships make it necessary in this case to use modified loudspeakers combining excellent reproduction with pleasing appearance. In passages, kitchens, cabins, etc. a small corridor loudspeaker is fitted which has a high efficiency and is very robust. The quarter deck which is also to be used for dancing is covered for sound by a large loudspeaker of reflex type.

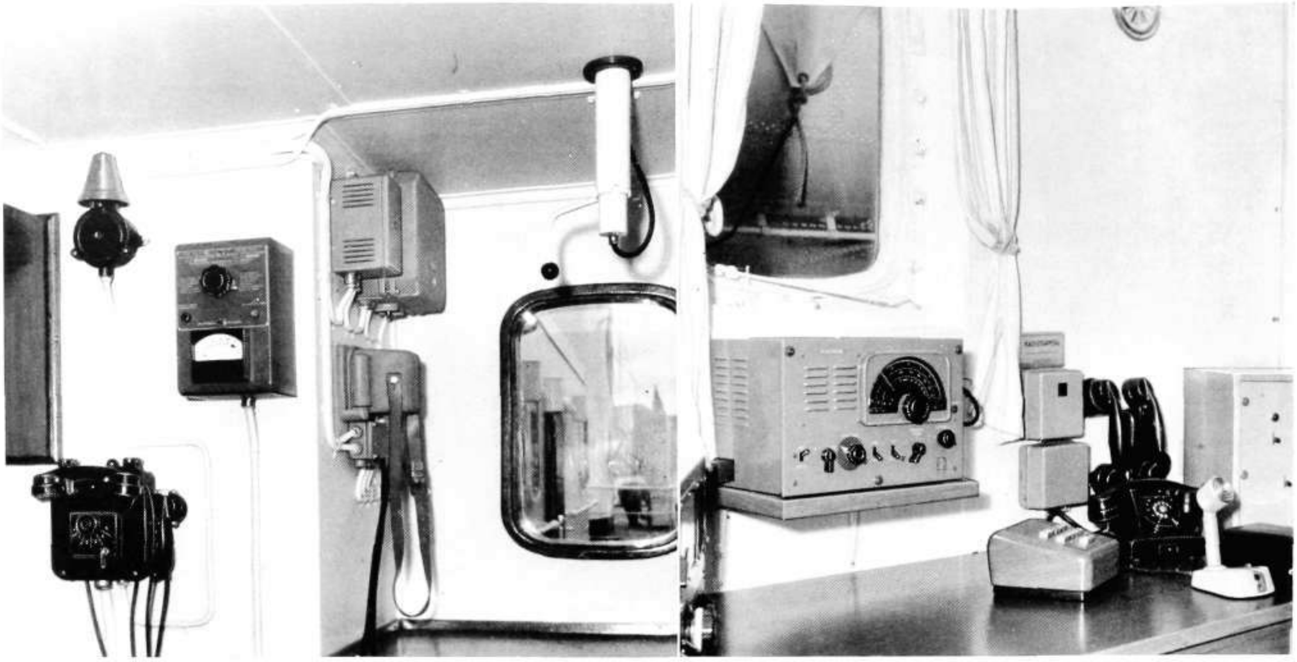


Fig. 4 X 7646

Telephone and telesignal equipment

left in the wheel house on the bridge, ship's telephone and loudspeaking master communicator; right on the desk of the wireless operator, control set, microphone for the loudspeaker system and automatic local telephone instrument; on the wall local telephones for connection to the bridge.

Telephone Equipment

For the communications between the bridge and the wireless operator a separate local telephone system is used with instruments of type *DEP 4001*. The engine room and the engineers are connected by an L M Ericsson ship's telephone, fig. 4. In addition the new loudspeaking ship's master communicator is used for transmitting orders to the deck crew with connections to forecastle and poop. One line is connected to a revolving marine loudspeaker mounted on the roof of the bridge. This is used for quay approaches, instructions to assisting tugs, etc.

Other communncations on board are covered by a domestic telephone system with 17 extensions. This is operated by an automatic exchange type *ALD 10011* for a maximum of 22 lines fitted in the radio control room. The exchange can take 3 simultaneous calls and offers priority to certain extensions.

Fig. 5 X 4396

Port passengers corridor, first class

left at the ceiling corridor loudspeaker, right guide signal board fo he stewardesses

Service Signals

The cabins are fitted with signal buttons for calling the stewardess and each has an indication lamp with restore relay and cancel button. The indication lamp is of a new type moulded in thermoplast with corrugated lenses giving a clear and distinct signal.

The stewardesses' cabins are provided with group signal boards for the service signals and the corridors are equipped with guide signal boards. The purser has a large supervision board enabling him to check that all calls and signals from the passengers are promptly attended.

Fire-alarm Equipment

The fire protection system on board includes a fire indicating plant divided into five groups. To enable the officers to locate at once which part of the ship is affected by a fire, a fire alarm installation divided in five sections with indicating contacts has been connected to a fire alarm control board installed on the bridge. This control board has been supplied by L M Ericsson and is made for five sections. It can be extended to 10 sections, fig. 6.

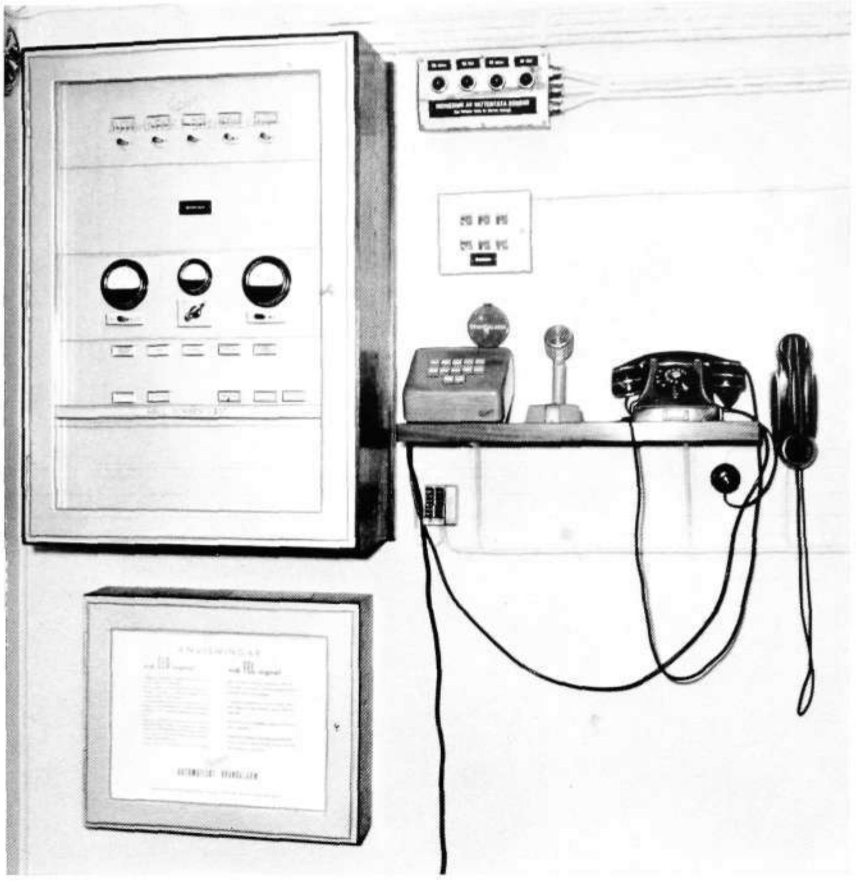


Fig. 6 X 6742

Automatic fire alarm control board

mounted on the bridge. Right control set and microphone for the loudspeaker system and local telephones.

The control board contains relays, signal lamps, keys, meters, etc. required for the operation of the system as well as keys and meters for battery charging.

The system is closed circuit controlled which means that all faults such as disconnections, leakages or short circuits which may occur on the wiring to the valves are automatically indicated by a fault signal in the control board. The control board is designed in such a way that it allows connection of alarm push buttons and detectors in position where such are required.

The system is operating on two 24 V, 30 Ah NiFe accumulator batteries.

When a group is put into operation by an outbreak of fire the contact device which disconnects the two-wire loop from the control board corresponding to the group is affected. The closed circuit is opened and the control board operates an alarm signal at the same time as the number of the section affected by the alarm is indicated.

Manual fire alarm can be initiated from fire alarm boxes *KEB 3201* on deck. These operate in this particular instance a simple drop indicator board. The drop indicator and the fire alarm control board enables the officer on duty to get a clear picture of a fire incident and to take the necessary steps to prevent an outbreak of panic amongst the passengers. He has then at his disposal the general fire alarm signal system over the loudspeakers and can broadcast information and instructions by means of the microphone.

The systems concerning safety on board are approved by the Swedish Board of Commerce and in applicable parts by the Swedish Fire Tariff Association.

New Ericsson Radio Receivers

C FREDIN, SVENSKA RADIOAKTIEBOLAGET, STOCKHOLM

U.D.C. 621.396.721

Outstanding among the Svenska Radioaktiebolaget's news for the 1953—1954 season are Klockett, a clock receiver with automatic switching, and the radiogram Grandett, which can be supplied with or without tape recorder.

Ericsson Klockett

With *Klockett* the Svenska Radioaktiebolaget presents a new feature—the so called clockreceiver—which automatically switches itself in on a predetermined time.

Often it happens that an interesting radioprogram is missed due to one not having switched on the receiver at the right time. Klockett is a guarantee against such forgetfulness as it contains in addition to a good receiver also an electric clock equipped with a device which automatically switches the set on at a predetermined time.

Klockett can also be used as an alarm clock. Klockett is noiseless and wakes the owner up discretely with the morning's wireless program instead of a hostile alarm signal.

Klockett is a table set, fig. 1, in a mahogany cabinet with simple, clean lines. The right hand portion contains a 5-valve wireless set with excellent sensitivity and good selectivity. It is provided with long, medium and short wave tuning and a built-in frame aerial. When necessary outer aerial and earth can be connected. Klockett gives a clear and pleasant reproduction well balanced even at low volume.

On the left hand portion of the receiver the clock with its connecting device is built-in. The clock is a synchronous clock and the receiver can, therefore, be used on A.C. 50 c/s only. The clock is of an excellent precision make. The dial is clear and distinctive with luminuous hands. A second-hand moving around the dial shows clearly that the clock is working.

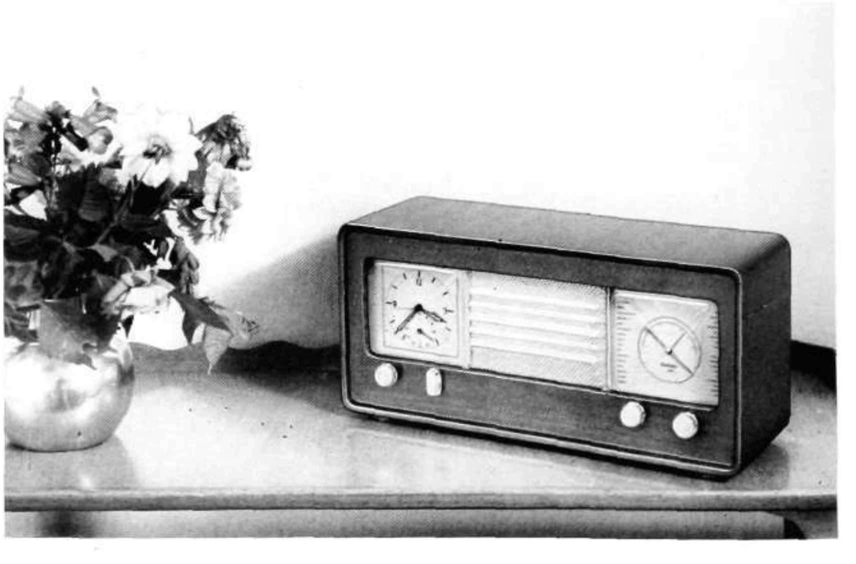


Fig. 1 X 6759

Ericsson Klockett

The controls are from left to right: setting knob, switch, volume control and tuning control.

Fig. 2 X 7651

Ericsson Grandett 1538 VB with tape recorder

right with roll tops and doors open. The controls are from left to right, volume control, bass and treble control, off-on, radiogram-switch, tuning and range knob

Below the dial the controls are to be found—a three-position switch and a knob. When the switch handle is in middle-position the set is disconnected. When it is turned to the right pointing against the dial the set is switched on manually just as any other wireless set. When automatic switching in of the set is required, the switch handle is turned to the left to point towards the clock. Switching in is obtained at the desired time, which is set by turning the knob to the left of the switch handle. A small hand at the lower part of the dial indicates the setting time. At the indicated time a mercury switch connects the receiver. From the above is seen that setting is very easy and is made with a few simple movements.

The rear of the clock is provided with arrangements for adjusting the hands and for starting the synchronous motor.

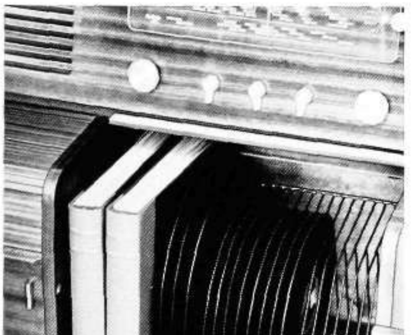


Fig. 3 X 4919

Ericsson Grandett 1538 V without tape recorder

The right hand compartment has space for record rack as well as record albums.

Ericsson' Grandett

Grandett is the biggest and most modern of the Ericsson radiograms. It is designed to contain tape recorder if so is desired apart from the receiver and record changer, all easily accessible in a cabinet with pleasant, modern lines, fig. 2.

The upper portion of the radiogramophone contains the wireless set with loudspeakers. They are mounted at the back of a panel with all controls easily accessible. The whole forms a unit which can be pulled out from the cabinet.

The wireless receiver is very sensitive and selective and is provided with an extra powerful output stage. It contains 7 valves including tuning eye (11 valve functions). The dial is copiously furnished with very legible station names; short wave tuning is facilitated by band spread.

The amplifier can be connected for wireless reception, ordinary records, long playing records and tape recorder. It is pushpull coupled and has separate controls for bass and treble.

The acoustic effect is covered by two similar loudspeakers with a total cone area of 600 cm^2 (93 sq.in.). The diaphragms are a shade different in order to supplement each other in the best possible way. The amplifier as well as the loudspeakers produce a very deep bass and a treble as high as that in the best recordings.

The lower portion of the radiogram is divided in two compartments both with roll tops and front doors. The left hand compartment holds a built-in 3-speed record changer and plays, therefore, all kinds of records. The gramophone is very accessible and can be operated without being moved from its position. Below it there is space for records.

The construction of the record changer is robust, the changer mechanism reliable and the motor silent. The mechanical transmission gear is made with the precision which is necessary for a distortion-free reproduction of the exacting records for $33^1/_3$ r.p.m. The pick-up is mechanically very responsive and the pick-up arm is balanced so as to obtain a needle pressure lower than 10 grammes. These properties are extremely important as they determine the life of the records. Among other properties of the pick-up may be mentioned the wide frequency range and the remarkably low intermodulation distortion.

The right hand compartment offers space for record albums and a special record rack. The tape recorder is fitted in this compartment when it is included in the Grandett. Underneath the tape recorder there is space for microphone and tape reels. If desired the tape recorder can be added later.

The tape recorder can be used for recording and reproduction of programmes from microphone, broadcast or gramphone. It is push button controlled and is adjustable for two tape speeds. The high speed is giving a total playing time of one hour per reel and gives a reproduction of up to 10 000 c/s. The low speed reproduces less treble, 6 000 c/s maximum, but doubles in return the playing time.

In spite of the extensive equipment the dimensions of Grandett are moderate. The height and the width are 90 cm ($35^1/_2$") and the depth 40 cm ($15^3/_4$"). Grandett is only supplied for 50 c/s. The cabinet is either silk matted natural mahogany or highly polished dark mahogany.

Ericsson LM NEWS *from* *All Quarters of the World*

30,000 Lines Installed by LME in South America and Mexico

The last few months have seen a number of L M Ericsson exchanges brought into service in various corners of the world. In South America installations totalling some 11,000 lines have been opened. The two Brazilian towns of Ribeirão Preto and Pelotas now have their exchanges working—2,500 lines at Ribeirão Preto and 5,000 at Pelotas. In Argentina 500 lines have been added to the Concepción del Uruguay exchange previously installed by L M Ericsson, and a new 1,500 line exchange has been opened at Pasto in Colombia. In Venezuela the Valera 600-line exchange was inaugurated on July 11.

Ceremonial Inauguration of Chilean Telephone Exchange

An automatic exchange has been put into service at the Chilean town of Arica. The ceremony opened with the playing of the Chilean national anthem by the Band of the 4th Infantry Regiment and was followed by the hoisting of the national colours in front of the telephone exchange. A large number of civilian and military representatives were present, including the Governor of Arica, don Manilo Bustos, and the Mayor, don Edmundo Flores Rivera. A sound film was taken of the ceremony which appeared in news reels throughout the country.

Arica is a large trading town with a free port serving Bolivia and southern Peru. A P.A.B.X. with 90 extensions is to be installed by L M Ericsson at a hospital in course of erection at Arica.

18,000 Lines Cut Into Service in Mexico City

Considerable enlargements of the Mexico City automatic exchanges are being undertaken. This year a total of 18,000 lines have been cut into service at the following exchanges: Valle 6,000, Peralvillo 5,000, Zocalo 4,000 and Chapultepec 3,000 lines. Work is also proceeding on other exchanges representing 13,000 lines.

Exchanges in Faroes, Turkey, Indonesia

In the Faroes a 1,500 line exchange has been opened at Torshavn. In the Turkish town of Kayseri 1,000 lines have been brought into service, and the Gambir exchange in Indonesia of 1,000 lines was opened on July 1. All these exchanges are equipped with L M Ericsson's 500-line selectors.

Automatic Exchange for Ängelholm

This summer a new automatic exchange catering for 3,500 lines was brought into service in Ängelholm, operating on L M Ericsson's 500-line selector system. Mr Håkan Sterky, Director General of the Swedish Telegraphs, was present at the opening ceremony. The conversion to automatic operation of a number of neighbouring rural exchanges took place at the same time, thus completing the first extension of the Ängelholm group of 13 exchanges. All communication within this area and with the Hälsingborg and Klippan areas is now established over the subscriber's dial without the assistance of an operator.

On the left, Dr. Mario Menoghetti, Mayor of Pelotas, has his finger to the starting button which will bring his town's new telephone exchange into operation. Below, the Arica exchange being blessed by the Bishop.

Show Room in Copenhagen

The show room of L M Ericsson A/S, Copenhagen, has met with great appreciation as a lecture and conference room for firms of consulting engineers, productivity organizations, schools and the like.

The above photograph shows a gathering of works managers and assistants discussing problems of internal communication on a 3-year evening course run by the Danish Institute of Factory Organization. Third from the left is seen the leader of the Institute, Mr Zimsen.

Employees of all ages flocked to Skansen on LM Day. The performance by the LM Amateur Theatrical Company of »The Fledgeling» by Selma Lagerlöf was a much appreciated feature of the day.

Rural Autoexchanges in Italy

The rural areas surrounding the two Italian towns of Verona and Legnano in the northern Po valley will shortly be converted to dial operation. The exchanges of these towns are already equipped with L M Ericsson's 500-line selectors. The Verona zone will comprise 48 terminal and sector exchanges spread over 11 sectors. Altogether the zone will contain 3,450 lines. The Legnano zone will comprise 13 exchanges catering for 760 lines in 4 sectors. All exchanges will be equipped with crossbar switches.

30,000 Visitors to Skansen on LM Day

This year was the seventh in which L M Day has been held at Skansen, and not far short of 30,000 men, women and children passed the turnstiles. The opening ceremony took place on the Solliden terrace to the accompaniment of music by the L M Orchestra, after which Mr Sven Ture Åberg delivered an address on the trading situation in different parts of the world.

The programme had been drawn up by the Head Factory Entertainments Committee, and the numerous musical and other entertainments were provided by office and workshop employees of the various L M Concerns.

Telephone Exchanges in Finland

The L M Ericsson-built exchange in the Finnish town of Kuopio is to be extended by an additional 1,000 lines. Rural exchanges equipped with crossbar switches are to be installed at Madekoski, Pikkarala, Lehtimäki, Mattkärr, Teuva and Sukula.

LM Automatizes Seven Brazilian Towns

A further seven Brazilian towns are to be equipped with L M Ericsson automatic exchanges. An aggregate of 5,000 lines will be installed at Maringá, Carangola, Martinópolis, Presidente Prudente, Alvarez Machado, Aracatubá and Aquidauna.

From our Visitors' Bok

A large number of visitors from far and near were shown over the Midsommarkransen factory this summer. The photograph to the right shows a Colombian delegation led by Dr. Camillo J Cabal Cabal, Managing Director of the Caja de Crédito Agrario, Industrial y Minero of Colombia. Among the delegation was also Dr. Douglas Botero Boshell, member of the Board of Empresa Nacional de Telecomunicaciones. (Below) Indira Gandhi, daughter of the Prime Minister of India. She was accompanied by Sulaiman Sait, First Secretary of the Indian Legation, on her left. On her right is Mr Holger Ohlin.

Right, the Mayor of Johannesburg, Mr H Miller, is studying the wiring up of a jack strip. In the photograph below is a Thailand delegation headed by the Minister of Finance, Mr Monty (nearest the camera). Below, right. Members of a French Productivity Committee become acquainted with L M Ericsson's automatic telephone systems.

Sweden Retains Second Place among Telephone Users

On January 1, 1952, there were roughly 79.4 million telephones in use in the world, an increase of 4.6 millions over the previous twelve months.

These figures are taken from telephone and Telegraph Co. Turning back through earlier statistics, we find that the world stock of telephones has more than doubled during the last 25 years. On January 1, 1927, the number of telephones in the whole world was 29.3 millions. From that time up to the Second World War there was an annual increase of about 1 million, and in 1939 the figure was 41.1 millions.

No statistics were prepared during the war. The first publication of figures following the peace showed a rise to 51.5 millions. The postwar increase has proceeded at a more rapid pace than the prewar. Between 4 and 5 million new telephones have been put into service every year, the record being reached in 1947 with 6 millions.

Twenty-five years ago only four countries in the world had over a million telephones, viz. U.S.A., Canada, Germany and Great Britain. France, Japan, Sweden, Italy and Australia now bring the number up to nine. In 1927 only U.S.A. had more than 15 telephones per 100 inhabitants (15.3). In 1952 there were five other countries. U.S.A. led with 29.3, closely followed by Sweden with 25.2. Canada had 22.1, Switzerland 19.9, New Zealand 19.9 and Denmark 17.5.

In Europe, the U.K. has the highest total number of telephones, 5,724,440 (telephone density 11.4), followed by Western Germany 2,700,104 (5.6), France 2,520,762 (5.9) and Sweden 1,788,874 (25.2). The statistics show only 861,181 telephones in Soviet Russia. It should be added that, as far as Russia is concerned, the figures refer to January 1, 1936, since which no official statistics have been issued.

The only country in the world which can boast of having 100 percent automatic telephone operation in the 1952 statistics is the Principality of Lichtenstein. Of the 1,967 telephones in the country all are connected to automatic exchanges. In Trieste 98 per cent of the 27,191 telephones are automatic, and in the whole of Holland 90.8 per cent out of 821,036. Nearly 70 percent of Sweden's telephones are dial instruments.

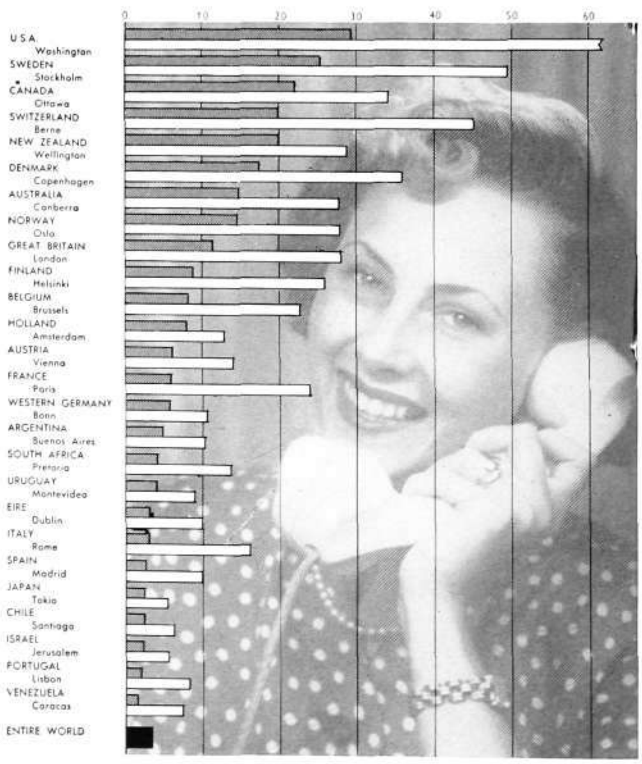
As regards telephone density in the capitals of the world, Stockholm was 25 years ago the undisputed champion with 28.7 telephones per 100 head of population. This lead was held until 1930, when Washington went ahead. The figure for Washington was then 32.7 and for Stockholm 30.5. Ten years later the positions were again reversed, Stockholm 40.1 and Washington 38.8. After the war Washington had regained the lead, and in the latest statistics Washington has 63.9 telephones per 100 head of population and Stockholm holds the second place with 49.5.

Points of interest from the statistics are that Stockholm, with its 371,886 telephones, has more than, for example, Rome with 257,538, and almost as many as Tokio, the population of which is roughly that of all Sweden. Only three cities in the world possess over 1 million telephones: New York 3.3 millions, London 1.7 millions, and Chicago 1.5 millions.

Several of the larger South American towns are plentifully equipped with telephones. Buenos Aires, the capital of Argentina, has 537,956; in Brazil Rio de Janeiro has 224,132 and São Paulo 127,697.

The statistics also show the number of calls made in different countries. The most talkative nation seems to be Canada, where 378.2 calls per person were made during the year. U.S.A. takes the second place with 376.3. Then comes Iceland with 364.8, and fourth Sweden with 309.6. Twenty-five years ago it was in U.S.A. that telephones were most used with 226.5 calls per person and year. Swedes have become almost twice as talkative during that time, as Sweden then lay fifth with only 115.2 calls per person and year.

Telephone density in different countries and capital cities. The black lines represent the countries, and the white their capitals.



U.D.C. 621.395.344:621.395.722(489.47)

BERGLUND, C: *Cut-over to Crossbar System in Aarhus.* Ericsson Rev. *30* (1953) No. 3 pp. 69—74.

On the lst of May 1953 six automatic telephone exchanges were put into operation at Aarhus covering a total of 31,800 lines and including a large automatic trunk exchange. The cut-over — without comparison the most extensive and complicated one in the history of L M Ericsson — is described in the article as regards the scope of operation, preparations and operating results.

U.D.C. 621.395.344:621.395.722(489.47)

BORREGAARD, N: *Conversion of the Aarhus Telephone Exchanges.* Ericsson Rev. *30* (1953) No. 3 pp. 75—79.

A shortened translation of a paper which the author read at a telephone engineering meeting in Denmark giving the outlines of the structure of the modern telephone system with L M Ericsson crossbar switches which has been used for the new local and trunk exchanges in Aarhus.

U.D.C. 621.395.663.2

WIBERG, E A: *New Five-Digit Counter.* Ericsson Rev. *30* (1953) No. 3 pp. 80—82.

The new five-digit counter RSA 200 described in the article is smaller and lighter than the earlier L M Ericsson four-digit counter in spite of an extended capacity. Thanks to high reliability and high speed the requirements for different methods of call charging are well satisfied.

U.D.C. 621.316.91:621.395.721

HENCKEL, A: *New High Tension Protection Equipments for Telephone Instruments.* Ericsson Rev. *30* (1953) No. 3 pp. 83—85.

The Ericsson Review No. 1, 1952 contained a description of L M Ericsson's high tension protection equipment. In this article a new design of the same high tension protection equipment is presented suitable for installation both indoors and outdoors.

U.D.C. 621.396.721

FREDIN, C: *New Ericsson Radio Receivers.* Ericsson Rev. *30* (1953) No. 3 pp. 90—92.

Short description of some of the new Ericsson receivers of the season 1953—1954: Klockett, a clockradio with automatic switching, and the radiogram Grandett.

U.D.C. 621.391:629.12.066

NORMARK, P: *Telecommunication Equipment on Board s/s Birger Jarl.* Ericsson Rev. *30* (1953) No. 3 pp. 86—89.

S/s Birger Jarl is the latest ship of Stockholms Rederi AB Svea and has recently been put into service between Stockholm and Finnish ports. The ship was built at the Finnboda shipyard in Stockholm and has been provided with modern telecommunication equipment from L M Ericsson as described in the article.

The Ericsson Group

ASSOCIATED AND CO-OPERATING ENTERPRISES

EUROPE

Danmark

L M Ericsson A/S *København V*, Trommesalen 5, tel: C 3438, tgm: ericsson-københavn

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 5*, 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. 1*, 329 High Holborn, tel: Holborn 1092, tgm: teleric-london

Production Control (Ericsson) Ltd. *London, W. C. 1*, 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: 780221, 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: 557470, 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

Liban

Telefonaktiebolaget L M Ericsson, Technical Office *Beyrouth*, Rue du Parlement, Immeuble Bisharat, tel: 162, tgm: ellem-beyrouth

Türkiye

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

AMERICA

Argentina

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

Canada

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

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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

AUSTRALIA & OCEANIA

Australia

L M Ericsson Telephone Co. Pty. Ltd. *Melbourne C 1 (Victoria)*, Kelvin Hall 55 Collins Place, tel: Cen. 5646, tgm: ericmel-melbourne

AGENCIES

EUROPE

Belgique

Électricité et Mécanique Suédoises *Bruxelles*, 56 Rue de Stassart, tel: 11 14 16, tgm: electrosuede-bruxelles

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Schweiz

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AMERICA

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Guatemala

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

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Nicaragua

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

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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

Electro-Industrial »Halven», O. L. Halvorssen C. A. *Caracas*, Apartado 808, tel: 53848, tgm: halven-caracas

AUSTRALIA & OCEANIA

New Zealand

ASEA Electric (N Z) Ltd. *Wellington C. 1*, Huddart Parker Building,

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CONTENTS

On cover: L M Ericsson's Telephone Answerer

H T Cedergren
— a Swedish Telephone Pioneer

New Year's Eve 1953 will be the centenary of the birth in Stockholm of Henrik Thore Thorsten Cedergren. His great contributions to the field of telephony deserve to be remembered on this occasion.

Cedergren graduated from the Institute of Technology in 1875, and in 1877 he took over from his father a jeweller's shop in Stockholm. By the end of that year the first American telephones had made their appearance in Sweden, and Cedergren had a line run between his home and the shop; this was the first installation of the kind to be put to practical use in Sweden.

When the American-controlled Bell Company opened a telephone operating service in Stockholm in 1880 and Cedergren became acquainted with the new means of communication in his capacity as a subscriber—with, be it said, a strong mechanical bent and an unusual business acumen—he came to the conclusion that the tariff charged in Stockholm of 240 kronor per year was much too high. The telephone was then looked upon as a luxury reserved to the more well-to-do classes. Cedergren thought this a mistaken view of the value of this genial invention. The telephone would fail of its purpose if it did not reach the greater public and become part of the fabric of the life of the country. But if that was to happen, it could not be regarded, as the Bell companies did regard it in Stockholm and elsewhere, solely as a means of reaping profits. It would be necessary to pursue entirely new principles, which were formulated by Cedergren in the following terms—low tariffs, limited dividends, adequate allocations to reserves, first-class service—which he believed would result in wide support from the public and yield a reasonable profit. What Cedergren meant by a reasonable profit he showed later in practice; earnings should suffice for the necessary allocations to reserves and payment of an 8 percent dividend. Cedergren was undoubtedly the first to visualize the important rôle that the telephone could play and the conditions necessary for its accomplishment.

With the initiative and energy that were characteristic of the man, Cedergren prepared to translate his visionary ideas into action, but not until he had assured himself of regular supplies of telephone material from Lars Magnus Ericsson's workshop—the best material available at the time. After many setbacks the 29-year-old engineer successfully brought into being the Stockholm General Telephone Company (Stockholms Allmänna Telefonaktiebolag), which was incorporated on April 13, 1883, with a share-capital of 90,000 kronor and with Cedergren as its managing director. In the management of this company, to which he devoted all his energy during the remaining 26 years of his life, Cedergren displayed his peculiar ability as organizer, adminstrator, technician and financier. His life was one of intense industry and constant struggle—first against the Bell Company, which, however, after a few years retired from the fray and sold its installations, and later against the Swedish Telegraphs, which in 1889 entered into competition within the Stockholm area. Yet despite the advent of this formidable competitor the Cedergren enterprise was able to maintain its predominant position in respect to number of subscribers. It should be remembered that, within a few years of the birth of the General Telephone Company, Stockholm had taken the first place among the cities of the world as regards telephone density and held the lead for many years to come. On December 31, 1908, only a few months before Cedergren's death, his company had about 51,000 subscribers in Stockholm. By July 1, 1918, when the telephone installations were taken over by the Swedish Telegraphs, this number had risen to 106,000. In the same year the amalgamation took place of AB L M Ericsson & Co and Stockholms Allmänna Telefonaktiebolag under its present form, Telefonaktiebolaget L M Ericsson.

At the beginning of the 20th century Cedergren extended his activities abroad. Two companies formed by the General Telephone Company, and working under Cedergren's direct management, obtained telephone operating rights in Moscow and Warsaw in succession to the Bell Company, whose concessions were not renewed. These systems were installed and operated on the same lines as adopted in Stockholm. As an example of the difference in tariff policies followed by the Bell and Cedergren companies in Moscow may be mentioned that the annual charge made by the Bell Company was 250 roubles (480 kronor), while Cedergren was content with 79 roubles (152 kronor) for the same type of subscription. Following the change-over the numbers of subscribers rose rapidly—in Moscow from about 2,300, representing the final figure of the Bell Company in 1901 after 20 years of work, to about 54,000 on January 1, 1917, when the system was taken over by the Tsarist government.

Cedergren's plans extended further, however, than working in merely local districts. At the beginning of 1888 his company applied for permission to construct long-distance lines to Gothenburg, Malmö and Sundsvall. The plan was a bold one, since at that time little experience had been gained of the properties of lines of such a length. Though the application was turned down, it undoubtedly led to a quicker solution of the problem of long-distance lines by the Swedish Telegraphs. As early as August, 1889, traffic was opened between Stockholm and Gothenburg on a quadded cable line.

Cedergren's achievements were known far beyond the boundaries of Sweden, and the tributes paid to him were many. One alone will be quoted here—from a telephone conference in London in 1898, when discussion ranged around the competition in Stockholm and the low tariff charges. Sir W.H. Preece, Chief of the Engineering Division of the British General Post Office made this statement on that occasion: »Cedergren, the head of the company in Sweden, is one of the most active and energetic men that the telephone world has seen, a man who has built up the company in its entirety, and I believe that the achievements in Stockholm are due far more to Cedergren's energy, go-ahead spirit and financial genius than to any reduction in tariffs».

On April 13, 1909—26 years to the day since the foundation of his great enterprise—Cedergren departed this life. In the history of Swedish telephony his name will remain indelibly carved beside that of the other great pioneer, Lars Magnus Ericsson.

Hemming Johansson

L M Ericsson's Telephone Answerer

H BLOMBERG, SVENSKA RADIOAKTIEBOLAGET & O ERICSSON, TELEFONAKTIEBOLAGET L M ERICSSON

U.D.C. 621.395.625.3

Some years ago L M Ericsson took up the problem of designing a simple but reliable apparatus with which a recorded message could be automatically transmitted from the subscriber's telephone when he was out and could not himself answer calls. The fruits of this work are now seen in the telephone answering machine, the design, functions and uses of which are described in this article.

When the Dane, Valdemar Poulsen, in 1899 presented the principle of magnetic sound recording and obtained a patent for his »telegraphone», one of the things he may have had in mind was to create an instrument which would record a subscriber's spoken message and automatically transmit it over his telephone to anyone calling him in his absence.

It is quite remarkable that Poulsen's idea has not been realized in practice during the more than 50 years that have passed. The reason is, of course, that the idea was far ahead of its time. At the beginning of the 20th century the technical resources to translate it into a system applicable to general use were quite simply non-existent. The science of electroacoustics and research in magnetic materials were still in the embryo stage, and the electron tube amplifier which was to make the device possible was not discovered until a long time afterwards.

The first satisfactory magnetic sound recorders were built in the 1930s. They found employment in broadcasting studios for recording radio programmes. The recording medium in these recorders was generally steel tape, but steel wire and magnetic foil or tape recorders soon followed. The way was now open to make use of magnetic sound recording in a simple manner for dictaphones and similar apparatus. The success of these tape recorders came during and immediately after the war, since when they have been increasingly employed for different purposes as their design has been improved and made less expensive. No magnetic recording device directly

Fig. 1 X 6777
Telephone Answerer
with controls placed on recorder cover

Fig. 2 X 6778

Recorder

with on and off switch, window, and record and play-back buttons

designed as Telephone Answerer, however, has previously come into common use.

When L M Ericsson started to work on the problem some years back, the goal set to those engaged on the design of the apparatus was that it should be suited for use by the broad telephone public and should be as simple to operate as possible. Its construction should be so simple and dependable that it would serve its purpose under any conditions of answering the telephone when the subscriber did not wish or could not answer it himself.

The result was L M Ericsson's Telephone Answerer which, after thorough tests covering two years of employment in the Swedish public telephone system, is now presented to the readers of Ericsson Review.

Design

The Telephone Answerer is connected in the circuit between the subscriber's line and the normal subscriber's telephone set. The message is spoken into the telephone handset.

In the form shown in fig. 1, the Telephone Answerer consists of a motor-driven magnetic recording device, comprising an amplifier and switching units composed of relays and cam discs within a case. The apparatus is made for wall-mounting, and its internal parts are inaccessible to the subscriber.

On the cover (fig. 2) is mounted a switch, for switching the telephone answerer on and off and, beside it, is a rectangular window in which a telephone symbol or white field appears, showing whether the set is disconnected from the line or is switched for answering or recording. In the top right corner is a non-locking »record» button inset in the case to prevent it from being pressed by mistake, and at the bottom left a »play-back» button.

The recorder is connected between the telephone and subscriber's line by a 4-point plug and jack. Connection to the electric mains is by a wall plug and a switch on the side of the case.

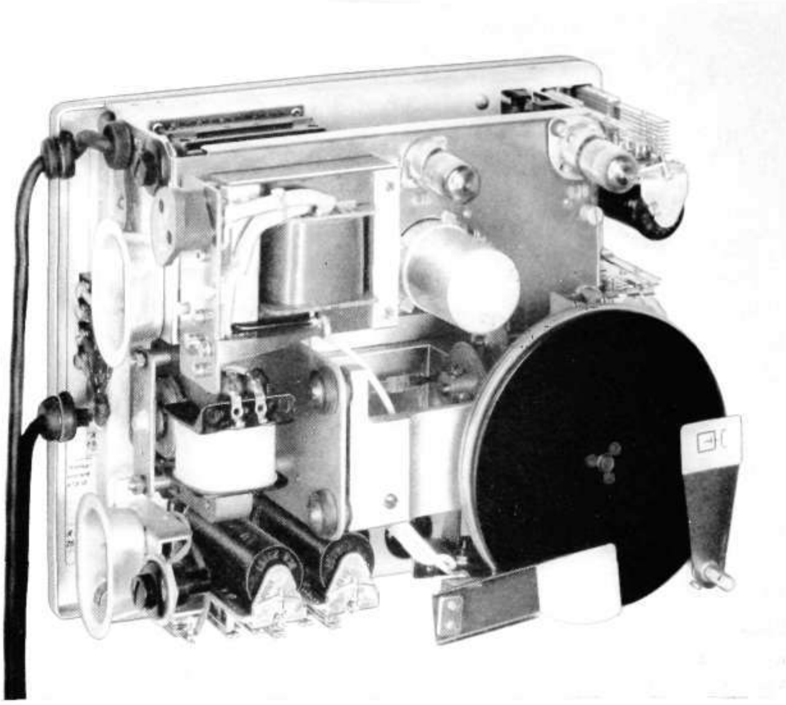


Fig. 3
Interior of recorder

X 6779

The recorder will operate on 110, 127 or 220 volts A.C. ± 10 volts.

The thorough construction of the recorder assures extreme reliability and simplicity of maintenance. It consists of three units shown in fig. 4.

On the base plate are, in addition to resistors, capacitors, rectifiers etc., three control relays and a number of cam disc contacts. A chassis, which can be easily detached from the base plate, carries the driving motor, the magnetic recording disc, consisting of a magnetic foil fixed to a heavy circular metal disc, and an arm supporting the recording and play-back head, and finally gears, worms and cam discs. The third unit consists of a second chassis carrying an amplifier and mains supply units.

Function

When the switch is turned towards the window and a telephone symbol appears in the window, the telephone is connected to the line and is used by the

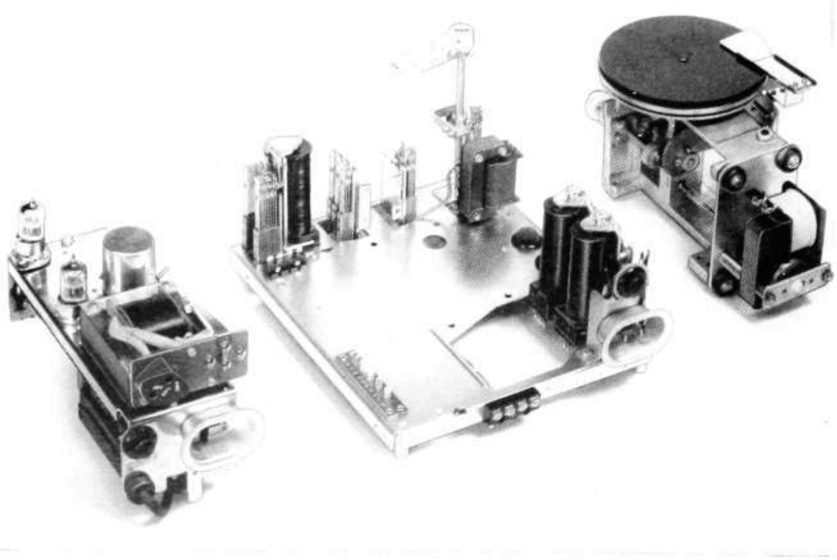


Fig. 4
Main components of recorder

X 6780

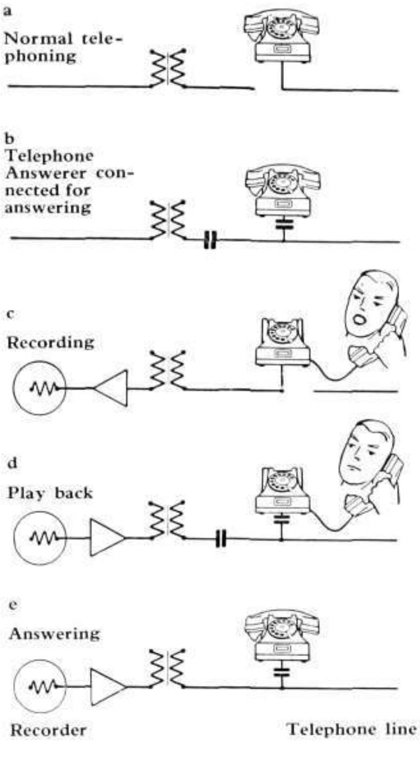


Fig. 5

Schematic of Telephone Answerer's functions

subscriber in the normal manner (fig. 5 a). When he wishes to use the Telephone Answerer, he turns the switch towards the record button in the top right corner, whereupon a white sign becomes visible in the window. The telephone line is thus switched over from the telephone to the Telephone Answerer (fig. 5 b), which is thus ready for use.

To record a message, the subscriber raises the telephone handset and momentarily presses the record button with any pointed object such as a pencil. He thereby actuates a recording relay in the recorder, so switching over the apparatus from the telephone line to the telephone (fig. 5 c). A motor relay is now set in action, which starts the recorder motor, and the magnetic disc commences to rotate. For a duration of about two seconds current flows through a demagnetizing coil which is rigidly mounted in front of the disc, whereby the disc is demagnetized as it rotates past the coil and a previously recorded message is erased. During this period a black sign appears in the window. Thereupon the recording and play-back head sets up a radial movement and its pole piece describes a spiral movement on the disc. At the commencement of this movement, a white sign appears in the window to indicate to the subscriber that he can start delivering his message. The time available for recording is about half a minute. This period suffices for recording at least 50 words which, after close study, has been found to be the most suitable length of message.

The white sign increases until, at the end of the recording time, it completely fills the window. The speech currents generated in the telephone transmitter pass through the amplifier on their way to the recording head, which magnetizes the magnetic foil, on which the message is consequently recorded. A message may run as follows: »12 34 56. This is Dr. Anderson's telephone answerer. Dr. Anderson is away and will return on November 1. Dr. Beckman is acting as locum, telephone 24 68 64. Dr. Beckman's number is 24 68 64». When the subscriber has completed his message, which he can do at any time during the recording period, he replaces his handset.

At the end of the recording period a switching action takes place in the recorder by means of the motor-driven cam discs and contacts actuated by them, whereupon the magnetic recording device repeats the above-described process, but with the amplifier in reverse connection (fig. 5 d). The recorded message can thus be heard in the telephone receiver and be checked by the subscriber if he keeps his handset to his ear. At the end of the play back period, the motor relay is deenergized by action of the cam disc contacts and the motor stops; at the same time the recorder is put back into the telephone line circuit. The recorder is now at rest, but with the amplifier connected, and is thus ready to receive and answer incoming calls. The play-back procedure described above can in fact be carried out at any time desired by pressing in the play-back button.

On receipt of a call, a ringing relay in the recorder is actuated and »answers» the call. The motor relay is energized and starts the recording equipment. The play-back head is now connected to the telephone line over the amplifier, and the recorded message is therefore delivered to the caller (fig. 5 e).

On completion of the $^1/_2$-minute period the cam disc contacts reverse the connections so that the message is repeated once again. Repetition of the message permits the caller to memorize it better or to make a note of any information given, such as a telephone number or date. After repeating the message, the machine stops automatically.

At any time he wishes, the subscriber can connect the telephone to the line in the normal manner by turning down the switch without thereby affecting a recorded message. He can thus interrupt a transmission or recording in order to speak to the caller himself, and reconnect the Telephone Answerer to the line again afterwards.

The Telephone Answerer is also produced with the controls placed on a separate key base. This is a telephone key base, as pictured on the cover, connected to the recorder by a multiwire telephone cord. This type of apparatus is designed to meet requirements of remote control, when desired either for reasons of space or convenience.

When the subscriber wishes to use the latter Telephone Answerer, he presses the switch-on button in the key base. The telephone line is thereby switched over from the telephone instrument to the telephone answerer, and the red lamp lights. After pressing the record button and lighting of the green lamp, the subscriber can start to deliver his message. During the last 10 seconds the green lamp flickers, indicating that the recording period is drawing to an end.

Recording of Incoming Messages

The primary object of the Telephone Answerer is to transmit a recorded message to anyone calling. It contains no equipment for receiving and recording messages from callers. A machine for this purpose must, inter alia, contain a magnetic recording device of sufficient capacity to record the many messages received during the subscriber's absence and will, therefore, be considerably larger and more complicated.

With Ericsson's Telephone Answerer, a very much simpler method of providing for these requirements has been adopted. The design of the Telephone Answerer simply incorporates arrangements for connecting to it a recorder of any commercial type, mechanical or magnetic, on which incoming messages can be recorded.

The connection is made by a special jack on the recorder (placed below the mains switch on the side of the cover (fig. 1), into which the starting circuit of the dictaphone or tape recorder can be plugged (fig. 7). The speech circuit of the dictaphone can be connected to the telephone line by another jack and plug.

The insertion of the start plug into the recorder jack actuates switches in the recorder which arrange that the recorded message is transmitted once only. The recorder remains connected to the telephone line for 60 seconds, as described above. After 20 seconds, however, the amplifier output is short-circuited and remains short-circuited for 30 seconds, after which 10 seconds is left. Thus during the 30-second short-circuited period the Telephone Answerer

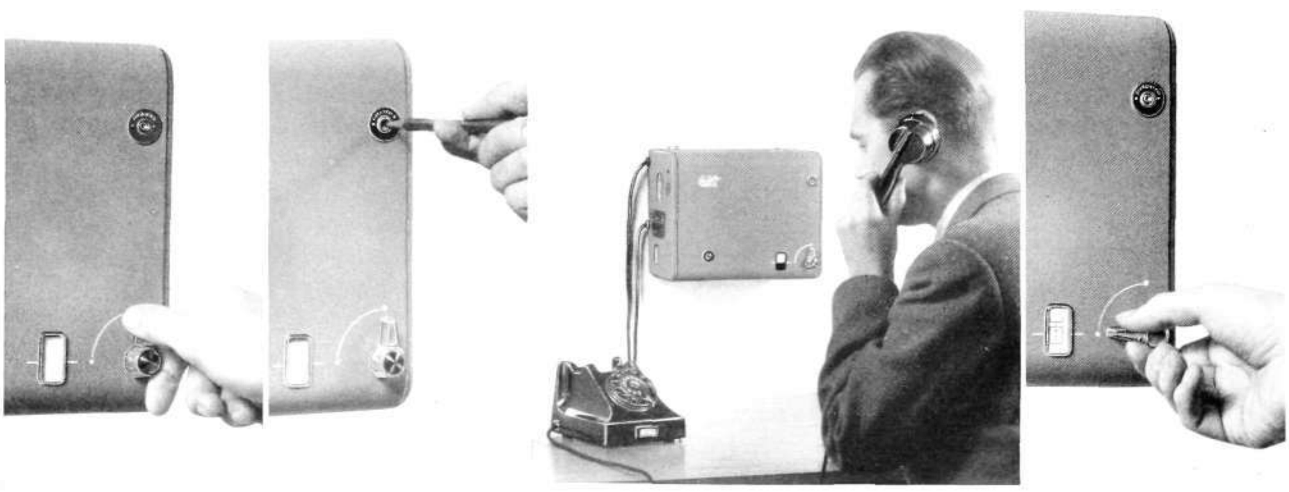


Fig. 6 X 7657

Manipulation of the Telephone Answerer

Photographs from left to right: switching the machine in answering position by turning switch to the right; pressing record button, after which the handset is lifted and recording can start; play-back of a recorded message. The right hand picture shows how the telephone is connected in by turning the switch to the left, whereupon a symbol representing a telephone instruments appears in the window.

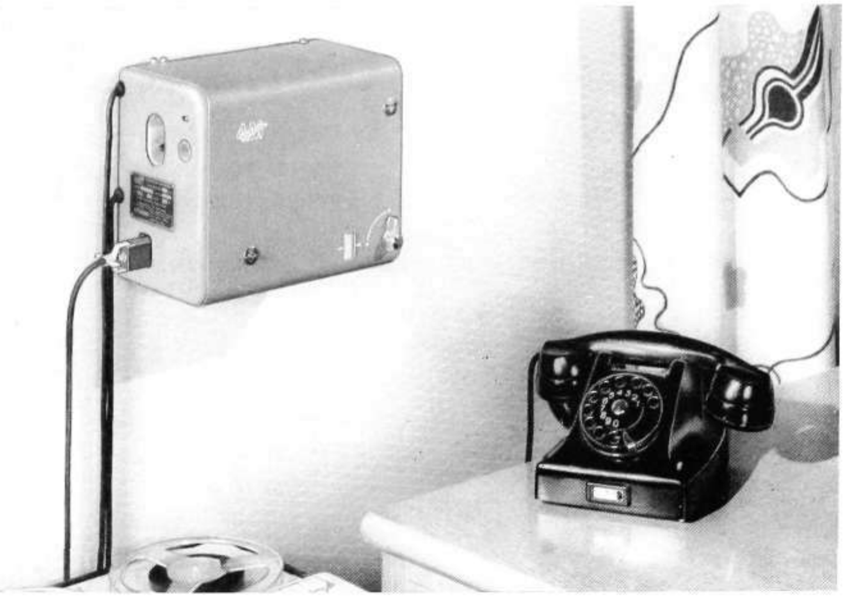


Fig. 7 X 6781

Telephone Answerer connected to tape recorder

for recording incoming messages

cannot deliver a message. The dictaphone is connected to the telephone line during the entire period and records everything that is said on it. Consequently the short-circuited period can be used for receiving the caller's message.

A message given to the recorder may in this case be of the following nature: »23 45 61. Peterson and Peterson, Solicitors, telephone answerer. Mr. Ronald Peterson is out until 11 o'clock. If you have an important message, please speak now». When the white sign fills about two-thirds of the window, that is when 10 seconds of the recording time are left, the words »Time is up. Thank you» should be spoken. Due to the short-circuit described above, these words are not transmitted by the machine until within 10 seconds of the end of the periods. As soon as the caller hears the words »speak now», he delivers his message during the 30—40 seconds at his disposal, at the end of which he hears the words »Time is up. Thank you». The callers' messages are recorded on the dictaphone together with the message given by the Telephone Answerer, the latter separating the incoming messages from one another.

This method of recording incoming messages on a separate dictaphone is greatly to be preferred to recording on the Telephone Answerer itself. Dictaphones are nowadays both dependable and fairly inexpensive instruments. When the subscriber is in, the dictaphone can be used by him for normal dictation and thus involves no extra outlay.

Uses

The simple and sound design of Ericsson's telephone answering machine and the extreme simplicity of its operation afford good prospects of success. Those who will most benefit by it are doctors, lawyers, taxi-offices, tradesmen, businessmen and others who cannot afford to have special staff to answer the telephone in their absence. For them the Telephone Answerer will meet a long-felt need. In larger organizations, too, where many people are often not in their office and calls are unanswered, so causing irritation and inconvenience, it can perform a valuable secretarial service.

Another category of users are shops which wish to impart information about, for example, lunch-closing hours or about bargains being offered on the following day, and so on. The possible uses of this interesting device are multitudinous. In Sweden, for instance, it has for some time past been used for telephone weather forecasts.

Choice of Automatic Telephone System for Copenhagen and District

S STENBÆK, SECTION ENGINEER, KJØBENHAVNS TELEFON AKTIESELSKAB (KTAS)

U.D.C. 621.395.344

The order for fully automatic exchanges of crossbar type for 82,500 lines as well as a large transit exchange and arrangements for interworking with existing demi-automatic systems, which KTAS placed with L M Ericsson, was preceded by thorough investigations. As this equipment has now partially been put into operation and is in the course of being errected an abridged translation is presented below of a paper published in the Danish periodical »Teleteknik» no 2, 1951 and describing the main points of this inquiry.

Earlier Copenhagen Telephone Systems

When KTAS in the twenties had to consider a new telephone system for Copenhagen, as the old LB and CB exchanges were approaching their final capacity, certain investigations were made regarding possible advantages of a fully automatic system.

With the wages and material prices at that time a fully automatic system did not prove economical and as it was considered expedient to retain a

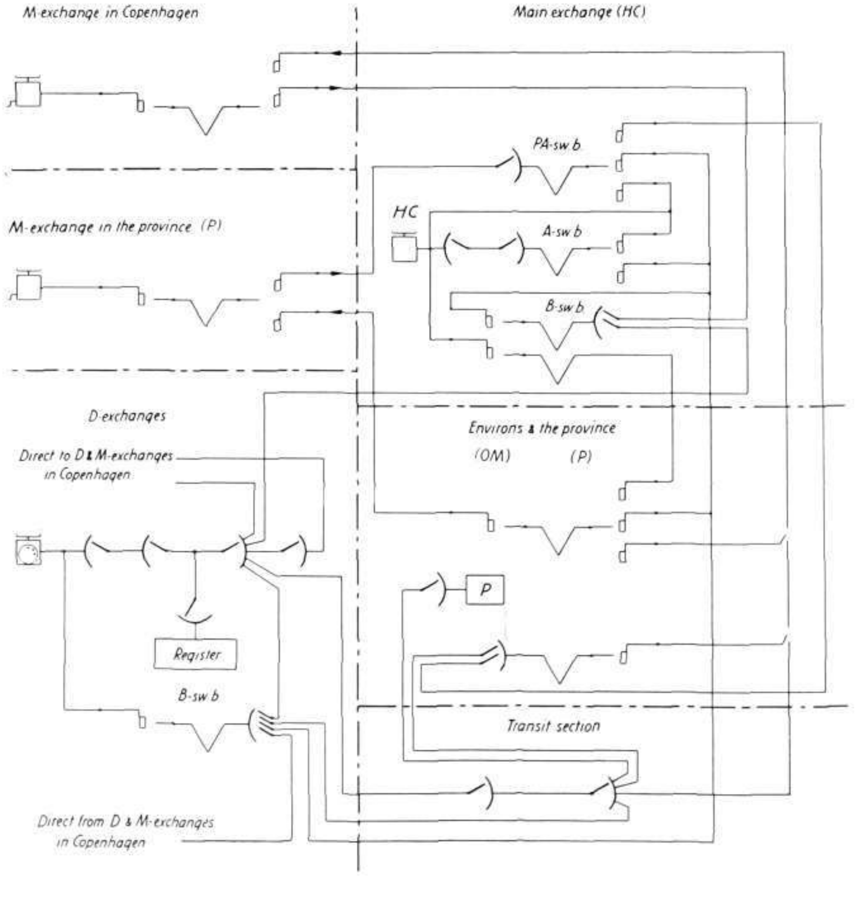


Fig. 1 X 6784

Traffic route diagram for the earlier Copenhagen telephone system

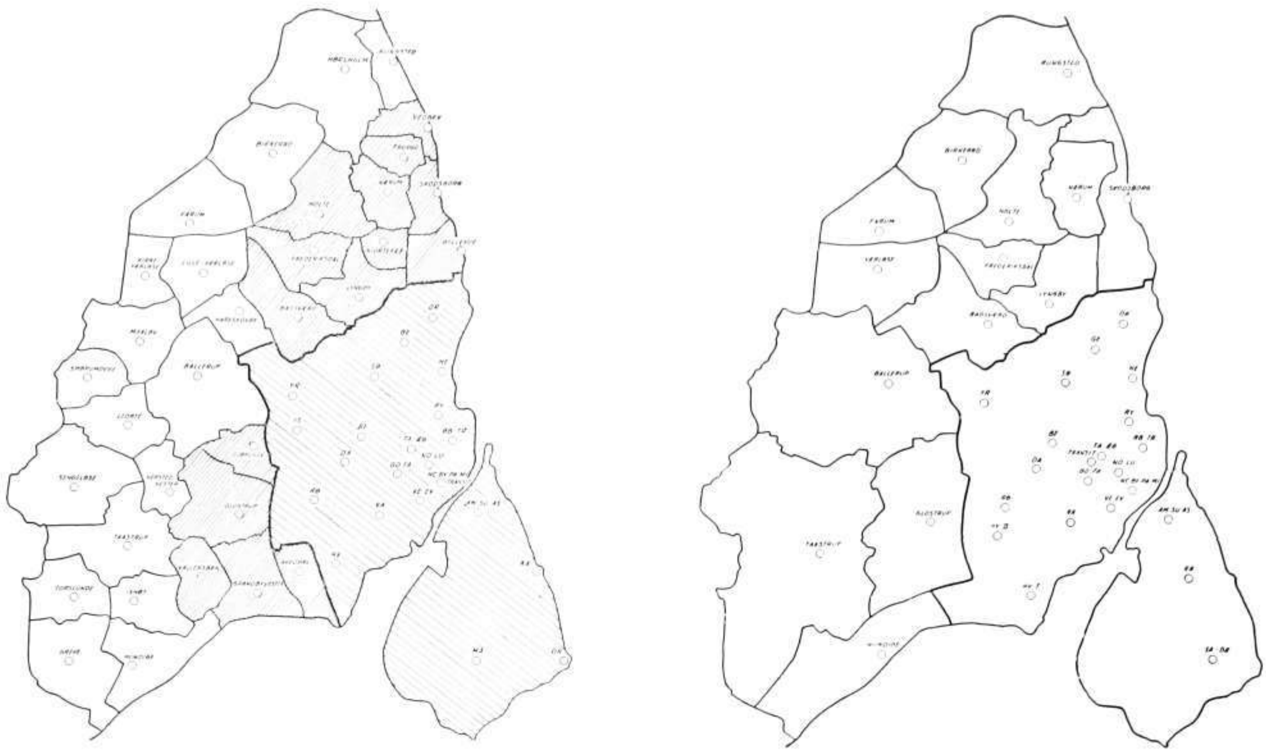


Fig. 2 X 7652 X 9124

Exchanges in Copenhagen before and after conversion to automatic operation

Copenhagen

belonging to the Copenhagen tariff area

manual stage in the establishing of a connection, the demi-automatic system was decided on.

This system, fig. 1, is characterized by the *A*-subscriber dialling and being automatically connected to the required exchange whereas the cord is set up and the calling of the wanted *B*-subscriber is carried out by a *B*-operator in the called exchange. The main exchange (*HC*) was retained from the old manual system. To this exchange were connected subscribers with a very high amount of traffic. The reason for this was that the greater part (about 60 %) of the calls from the main exchange subscribers did not go outside the exchange and such calls could be connected by one operator only. As a comparison it may be mentioned that the percentage of internal calls in the district exchanges (*D*) was about 20 %.

The *HC* subscriber sets have no dial. A call is initiated by the *A*-subscriber lifting the handset and he is then connected to an *A*-operator by automatic distribution. This operator establishes connection in the multiple for main exchange subscribers or to district exchanges in the demi-automatic system.

In addition there are LB exchanges (*M*) in the vicinity of Copenhagen. These can be called directly by the *D*-exchange subscribers by dialling 2 digits. This applies to the exchanges Kastrup Magle, Dragör, Hvidovre, Rödovre, Islebro and Yrsa.

Outside the exchanges, which in this way are connected to the demi-automatic system, are the »Environs» which together with Copenhagen will form a trunk area in the new fully automatic system, see fig. 2. The Environs are covered by 33 exchanges 15 of which belong to Copenhagen from tariff point of view. The latter are connected from demi-automatic exchanges and the main exchange over the »Environs board» (*OM*) with direct demand service whereas other exchanges in the Environs are obtained by ordering and ring-back in *OM*. This form of service is also used for *D*-subscribers to subscribers in the province (*P*) covering Sjælland outside the Copenhagen trunk area.

The Planning of a New Telephone System

Due to improved communications a considerable increase has lately taken place of subscribers in the Environs and the exchanges there are approaching final capacity. During the war it was realized that a reconstruction of these exchanges was imminent and a committee was, therefore, appointed in order to inquire into the future development of the Environs. The committee considered whether fully automatic exchanges should be erected or if the demi-automatic system should be extended to include also the Environs and if the existing exchange areas should be retained.

The committee delivered a report in the beginning of 1945 and had come to the conclusion that at the price-level then prevailing a conversion to fully automatic operation would mean some economical advantages and that certain economies would be effected by reducing the number of exchange areas. In a fully automatic network the 33 exchange areas would be reduced to 14.

With the enormous increase in the number of ordered telephones at the end and after the war it was apparent that the demi-automatic exchanges soon would be unable to receive further subscribers. It was then decided that a new telephone system should be considered also for Copenhagen.

There was no doubt that the calculations for Copenhagen would give the same result as those for the Environs especially in view of the steady increase in the wages after the war. It was, therefore, in fact a foregone conclusion that a complete conversion to fully automatic operation was to take place in Copenhagen as well as in the Environs. The investigations carried out were, therefore, in the first place concentrated on the question to which extent the first conversion stage should be carried out.

The investigations resulted in the conclusion that 82,500 fully automatic numbers divided on 13 exchanges were to be installed up to 1956. The new numbers required were estimated on the basis of the following assumptions:

1) that apart from normally incoming orders all accumulated orders had to be cleared within 6 years.

2) that existing demi-automatic exchanges would be extended to 10,000—12,000 numbers as far as this was possible in existing B-boards.

3) that remaining exchanges in the Copenhagen trunk area were extended to final capacity determined by the multiple and the premises.

4) that a fully automatic exchange was to be errected sufficiently large to take the *HC* subscribers in its exchange area.

5) that no new subscribers were to be added to *HC*.

6) that the fully automatic exchanges were to be big enough so as not to require extensions within 5 years of being put into service.

Tenders

A tender specification was drawn up for the 82,500 numbers and four companies, ATE, Siemens, Standard and L M Ericsson were invited to tender on January 17th 1950.

From the 4 companies 6 tenders were received, as Standard and L M Ericsson each produced two alternatives.

The ATE tender included a 200-line fast operating motor-driven selector as finder, whereas the group and line selectors were of the Strowger type.

In the Siemens system a fast operating motor-driven selector was offered for all selector stages.

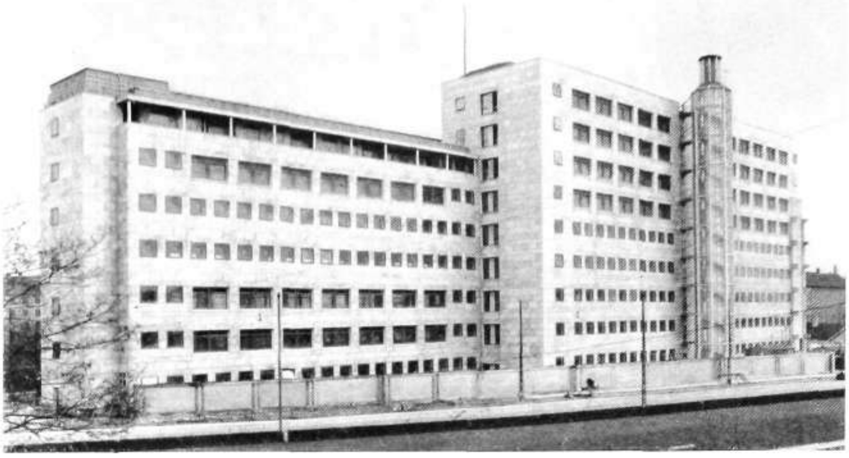


Fig. 3 X 6768
The telephone building at Borups Plads

Standard quoted on the one hand a system with sliding contacts, »Universal system U_2» and on the other a system with pressure contacts, the mechanical-electronic ME system.

One of the L M Ericsson alternatives referred to the known system with 500-line selectors and the other to a crossbar system with by-path connection.

The tenders were inspected in view of the following general demands on a future telephone system:

a satisfatory and noisefree transmission,

short connecting times in view of national automatic operation and future rapid impulsing from the subscribers' sets,

reliability and lowest possible maintenance cost.

The KTAS experiences of sliding contacts made it desirable to avoid such contacts unless exceptional technical advantages were obtained. As this was not the case, the interest was focussed on two systems containing selectors with pressure contacts, viz. the Standard ME system and the L M Ericsson crossbar system.

Without entering into technicals details for the two systems it should be mentioned that the Standard ME System must be considered new and untried as at the time of the tender only a hand-made model of the selector was available and the electronic control devices were in the laboratory stage.

At the time when the tenders were inspected the L M Ericsson system could from a circuit point of view also be classed as comparatively new and untried as the first exchange of this type in Helsinki was only partially in operation. With reference to the components included in the system these must, however, be considered as known and tested. The selector in the system, the crossbar switch, has been used in Sweden since 1919. It has proved to be an excellent connecting device and the Swedish telephone administration, therefore, decided to employ the crossbar switch side by side with the machine-driven systems. At that time the relay and circuit technic was not sufficiently developed for a successful operation according to the by-path system, which was now offered, and the exchanges were then built up similarly to the Strowger systems. The satisfactory Swedish experiences were certainly an important factor when the Americans in the thirties decided to go over to crossbar systems. The Americans applied the by-path system and the technics in this field are now so developed and the operation experiences are so satisfactory that the telephone administration in Sweden also have adopted this principle.

2*—300003

The principal difference between the American and the Swedish systems can be briefly stated as follows. The American system operates with 8 to 10 cooperating markers per 10,000 numbers, whereas the Swedish telephone administration works with 1 marker per 100 numbers and L M Ericsson with 1 marker per 1,000 numbers.

The L M Ericsson tender covered a fully automatic system in which at least the selector had been adequately tried, by-path connection was used and the price was lower than that for Standard's system with pressure contacts. As in addition the KTAS general demands were considered to be covered, the KTAS technical department recommended the crossbar system offered by L M Ericsson to be used for the conversion of the Copenhagen trunk area to fully automatic operation.

When the matter had passed through all pertinent instances, the »Telefontilsynet» in October 1950 confirmed that the Ministry of Public Works had given its approval to KTAS accepting the L M Ericsson tender.

Building Schedule

The original intention was that the first fully automatic exchange was to be put into service about January 1953 and that the 82,500 numbers were to be installed inside 1953—1955. The economical conditions in the country made it, however, necessary to reduce the funds allocated to the telephone administration and the conversion work will, therefore, probably proceed at a slower rate; it is, however, estimated that the first exchange will be put into service about January 1954 and that the 82,500 numbers will be installed over a six year period instead of over three years. The Copenhagen netgroup will, therefore, for a considerable time consist of a main exchange as well as demi-automatic exchanges, LB exchanges and fully automatic exchanges.

In the demi-automatic system there is a local transit exchange as well as a trunk and toll exchange at Nörregade. It has been queried whether this position still will be the correct one when the conversion of Copenhagen and district has been completed. In order to clarify this a committee was appointed consisting of engineers from KTAS as well as the PTT in order to get an opinion of the conditions after the conversion of the trunk traffic to automatic operation. The committee worked out the centre of the Copenhagen network and found that this was situated in the vicinity of Borups Plads.

Exchange Premises

A building has since been errected at Borups Plads, see fig. 3. The fact that the first floor contains an M.D.F. for 220,000 pairs on the line side gives an idea of the size of this building.

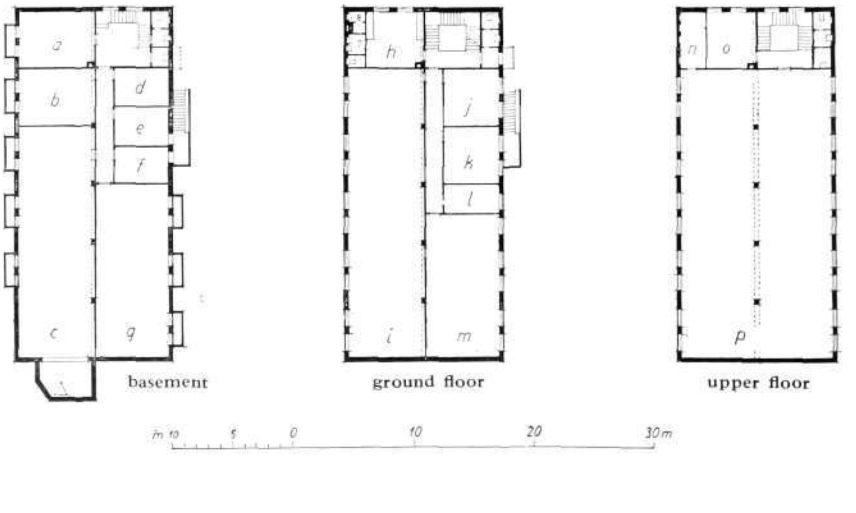


Fig. 4 X 6769

Standard building for automatic exchange

- a boiler-room
- b stores
- c cable vault
- d shelter
- e bicycle shed
- f spare
- g accumulator room
- h entrance
- i M.D.F. room
- j cloak room
- k canteen
- l stores
- m machine room
- n office
- o stores
- p selector room for 10,000 numbers

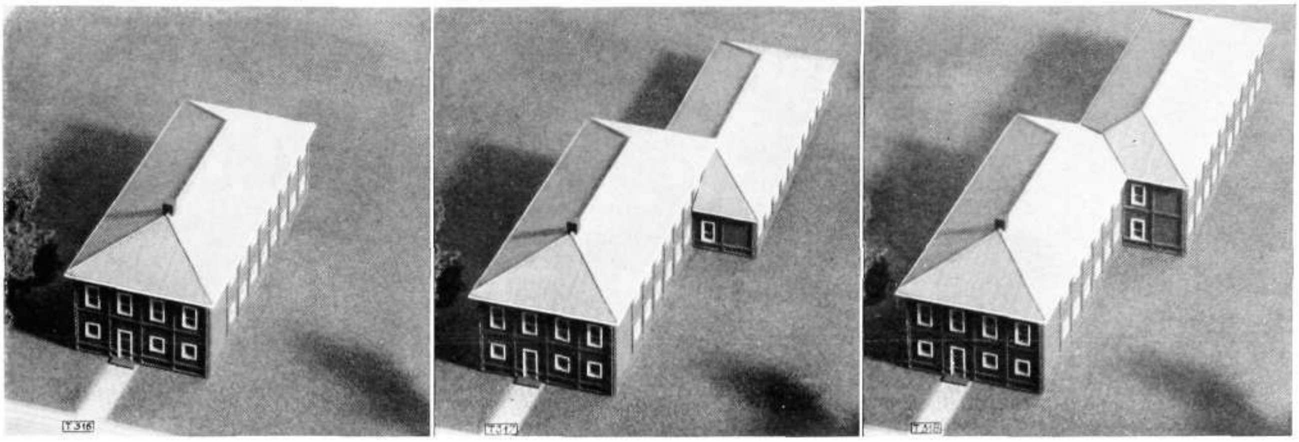


Fig. 5 X 7654

Building for automatic exchange

left for 10,000, centre for 20,000 and right for 30,000 numbers

In Copenhagen and district new premises are now being built for fully automatic exchanges. As the number of exchanges in the Environs have been reduced from 33 to 14 they will be of such a size that they all can be extended to 10,000 numbers or more. The normal building, fig. 4, that is used in the Environs is, therefore, initially dimensioned to take automatic equipment for 10,000 numbers.

If the exchange exceeds 10,000 numbers, the intention is to add an extension in line with the original building, an extension of one floor increasing the capacity to 20,000 numbers and of two floors to 30,000 numbers, fig. 5.

In the Copenhagen area it has been found preferable to limit the exchange capacity to 50,000 numbers and this will probably result in some of the present exchange areas being divided in two.

In the fully automatic system the main exchange will of course disappear and be divided on the future automatic exchanges.

The LB exchanges will probably be replaced at a comparatively fast rate whereas the demi-automatic exchanges will be replaced later as financial and practical reasons limit the quantity of automatic numbers which can be installed each year.

The Copenhagen New Automatic Telephone System with Crossbar Switches

V JOHANSEN, SECTION ENGINEER, KJØBENHAVNS TELEFON AKTIESELSKAB (KTAS)

U.D.C. 621.395.344

In this extract from a paper, read at the Elektroteknisk Forening in Copenhagen and published in »KTAS Nyt» No. 3, 1953, the principles are outlined for the L M Ericsson fully automatic system with crossbar switches which is being installed in Copenhagen. The article also describes the equipment required for the interworking with existing exchanges of demi-automatic rotary system which successively are to be replaced by the new system.

The Construction of a 10,000-unit

The new fully automatic crossbar system in Copenhagen is built up of units of 10,000 numbers consisting of crossbar stages in link connection (see Ericsson Review no 4/1951). An exchange for 10,000 numbers is divided in 10 groups of 1,000 numbers, each group consisting of a link connection in four stages with corresponding marker. The group selectors which connect outgoing calls in the required direction and incoming calls to the 1,000-group containing the called subscriber are constructed in units of 2 × 80 entries and 2 × 400 outlets in a 2-step link connection with corresponding marker.

The calling subscriber *A* utilizes 2 of the 4 selectors in his 1,000-group as a finder stage *S*, in which a concentration of the traffic takes place, see fig. 1. The register *REG* receives the dial impulses from the subscriber and transfers the order to the marker *1GVM* for the outgoing group selector in the *A* exchange and then to the markers in the *B* exchange *2GVM* for the incoming group selector and *SLM* for the 1,000-group. When a 1,000-group is operating as line selector all 4 stages in the connection are used.

When *A* is lifting the handset, his line relay *LR* operates and the call is signalled to the marker *SLM* which connects the call through the finder *S*, the finder relay set *SR* and the register finder *RS* to a free register *REG*. The register transmits exchange tone (continuous tone 450 c/s). *A* dials the number for *B* (6 digits). When the register has received the digits, the marker *1GVM* for the outgoing group selector *1GV* is called and receives from the register 2 direction digits for connection in the direction of the *B* exchange. After this the marker *2GVM* for the incoming group selector in the *B* exchange is called and this marker receives from the register a digit causing the connection of *2GV* to the *B* final selector group *LV*. The line finder's marker *SLM* is then called and receives the 3 last digits which are used to select the required subscriber's line *B*. The connection from *A* to *B* is then established, the register is restored and can be used for a new call.

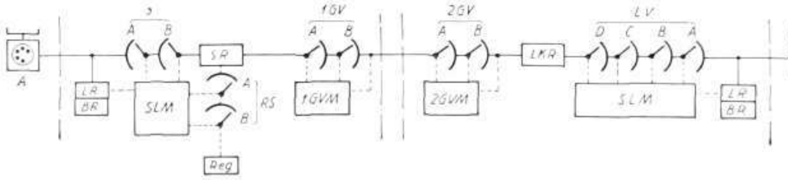


Fig. 1 X 6770
Routing diagram of the crossbar system

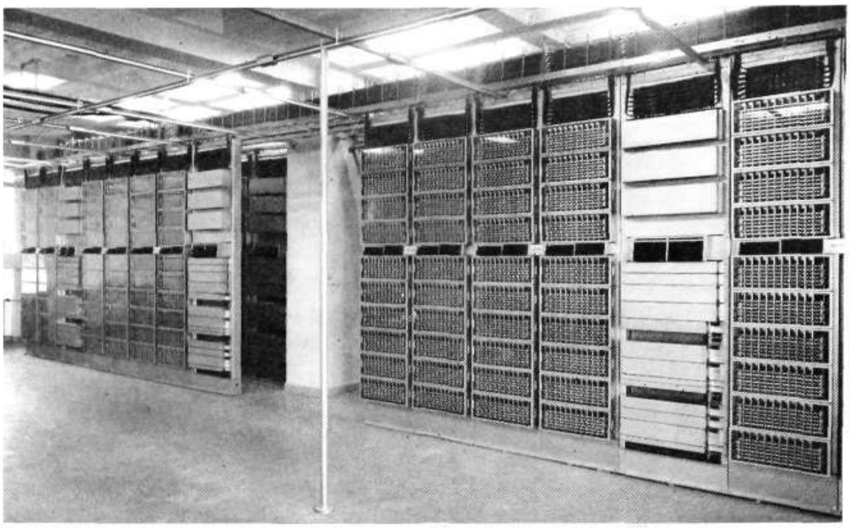


Fig. 2 X 6774

Rack of crossbar switches in the transit section

Intermittent ringing signal (25 c/s) is transmitted from the final selector relay set *LKR*, and when *B* answers the connection is completed. If the *B* subscriber is engaged disconnection takes place and the *A* subscriber receives busy tone (intermittent tone 450 c/s) over his own cut-off relay *BR*.

In order to obtain a sufficient number of outgoing directions the exchanges are in certain cases arranged in several consecutive group selector stages or for traffic over a transit section. This consists of group selector stages placed in the exchange at Borups Allé and handles traffic from one exchange to another when this traffic is so small that a direct junction is not profitable.

The registers are partly common for a 10,000-group. They store the digits and do not commence connection before the *A* subscriber has dialled 5 of the 6 digits in the *B* subscriber's number. Selectors and lines are, therefore, not unnecessarily occupied while the subscriber dials the number.

The digits are transferred from the register to the markers. As these are common for many connecting devices they must only be occupied a very short time for each call. The digits are, therefore, transferred by means of a fast operating D.C. code of telegraph type. The transfer speed is about 10 digits per second. The signals can be transmitted over lines with up to about 2,200 ohms line resistance or a leakage of 10,000 ohms. The corresponding values for lines from a subscriber's station to the exchange are 1,000 ohms line resistance or 10,000 ohms leakage.

The system is arranged for re-coding of the number dialled by the subscriber, giving scope for free choice of the route to be used in each particular case. The re-coding does not take place in the register but in the marker and it is, therefore, not necessary to interfere with all the registers when a traffic route is to be changed. The alteration is only made on the few group selector markers which are effected by the change.

If a marker is busy a call can wait until the marker becomes disengaged. If a marker cannot effect a connection it is released after about 0.2 s in order not to hold up subsequent calls. When a connection cannot be established the subscriber receives busy tone.

To give an idea of the size of a marker it can be mentioned that a marker for a 1,000-group consists of 650 relays. An outgoing call occupies the marker about 300 ms whereas it is occupied about 800 ms for an incoming call. The

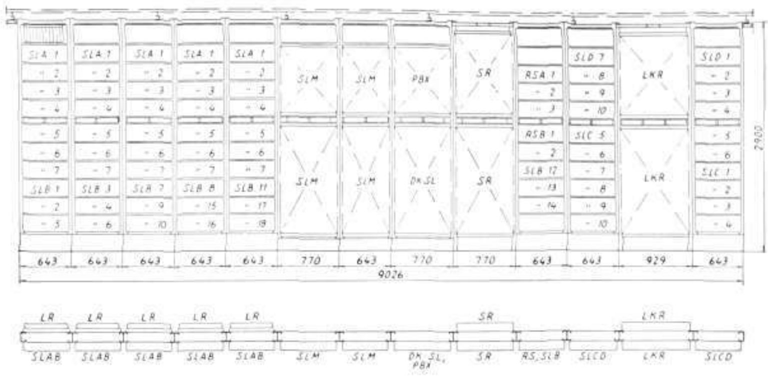


Fig. 3 X 6771
Elevation of a 1,000 group

latter time is longer due to the marker in this case having to receive 3 digits before connection is established. A group selector marker consists of about 400 relays and the occupation time per call is about 300 ms.

As it is difficult to extend an *SL* stage in actual operation this should from the outset be amply dimensioned, whereas on the other hand the group selector stages without any difficulties can be extended as required.

The markers are common to an extensive amount of equipment and their reliability is, therefore, extremely important. If an *SL* marker is completely out of order, 1,000 subscribers will be blocked, whereas a similar fault on a *GV* marker only means a reduction in the number of available traffic routes. Everything has, therefore, been done to ensure a high reliability such as the use of duplicated and quadruplicated contacts as well as plug-in arrangements for the more important elements. No operation troubles are, therefore, expected on this point. In addition it will be possible later to arrange cooperating markers.

In a 1,000-unit, see fig. 3, the line relays and some other relays are mounted on the rear of the rack. The group selector unit, see fig. 4, consists of 2 × 80 entries and 2 × 400 outlets with a common marker. The space requirements, see fig. 5, for the automatic equipment of an exchange calculated for about 1 outgoing call per subscriber during a busy hour, are approximately 24 m^2 per 1,000 subscriber's numbers with a rack height of 2,900 mm and 700 mm wide aisles. The ceiling height is 3,700 mm but 3,500 mm is sufficient.

In the Copenhagen fully automatic exchanges the well-known crossbar switch is used, but the exchanges are working according to new principles of the same kind as those for the Aarhus exchanges recently put into operation, see Ericsson Review 3/1953. It should, however, be mentioned that KTAS already have some experience of these principles as similar systems have been used for the small exchanges Kirke-Värlöse and Liseleje. These exchanges have been in service for three years and have during this time required no maintenance due to wear or contact faults and it is expected that the satisfactory experiences from these exchanges with regard to reliability and low maintenance costs will be confirmed by the new exchanges in Copenhagen.

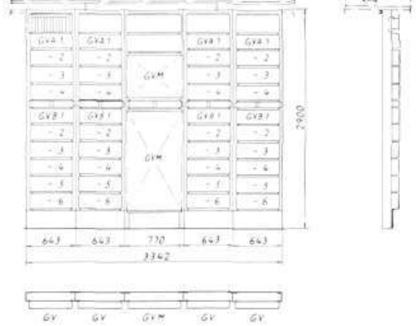


Fig. 4 X 4920
Elevation of a group selector unit
with 2 × 80 entries, 2 × 400 outlets and common marker GVM

Power Supply

The operating voltage for the exchanges is 48 V, but this will increase to 52 V at direct operation from automatic metal rectifiers, for 300 A per unit with 2 batteries for each 24 cells. The rectifiers, which are supplied from 3 × 380 V A.C. (50 c/s), are built up in chain with a constant voltage rectifier which controls subsequent sequence connected rectifiers. The current consumption is estimated to about 600 A per 10,000-unit, but as the new standard building is capable of being extended to 30,000 lines, the charging and accumulator rooms are dimensioned for an installation up to 1,800 A. The rectifiers are calculated for a load corresponding to twice the number of called

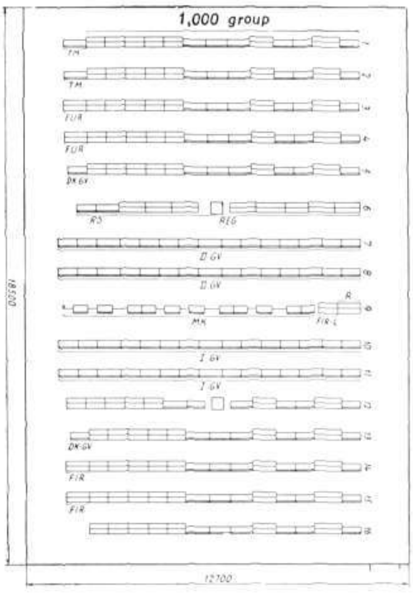


Fig. 5 X 4921

Floor plan of an exchange for 10,000 numbers

lines, but one unit is always anticipated in reserve. The rectifier maintains the voltages, within ± 1 %. The batteries are for the initial stage each dimensioned for a reserve of 2 hours after 20 years subscriber increase, the lowest voltage for discharged batteries being specified to 43.5 V.

The Copenhagen Trunk Exchange Area with a Transit Section at Borups Allé

The area around Copenhagen with outgoing and incoming traffic being in the main handled over a trunk exchange either manually or automatically is referred to as the Copenhagen trunk exchange area, fig. 6. This trunk exchange will be installed in the new large telephone building at Borups Allé together with a transit exchange for the local traffic. The building is shared by KTAS and the PTT and will contain carrier equipment, automatic equipment for national trunk traffic and traffic within the KTAS concession area, trunk position, special positions and in the final stage four exchange units for 10,000 numbers.

Interworking between Old Systems on Sjælland and the Copenhagen Fully Automatic Systems

In fig. 7 the heavy lines indicate the interworking between the old systems and the new fully automatic exchanges.

The telephone instruments, which are connected to LB exchanges (*M*) and the main exchange (*HC*) are not provided with dials and the subscribers in these exchanges have to call fully automatic exchanges (*F*) over semi-

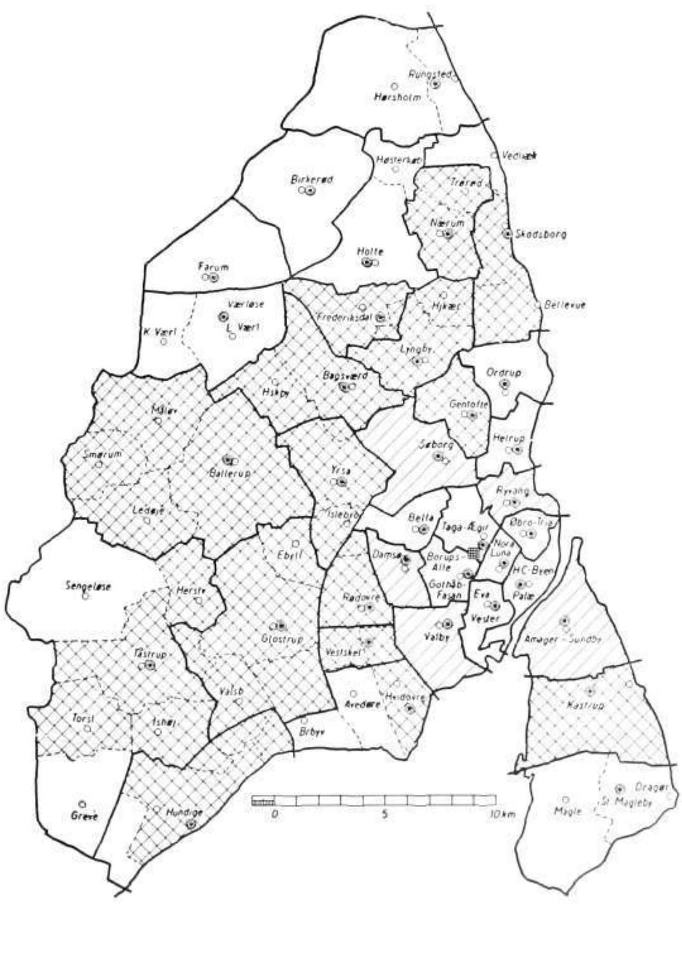


Fig. 6 X 6772 X 9125

The Copenhagen trunk area after the first building stage with fully automatic exchanges for 82,500 numbers

- ◉ fully automatic exchange
- ○ exchange to be closed down
- —— exchange boundary
- - - - - » » disappearing
- ▩ fully automatic area
- ▨ partly fully automatic area
- ☐ area with old system

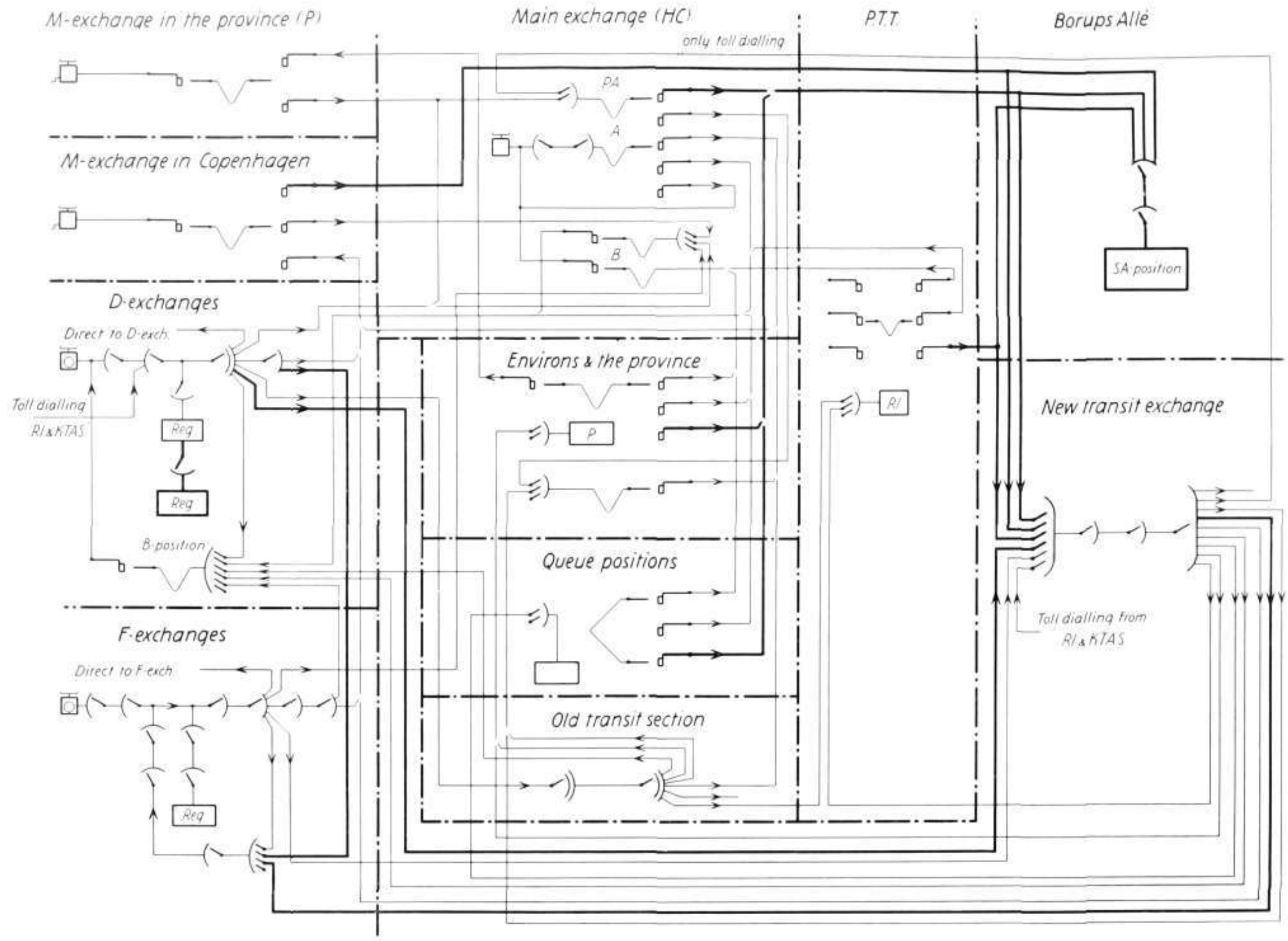


Fig. 7 X 7660

Routing diagram showing the interworking between old systems on Sjælland and the new fully automatic system in Copenhagen

automatic positions (*SA*). The operators at these positions transmit the required *F*-number by means of key-sets and the connection is established over the transit section at Borups Allé. The registers for the *SA*-positions transmit the numbers by means of D.C. code impulses to the effected markers. The subscribers in the demi-automatic exchanges (*D*) have dial instruments but the *D*-registers are arranged to receive 1-digit or 2-digit numbers, *viz.* »Central» and »Help» or the first two letters of the exchange number. It has, therefore, been necessary to add to the *D*-register auxiliary registers which have been arranged to receive 8 digits in view of future rural automatic systems. The auxiliary registers are not connected for calls to the main exchange (one digit only) but immediately on receipt of the first impulse of the second digit. The first and second digits are transferred before the third digit is received by the auxiliary register. For 2-digit calls to the old systems the auxiliary register is released when the 2 digits have been received. In this way a blind call is made to the register but the duration is only 0.8 secs. This method has been preferred as the number of blind calls will gradually diminish as the conversion to automatic operation is progressing and as it meant the smallest amount of alterations on the existing *D*-registers. When dialling fully automatic subscriber numbers and calls which establish connection over the new transit section, the auxiliary register receives all dialled digits, which are transferred to the markers by means of D.C. code impulses establishing the connection. Some of the incoming trunk calls and all incoming queue calls to *F*-subscribers as well as calls ordered by *F*-subscribers which are established by ring-back procedure, are connected over the *SA*-positions. A great portion of the trunk traffic to Copenhagen will, however, be handled by direct long distance dialling from operators in other exchanges over group selectors in a *D*-exchange installed in the *HC* building. This long distance exchange will, however, later be transferred to the new transit section and will be considerably extended both for PTT and for KTAS. For calls over direct dialling lines the operator in, for instance, Aarhus can dial a *D*-exchange or a fully automatic subscriber but in the future automatic subscribers will be able to carry out the dialling from their own sets.

The existing Rotary *7D*-exchange at Frederiksdal will be provided with traffic equipment enabling its subscribers to dial up to 8 digits and to dial a *D*-exchange and other *F*-subscribers. In the same way *D* and *F*-subscribers will be able to dial the numbers of Frederiksdal subscribers. On account of their fast operation the crossbar switches are particularly suitable as interwork equipment during a transition from one system to another.

Special Services

In a manual system it is comparatively easy to arrange various special services owing to the subscriber multiple where the operator is able to read different subscriber indications. When changing to fully automatic operation the conditions will be different but it was nevertheless considered desirable to retain the earlier special services. In the fully automatic system the special services are called by special numbers in the series *000—009* and *090—099* and connection takes place over the new transit section. The expensive intermediate connection over *HC*, which earlier generally was necessary, is then avoided. Direct dialling to the special services will, however, be gradually introduced.

For the fully automatic subscribers new positions are arranged at Borups Allé for ordering and operation of absent subscribers service. By dialling *004* connection is obtained to an ordering position. Absent subscribers' service is marked by the operator by inserting a plug with rectifier circuit in a subscriber jack field containing a jack for each *F*-subscriber in the Copenhagen trunk area. A jack field for 5,000 *F*-numbers is 1 m high and 0.6 m wide. For each call to an *F*-subscriber the marker tests if a rectifier plug is inserted in the subscriber jack and if the subscriber is connected for absent subscribers' service. The necessary signals are connected over one line per 1,000 *F*-subscribers between the *F*-exchange and Borups Allé. If the required subscriber is connected for absent subscribers' service the call is not completed, but the register for the *A*-subscriber establishes a connection to the service position. The call is received in a position where the subscriber's filing card is available and to the assistance of the operator the number of the *B*-subscriber is indicated on a lamp panel.

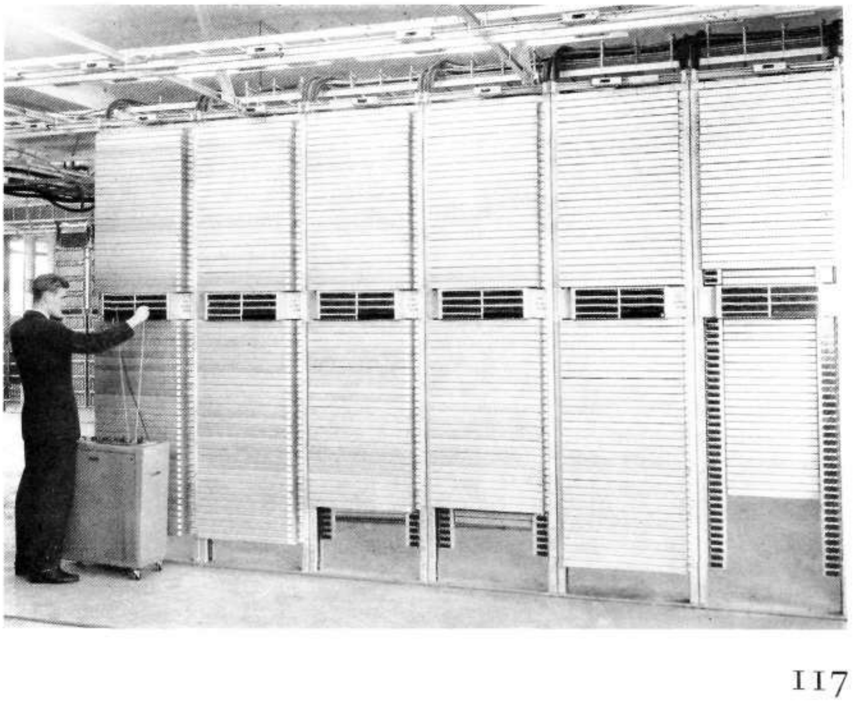


Fig. 8
Relay rack, transit section

X 6775

Fig. 9 X 4923
Interior of the transit section

Number reference is arranged in the same way as for absent subscribers' service but is differentiated by the use of a different rectifier plug. The use of three different plugs is, however, being considered and signals will then be obtained for subscriber with absent service, for number reference or for vacant number.

Charging

In the old telephone systems within the KTAS area local calls were metered for *HC* on meters fitted in the exchange and for the *D*-exchange on meters in the subscriber's instruments. For LB-exchanges random metering was used. Trunk calls were charged per commenced 3-minute periods at a rate depending on the distance.

In the *F*-system meters are arranged in the exchanges which are to meter local as well as trunk calls using the »Karlsson-method». According to this method metering impulses are transmitted with regular intervals to the *A*-subscriber's meter each step on the meter corresponding to a unit price. The interval between the impulses is reduced with increasing distance between the two subscribers. This method of metering will only be used for calls dialled directly from *F*-subscribers or for certain direct connections over manual positions. Connections which are established by ring-back procedure to *F*-subscribers are charged as previously by ticketing.

Numbering

The number of subscribers in Copenhagen is at present about 260,000. For Copenhagen (as for the rest of Sjælland) 6-digit numbers have, therefore, been chosen for calls within the trunk area. Each trunk area is characterized by one single digit, for Copenhagen *1* and for the remaining Sjælland *2*. Calls from Copenhagen to the rest of Sjælland and vice versa are preceeded by *0* and the trunk number in front of the subscriber's number.

In other parts of Denmark a somewhat different numbering method is used but all numbers will probably have 8 digits.

The numbers available for the Copenhagen trunk area amount to 900,000 which is estimated to be sufficient up to 1980. At that time it is, however, possible that Copenhagen has to utilize one more trunk digit. The numbers in the Copenhagen trunk area will then have 7 digits but the aggregate number will still have 8 digits as the 7 digits only have to be preceeded by *0*.

The new *F*-system is very flexible with reference to group numbers as in a 1,000 group the same subscriber can pick out numbers in any order and any of these numbers can be chosen as the group number. If a subscriber dials a number other than the group number connection will be established to the dialled number only.

The Ductilometer Test — a New Method of Establishing the Ductility of Metals

E JONNERBY, AB ALPHA, SUNDBYBERG

U.D.C. 620.163.3

AB Alpha has introduced a new method of testing the ductility of materials such as wire, sheet or strip. According to this method the material is made to fracture by means of repeated carefully controlled bending operations to adjustable angles. The bending operations are carried out in a special instrument, the Ductilometer, made by AB Alpha. The design and function of the Ductilometer is described below. Examples of tests carried out give a picture of the application of the method.

Raw material tests by means of bending in one form or another is a very old method, indeed as old as the raw materials themselves. The Swedish king Charles XII is said to have used or specified bending tests for the sword blade material, which was secured in a vice and then was bent forwards and backwards until it was breaking. The number of bends required was an indication of the quality. In spite of its age, simplicity and wide use the bending test has never attained the status of a testing method proper and could only be classed as a workshop method, *i. e.*, a method where the personal judgment effects the result. The bending has been carried out by the test object being bent to a certain radius without showing cracks or by bending it over an mandrel to an angle of 90° in both directions until fracture occurs. The first type of test is applied to welded material and the second type to wire and strip. As an example the following table may be quoted over the German specification DIN 51211 where the arbour diameter is specified as a function of the diameter of the test wire.

Wire diameter	Mandrel diameter
—1.2 mm	5 mm
1.2—2.3 »	10 »
2.3—3.0 »	15 »
3.0—3.5 »	20 »
3.5— »	30 »

The leaping changes in the mandrel diameters in this case give raise to difficulties when judging the result and the tendency to double bend in the test object cause a variation in the results.

The properties of the material which are established with these tests have not been defined but they can be approximately expressed as the forming property or ductility, *i. e.*, the ability of the material to stand up to plastic deformations. With reference to sheet for deep drawing purposes &c. this property has been tested in an Erichsen or similar instrument the sheet being subjected to stretching to an extent which is considered to correspond to the deformations taking place during actual pressing. The individual setting is in this case very important.

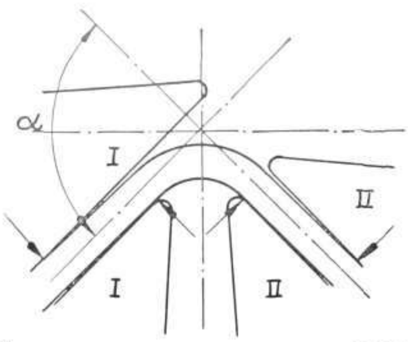


Fig. 1 X 4897

Schematic view of the bending in a Ductilometer

- I movable guide jaws
- II clamping jaws
- ↑ load application points

Principle

According to the method now introduced by AB Alpha for ductility testing the material, wire, sheet or strip, is made to fracture by means of repeated carefully controlled bending operations to certain adjustable angles. The bending takes place without the use of a mandrel and the distance between the load application points controls the intensity of the bend. The clamping jaws II secure the test object in position and the movable guide jaws I are moved forwards and backwards during the test and are guided in such a way that correct intensity is obtained. The bending takes place to certain fixed angles. The intensity, *i. e.*, the extension and compression of the outer and inner fibres, is a linear function of the bending angle and is calculated as follows:

$$\varepsilon = \frac{t}{2\,R} \cdot 100\,\%$$

where ε = intensity

t = thickness of the test object

and R = mean radius.

The intensity obtained for bending to different angles α can also be expressed, thus:

$$\varepsilon = k \cdot \alpha$$

The constant k in this formula is for the instrument now constructed approximately $^1/_3$, *i. e.*, a bend of 90° extends the outer fibres 30 %, and of 45° gives an extension of 15 % &c. The number of bends which the material will stand up to for a couple of angles constitutes the quality number which according to this test method characterizes the material.

Design of the Ductilometer

The instrument used for this test, the *Ductilometer* is schematically shown in fig. 2.

The clamping jaws are fixed on the right handle and are pulled up by means of a hand wheel. The guide jaws on the left hand side are controlled by a lever under the left handle and are locked in position by a clamping screw over one of the jaws.

The base ring is provided with holes for stop studs which are placed in positions corresponding to the required angle. The holes are marked 30, 45, 60, 75 and 90°. The counter on the left hand side indicates the number of bends and is read when the test sample breaks. The sector plate on the right hand side carries angle indications and is set to the required bending angle compensating for the distance between the two jaw pairs and the distance between the load application points on the test object which determines the radius according to fig. 1. In this way correct intensity is ensured.

The centre of the instrument carries on the under side another correction screw which is set in relation to the thickness of the test object and determines the movement of the guide jaws.

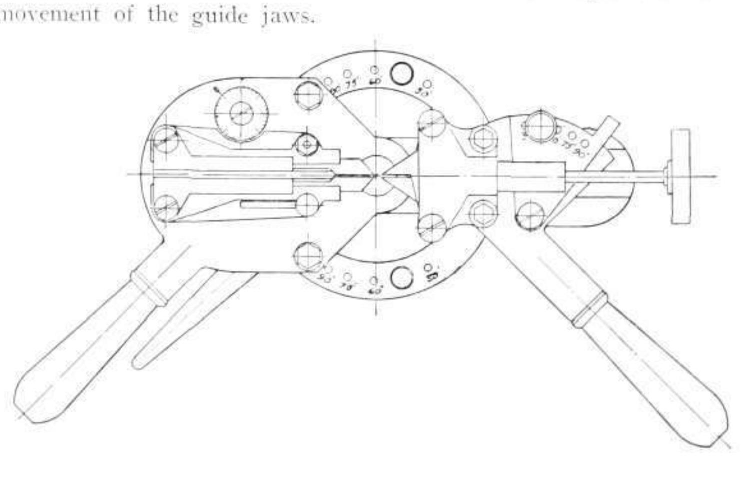


Fig. 2 X 6738

Ductilometer

Fig. 3 X 6740
Ductilometer
Starting position for test

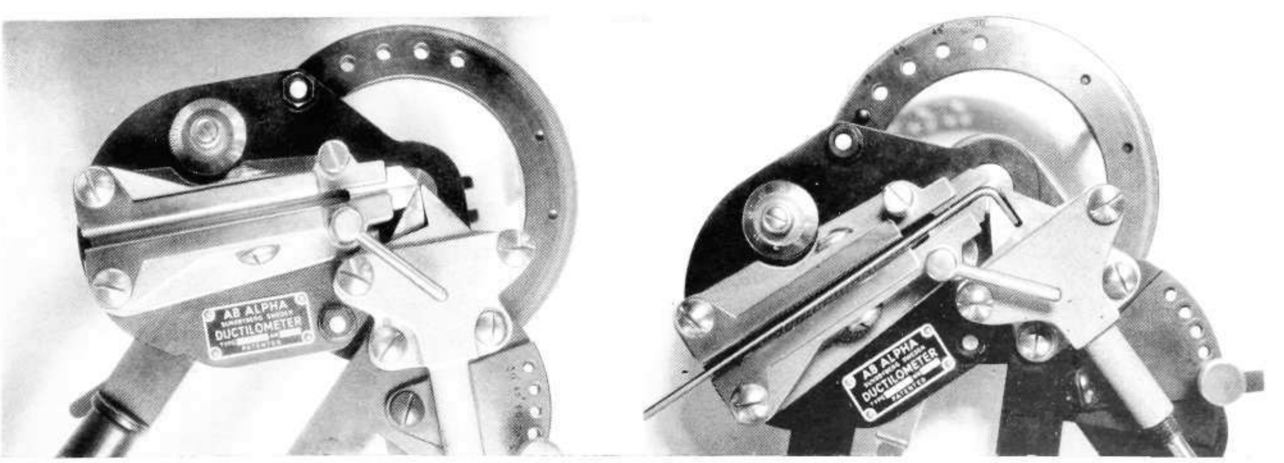
The instrument is made for material thicknesses up to 4 mm ($^5/_{32}''$) and for a maximum width of about 10 mm ($^{13}/_{32}''$).

The bending is carried out by hand. The width of the test object must, therefore, be adjusted according to the force that can be exerted by hand and the hardness of the material. Fig. 3 shows the instrument in starting position for testing and fig. 4 left at 90° bend with material thickness 0. At zero material thickness the jaws are as close together as possible and the movement of the guide jaws is zero. Fig. 4 right shows the centre of the instrument at 90° bend but with material thickness 4 mm ($^5/_{32}''$). The guide jaws in this case obtain maximum movement and the outside jaw can be seen projecting over the inside one. For other angles the movement of the guide jaws is in proportion to the angle. Fig. 5 shows the instrument in operation.

Test Procedure

Before starting a test the correction screw at the centre spindle on the underside of the instrument is set to the approximate thickness of the test objects. The scale is calibrated in half-millimeters from 0 to 4 mm. The instrument is placed on a desk with open clamping jaws and guide jaws. The stop studs are fitted for the required bending angle and the angle sector is set to the same angle. The counter is set to zero. The test object is inserted between the jaws and the clamping jaws are pulled to by means of the clamping wheel. The guide jaws are then closed up with the lever under the left handle but leaving the test object free. The position of the guide jaws is secured by means of the locking screw on the upper side.

Fig. 4 X 7644
Ductilometer
at 90° band and material thickness 0, right, material thickness 4 mm



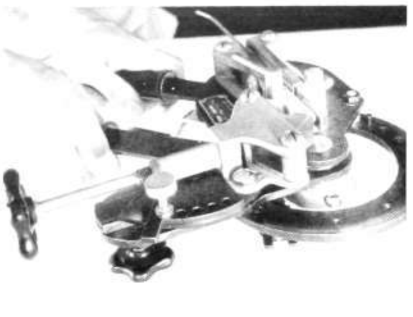


Fig. 5 X 4910
The instrument in operation

If it is difficult to secure the test object due to insufficient length the dovetailed mounting plate for the clamping jaws can be pulled out after loosening a locking knob on the underside. The test object is fixed in the jaws, the mounting plate is pushed back to its original position and is secured by means of the locking knob.

The bending is then carried out by moving the handle horizontally without jerks alternately against the stop studs until fracture occurs. The counter is read and indicates the number of bends in full or half strokes. A full stroke is a movement from a neutral position to an extreme position and back again. When testing thin material it may happen that a breakage can pass unnoticed. In such a case it is advisable to pre-load the free end of the test object by means of a small spring which pulls out the broken end from the guide jaws.

For a complete test bends should preferably be carried out for three different angles with a few tests for each angle. Homogeneous material will show a deviation between the different tests by not more than about 0.5 bends.

Examples of Tests Carried Out

Fig. 6 shows the progress of a test on a 3 mm CrMo-wire. The bends have been made to 45°. The test has been interrupted after the indicated number of bends. The figure illustrates the limited extent of the zone of deformation and how no double bends occur; the wire is quite straight at the full bend. For progressive numbers of bends the characteristic contraction can be noticed similar to that obtained with stretching tests. The zone of deformation is in length 1.5 times the wire diameter.

For tests carried out as described above a bending number is obtained for each angle tested. The relationship between the number of bends and the angle can mathematically be expressed as a hyperbola as illustrated in fig. 7. The equation of the hyperbola is: $n(\alpha - \alpha_1) = C$

where n = the number of bends at angle α.
α_1 = limit value indicating the property of the material with reference to work hardening,
and C = ductility number.

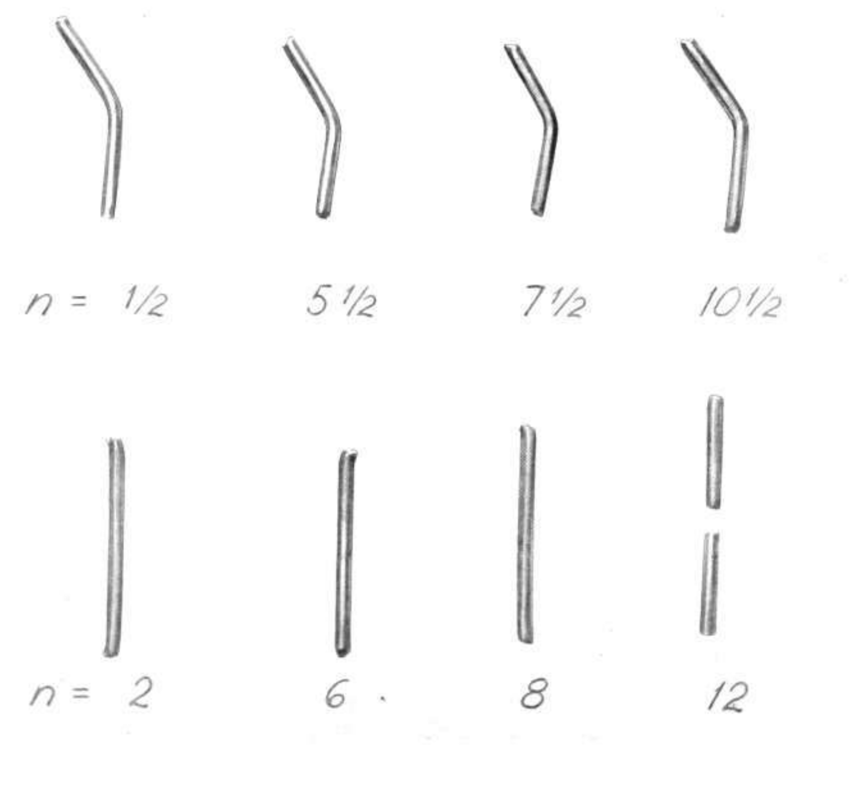


Fig. 6 X 6757
Ductilometer test with a 3 mm CrMo-wire
interrupted after specified number of bends. Bending angle 45°.

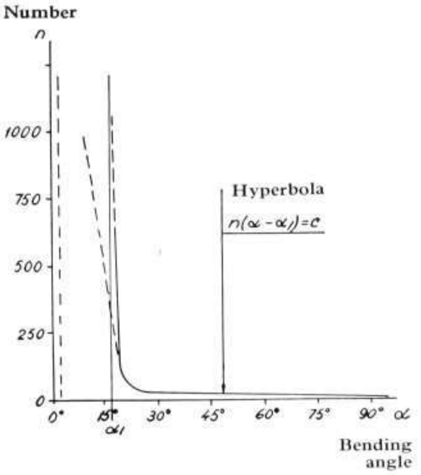


Fig. 7 X 4898

The relationship between bending number and bending angle

An interesting feature of this function is that the number of bends reach infinity not at angle 0 but for a certain definit angle α_1 which is representative for each material and independent of variations in yield point, breaking point or elongation. The α_1 value which may be anything between 0 and 35° is definitely of such an order that plastic deformation takes place and cannot, therefore, constitute a limit of fatigue in the proper sense. When testing at angles near and below this value at number of bends around 500 a deviation is also obtained from the hyperbola to which the other results conform; the curve intersects the asymptot and approaches a new limit value corresponding to a very small angle. This limit value is the usual limit of fatigue which will be found at about 2×10^6 alternations. This last portion of the curve is as known logarithmic but the transition from one curve to the other has as yet not been clarified.

For practical reasons the test results are not entered on a linear coordinate system but the results are plotted in a system according to fig. 8 where the ordinate is the inverted n-value transforming the hyperbola into a straight line. The limit value α_1 is obtained in this curve as the extrapolated intersection α_1 on the angle axis. The curve from this point to angle 0 corresponds to fatigue within the elastic zone. Point α_1 is as mentioned above independent of yield point, breaking point and elongation but very closely related to the property of work hardening for the material.

Limit value zero is obtained for lead which has no work hardening properties at room temperature. Otherwise the following values have been found for different material:

Material	α_1
Lead + 20° C	0
Lead — 40° C	20
Pure aluminium	6—15
Aluminium alloys	10—25
Copper	16—20
Ordinary carbon steel	16—25
Stainless steel (ferritic)	21—25
Brass	27—35
Stainless steel (austenitic)	30—35

Each type of material occurs in certain bands but the components which determine the variations have yet to be investigated. For a definite material, however, the α_1-point is constant, independent of thickness and condition. It is, therefore, possible to determine whether a sample agrees with another with reference to material type (analysis) and at the same time establish if the material has the required degree of ductility as defined by the constant C in equation $n(\alpha - \alpha_1) = C$ of the hyperbola. The values of the constant C vary between 100 and 2,000 approx. It is yet too early to define the limits for what a material with a certain C-value will stand up to. The investigations which have been carried out with the Ductilometer have mainly concerned comparisons between different materials for certain purposes establishing differences in ductility which have been proved by practical experiments but have been difficult to define by previously known test methods. Investigations where analysis, mechanical properties and practical experience can be related to the Ductilometer tests, have in the first place been made on sheet or strip and with the same thickness of the material compared. The thickness of the material has, therefore, in this case not been of any importance as the only consideration has been a comparison of different materials and a classification of these irrespective of the absolute forming properties.

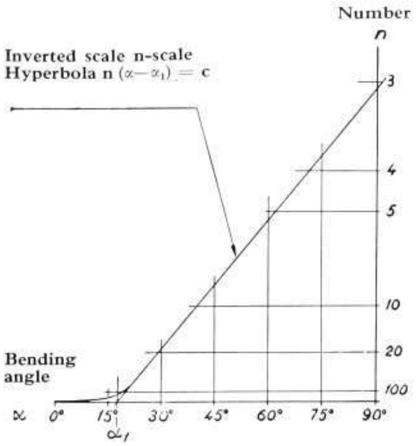


Fig. 8 X 4899

Diagram over test results

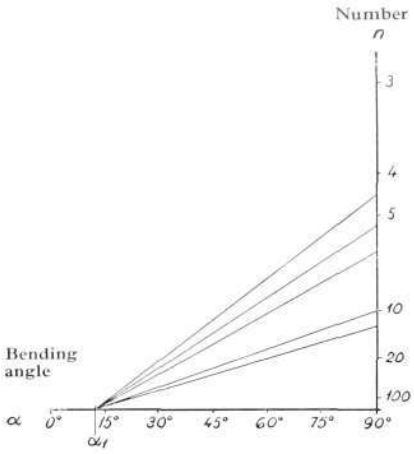


Fig. 9 X 4900

Test result for 1 mm pure aluminium sheet

Test of pure aluminium sheet

As an example of a test where one material only has been investigated, fig. 9 shows the results of the test on 1 mm (.040″) pure aluminium. The original material was cold rolled sheet cut up in pieces along and across the direction of grain. The different pieces were annealed during 30 mins at the temperatures indicated. A high *C*-value implies that the line has a low inclination and that the material is ductile. An absolutely brittle material has a *C*-value equalling 0 and the line is vertical.

Annealing temp. °C	α_1	$C_{\text{along grain}}$	$C_{\text{across grain}}$	Hardness $H_{v\ 10}$
not annealed	14	365	275	46
200	14	400	335	44.3
250	14	490	490	37.8
300	14	790	790	24.8
350	14	915	980	22.3
400	14	915	980	22.1
450	14	915	980	21.3

It will be seen above that there is a definite difference between samples across and along the grain in not annealed condition, but this difference is equalized with annealing. For high annealing temperatures the direction across the grain becomes more favourable.

The ductility number is highest at 350° C and the relationship between the ductility number and hardness as a function of the temperature follows the curves quoted in the suppliers' material specifications for pure aluminium.

Investigation of three different qualities of deep drawing sheet

Sample No. 1: Cold rolled Siemens Martin
Sample No. 2: Cold rolled Belgian Thomas steel
Sample No. 3: Hot rolled Siemens Martin according to DIN ST VII a.

Analysis according to suppliers' specification:

Sheet No.	C	Si	Mn	P	S	Cu	N
1	0.06	—	0.35	0.015	0.035	0.14	0.004
2	0.03	—	0.28	0.030	0.023	0.08	0.008
3	no information						

The mechanical properties are:

Sheet No.	σ S Yield kg/mm²	σ B Breaking kg/mm²	δ % Elongation	Thickness mm (0.40″)
1	27.5	31.5	24	1
2	31.2	37.0	44	1
3	17.2	27.4	29	1

The Ductilometer tests gave the following results.

Sheet No.		α = 45°	60°	75°	90°	α_1	C
1	along	44, 45	27, 28.5	19.5, 20	14.5, 14.5	19	1140
	across	31, 32.5	19.5, 20.5	13, 13.5	10.5, 12	19	780
2	along	31, 34	20, 23	15.5, 15.5	12, 12	19	850
	across	17.5, 18.5	11, 11.5	7, 9	6.5, 7	19	480
3	along	20.5, 22	14.5, 15.5	9.5, 11	8.5, 9	17	610
	across	13.5, 15	9.5, 11	7.5, 8	6, 6.5	17	440

In actual production sheet No. 1 has proved to be definitely the best, the other following in order 2 and 3.

It will be seen that the forming properties of the material cannot be deduced from the mechanical properties specified. The load-elongation diagram obtained from an ordinary stretching test does not take into consideration the contraction of the material during the progress of the test. For a proper estimate of the forming properties the contraction or the maximum local elongation in the breaking point is the most important factor. In a stress-strain diagram which accounts for the actual specific load, diagrams are obtained which up to the breaking point are similar to a normal load-elongation diagram, but after this point differ and run practically in a straight line up to the breaking point. The inclination of the latter position of the curve is a measure of the tendency to work hardening for the material, *i. e.*, it corresponds to the α_1 point in the Ductilometer diagram and the projection of the curve on the elongation axis corresponds to the *C*-value. Test which have been made on the one hand on a copper bar and on the other on a brass bar shows how the materials behave differently in a stretching test. The copper bar flows locally whereas the flow on the brass bar extends over the whole stretched length. In both cases, however, the local elongation is quite different from the ordinary fracture elongation obtained in a stretching test. The *C*-value obtained in the Ductilometer may be taken as the angle at which the sample breaks for one bend. On the basis of the relationship between the angle and the intensity it can be established, for instance, that a steel with a *C*-value of 500 will break for an elongation of $^1/_3 \times 500 = 170\,\%$. Such a local elongation can also be obtained in a stretching test just in the point where fracture occurs.

Investigation of steel wire with 3 mm (.118") diameter intended for cold forming of screws with counter sunk head and round head (flat shoulder)

The two wire samples tested were:

1. Thomas steel $\sigma B = 61.2$ $\delta = 8.8\,\%$
2. Siemens Martin $\sigma B = 62.8$ $\delta = 13.6\,\%$

Tests in the Ductilometer gave the following values:

Sample No.	45°	60°	75°	90°	α_1	C
1	11	7	5.9	4.5	17°	306
2	12.4	8.5	6.1	5.1	17°	349

According to information from the works wire No. 2 could be used for forming both types of screw heads whereas wire No. 1 could only be used for counter sunk heads. Attempts to form round heads with this wire resulted in the heads dropping off.

Comparison between Ductilometer tests and ordinary bending tests

The Ductilometer test and also the ordinary bending test can be considered as fatigue tests within the plastic zone. In order to establish to what extent these two tests are comparable the Alpha laboratory has made an investigation of steel 0.35 C which on the one hand was fatigue tested by rotary bending and on the other was tested in the Ductilometer. The fatigue test was carried out in an Alpha instrument for rotary bending and the test was made on the one hand with weight loaded bars and on the other with constant deflections on the sample bars.

The average values obtained from the fatigue test are:

at 3 000 r.p.m.

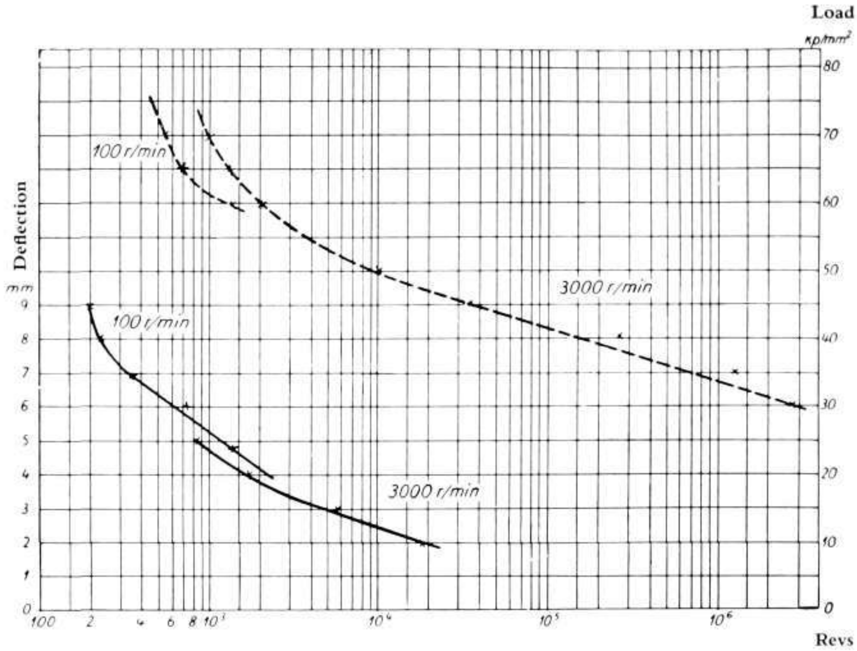
Load kg	30	35	40	45	50	55	60	65	70
Revs 10^4x	250	130	25	3.6	1.0	0.37	0.2	0.14	0.10

at 100 r.p.m.

Load kg	60	65	70
Revs	1,400	600	560

Fig. 10 X 6747

Result of fatigue tests with rotary bending



Deflection mm	2	3	4	5	6	7	8	9
3,000 r.p.m.	18,000	5,760	1,700	850	—	—	—	—
100 r.p.m.	—	—	1,800	1,200	750	370	232	200

These results are illustrated in fig. 10 where the revolution scale is logarithmic. As the 3,000 r.p.m. rate caused excessive heating at high loads and as this rate furthermore cannot be compared with the speeds possible by manual operation of the Ductilometer, the tests were also made at 100 r.p.m. The effect of this will be seen in the diagram. The results of the test with constant deflection has been plotted in a diagram, fig. 11, where the number of revs has an inverted scale corresponding to that used for the Ductilometer test. The character of this curve is the same as that obtained in the Ductilometer but the number of tests carried out so far is yet too small for any conclusion to be drawn. It seems, however, as if the normal logarithmic relationship

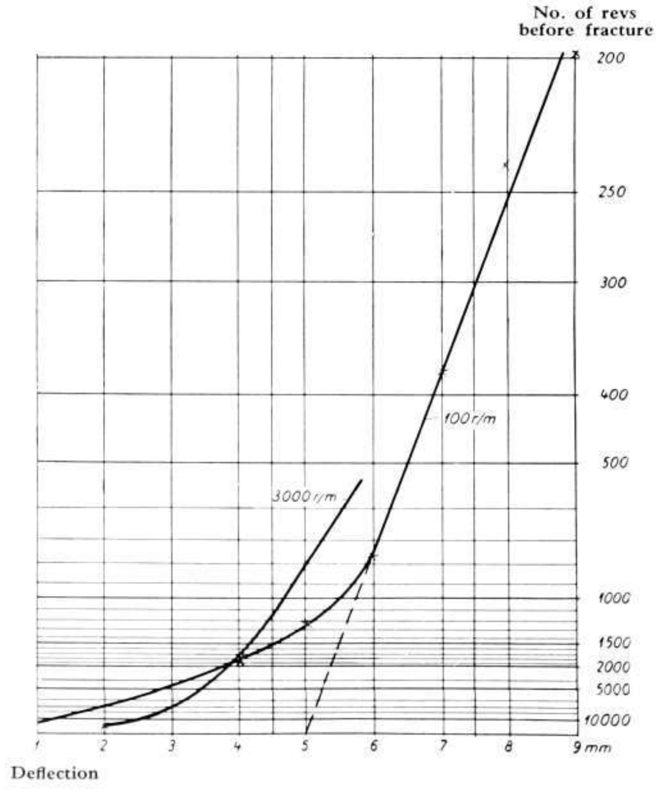


Fig. 11 X 6748

Result of fatigue tests with constant deflection

between load and revolutions is discontinued at about 1,000 revs and that the relationship then is a hyperbola function as indicated by the Ductilometer.

The new test method which has now been introduced and the test instrument of which deliveries have already started, has been protected by patents and is intended for use on the one hand for laboratory research and classification of raw materials and on the other for routine tests of raw materials or components received which will be subjected to forming operations in the works.

The two quality values otbained by the Ductilometer are fundamental when estimating whether a material is suitable from forming point of view but must be judged differently in relation to the nature of the deformation which the material is going to be subjected to. As examples may be mentioned deformation by bending, drawing and deep drawing. In the first instance the C-value is the most important one whereas for drawing and deep drawing both α_1 and C are decisive factors. The material must in the latter case also to a certain extent be capable of hardening during the deformation, as determined by α_1, and possess a certain degree of ductility, as determined by the C-value.

Definite values of the two quantities in relation to their practical importance in judging a material has not yet been obtained but research has commenced with the intention of establishing such a relationship and of developing a basis for a standard of method and instrument.

A New Power Relay

H BAYARD, L M ERICSSONS MÄTINSTRUMENT AB, STOCKHOLM

U.D.C. 621.318.525

It is always desirable for an electric energy consumer who subscribes for a certain definite quantity of power to utilize the current subscribed for to the full extent without exceeding the subscription limit, however. Ermi's power relay has been designed with a view to assisting consumers in their endeavour to utilize the subscription power in a rational manner. The power relay is simple and reliable in operation and it is found particularly serviceable for use in installations in which a part of the load may be temporarily disconnected through contactors without inconvenience, as is the case with electric heating boilers, pumps for water storage tanks and grinding machines in paper mills, for example.

Ermi's power relay may be employed for transmitting optical or acoustic signals or for the entirely automatic regulation of electrical apparatus, that is to say, the disconnection of the apparatus as soon as the subscription limit is reached or exceeded, and its reconnection when there is no further risk of exceeding this limit.

In principle, the relay is designed with a measuring system connected similarly to a normal kWh-meter without a counting mechanism, but the rotor system has been provided with a spiral spring producing a counter-torque to that of driving measuring systems, see fig. 1. The rotor system's angular torque thus constitutes a measure of the power taken. The rotor is fitted with a contact which can move between two manually adjustable contacts. The signals or operating impulses may thus be obtained for two arbitrarily selected outputs, a maximum and a minimum output.

Fig. 1 X 7647

Power relay

right: with cover removed

1 rotor
2 contact device
3 damping magnet
4 current system
5 voltage system

Fig. 2 X 4908
Setting the power limits

The relay responds to the momentary variations in the output, being slightly damped by a permanent magnet. In cases where overloads of short duration are of frequent occurrence but do not appreciably affect the mean load it is therefore advisable to connect up a time limit relay as an intermediate relay. In this way unnecessary interruptions in service and wear at the contactors, etc. are avoided. Ermi also manufactures an intermediate relay type *VEB 86* with a time limit which is designed for use with the power relay and can be set for time limit periods from 15 s to 3 mins. This intermediate relay is provided with a mercury switch for operating contactors, a signal bell or the like.

All external conductors for the power relay are connected to a common terminal panel of moulding material.

Construction and Functioning

The relay is built into a black-enamelled case and is intended for surface mounting on a wall in the normal form but it can also be supplied with a frame for flush mounting. On the front of the cover there is a sealed opening through which two pointers, *1* and *3* in fig. 3, are conveniently accessible for the manual adjustment of the required output. The pointer *1*, the minimum pointer, is normally intended for the adjustment of the lower output, the pointer *3*, the maximum pointer, being used for adjusting the higher output. The pointers indicate the position of the contacts (*8* and *10* in fig. 3), and can be set over a scale graduated from 0 to 120 % of the relay rating.

As mentioned earlier, a spiral spring provides a counter-torque to the driving measuring systems. One end of this spring is attached to the spindle *7* of the rotor system, the other end being connected to a fixed panel. The spiral spring at the same time serves as a current-carrying conductor to a moving contact (*9*) consisting of a small permanent magnet with an arm which is fixed to the rotor spindle.

The two adjustable contacts, the minimum contact (*8*) and the maximum contact (*10*) consist of steel springs coated with a rare metal. When the moving contact approaches the stationary one and reaches a certain position the steel spring is suddenly attracted and instantaneous closure is produced.

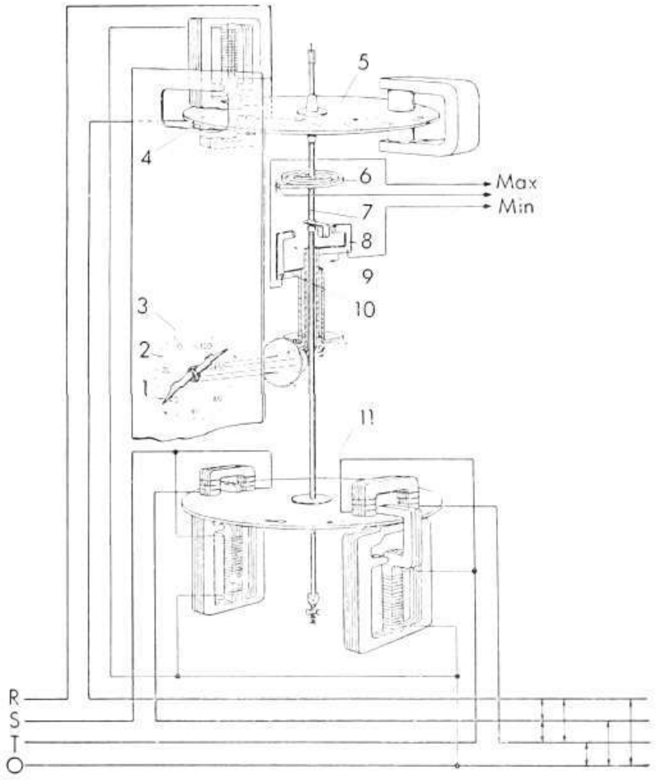


Fig. 3 X 6749
Diagrammatic view of the power relay

1 minimum pointer
2 scale
3 maximum pointer
4 index for reading the wattmeter scale
5, 11 rotor discs
6 spiral spring
7 rotor spindle
8, 10 adjustable contacts
9 moving contact

Fig. 4 X 4909

Relay with rotor disc and wattmeter scale

When the contacts recede from one another the spring is released in the same way and the interruption is likewise instantaneous. With this form of construction, in addition to the instantaneous movements, the advantage is also gained that the establishment of contact is clearly marked.

In consequence of the fact that the rotor disc, which is visible through a window in the front of the cover, is graduated from 0 to 120 % of the relay's rated load, it can serve as a wattmeter and the power consumption of the installation may be read off directly as a percentage of the rated load. Thus 100 scale divisions correspond to the relay's rated load.

It is also possible with the help of the rotor scale to check the power limits for which the setting has been made and undertake adjustments. Readings are taken by means of an index on the scale plate.

The relay can only be employed as a wattmeter when the maximum or minimum contact is not in the closed position.

Fig. 5 illustrates a form of regulation with a power relay (*5*) and intermediate relay type VEB 86 with a time limit (*6*) as the operating device. In addition to lighting (*4*), the equipment connected up in the installation includes two motors (*1* and *2*) and a heating load (*3*) for example. In this case the motor (*2*) can be disconnected from time to time without entailing inconvenience and is therefore connected through a contactor which is actuated by the operating device.

An optical signal such as a glow discharge lamp (*7*) is also connected to the maximum contact of the power relay.

Of the power relay's two pointers which may be adjusted for arbitrarily selected outputs, the maximum pointer is set at the subscription limit and the minimum pointer at a lower output adjusted in such a way that the motor (*2*) after being switched out by the operating device, is not reconnected again immediately but only after the output has fallen still further. By this means the motor is prevented from being continuously switched on and off. The difference between the two limits indicated by the power output must therefore be greater than the output of the motor which is regulated entirely automatically.

When the output reaches or exceeds the subscription limit the maximum contact closes a circuit, whereupon the lamp lights up and the intermediate relay comes into action. If the load continues to exceed the maximum output for a period of 30 seconds for which the intermediate relay has been set, for example, the latter will disconnect the motor.

The intermediate relay VEB 86 is so constructed that after receiving the impulses from the maximum contact it remains in the open position until the power output has fallen to the lower power limit for which adjustment has been made. The minimum contact then closes a circuit which actuates the intermediate relay in the opposite direction, whereupon the motor is switched in again.

In the diagram, fig. 6, the two power limits are indicated at P_1 and P_2 the latter of which is the subscription limit. As may be seen from the load curve, section I—II, the subscription limit has been temporarily exceeded, which

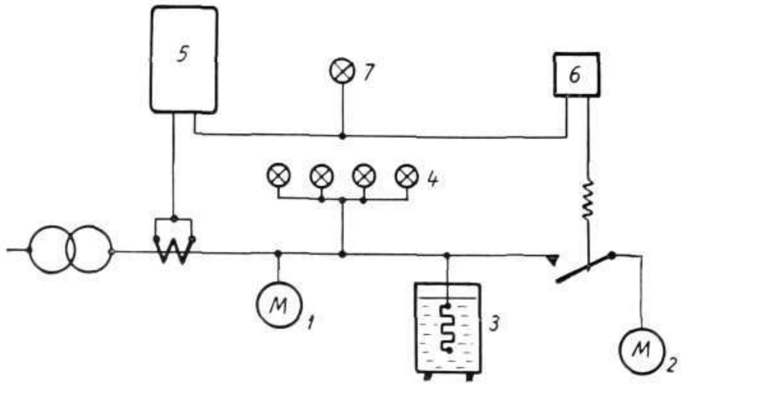


Fig. 5 X 6744

Example of an installation with a power relay

1, 2 motor load
3 heating load
4 lighting
5 power relay
6 intermediate relay with time limit
7 glow discharge lamp

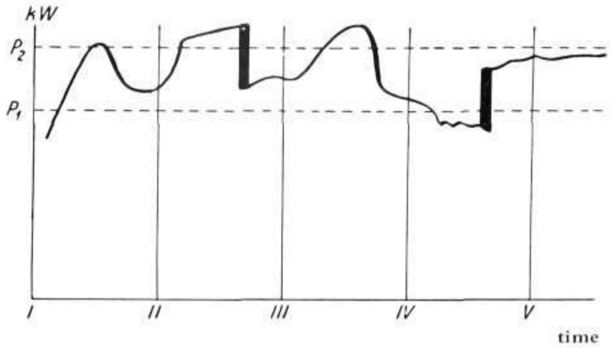


Fig. 6 X 6745
Load diagram

however, does not cause the disconnection of the motor as the intermediate relay has a time limit. In section II—III the subscription is again exceeded and this time for a longer period, whereupon the motor is switched out which results in a decrease in the output taken. If the power subsequently increases as in section III—IV without the motor being connected up again, a signal is given by the lamp to show that the subscription limit has been reached or exceeded. Finally, section IV—V indicates the reconnection of the motor when the output has fallen to the lower subscription limit.

Technical Data

Principle: Ferraris. Rotor system with spring counter-torque and contact devices.

Power limits: The power relay can normally be set between 0 and 120 % of the rated output. The minimum distance between the two power limits open to selection is about 6 % of the rated output.

Measuring accuracy: On the closure of the contacts the error may amount to ± 3 % between 30 % and 100 % of the rated output.

Power consumption in the voltage system: about 0.7 W.

Breaking capacity of the contact device: 30 mA at 220 V resistive load. The maximum permissible voltage across the contacts is 220 V.

Normal Forms

Rated voltage:	110, 190, 220, 380 and 500 V
Rated current:	5, 10 and 20 A
Rated frequency:	50 c/s
Weight:	3.6 kgs

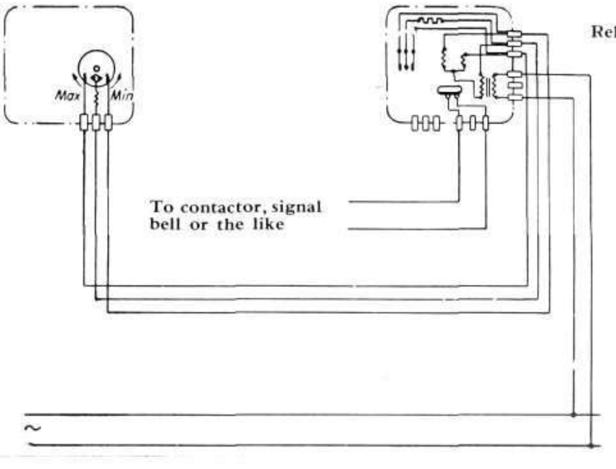


Fig. 7 X 6746
Power relay with time-limiting intermediate relay
Connection diagram for the operating circuits

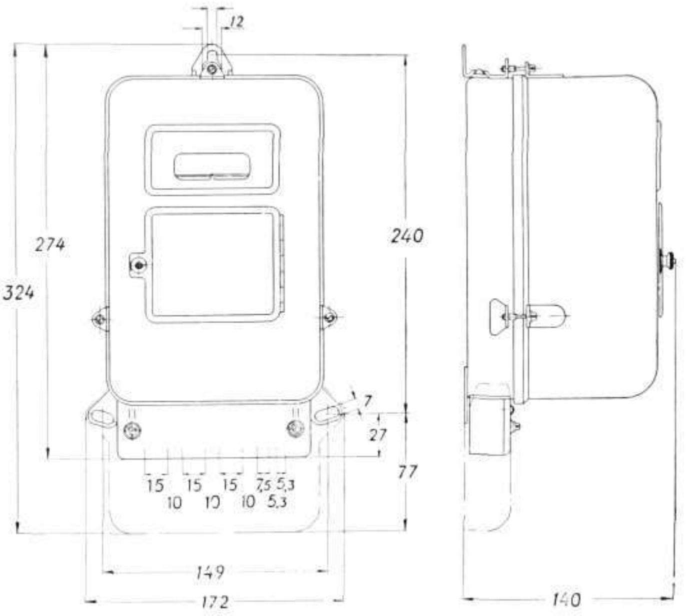


Fig. 8 X 6739

Dimension sketch for the power relay

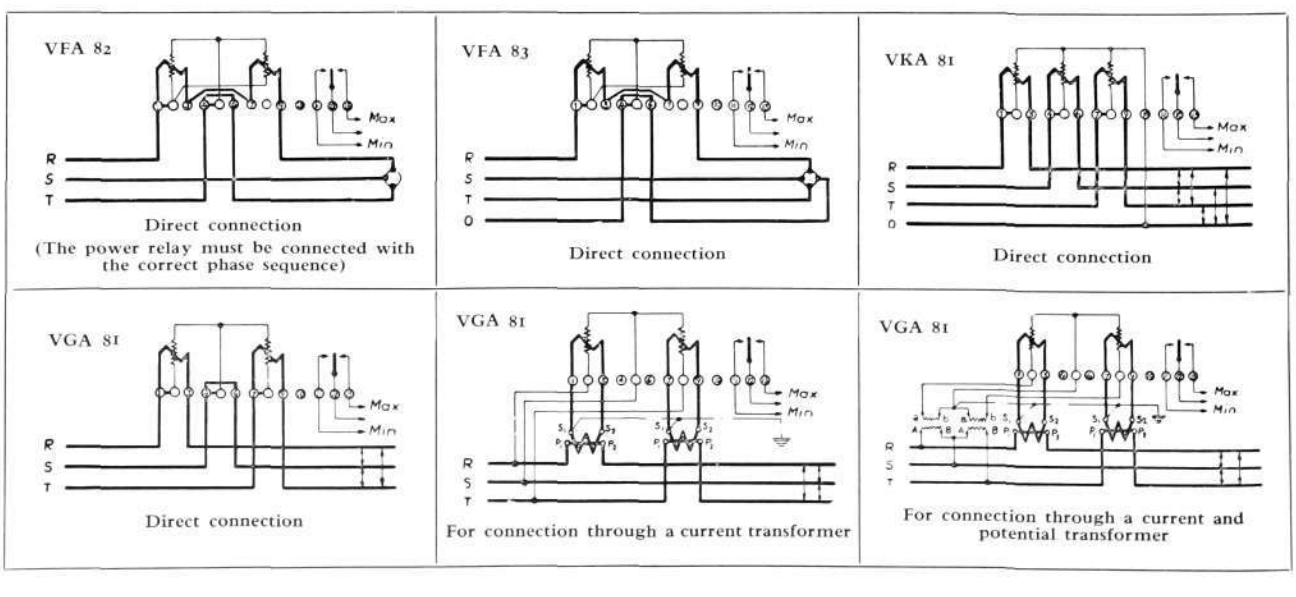
Type Designations for the Different Forms

Type	Network system	Load
VEA 81	single-phase	
VFA 82	three-phase without neutral	symmetrical
VFA 83	three-phase with neutral	symmetrical
VGA 81	three-phase without neutral	as required
VKA 81	three-phase with neutral	as required

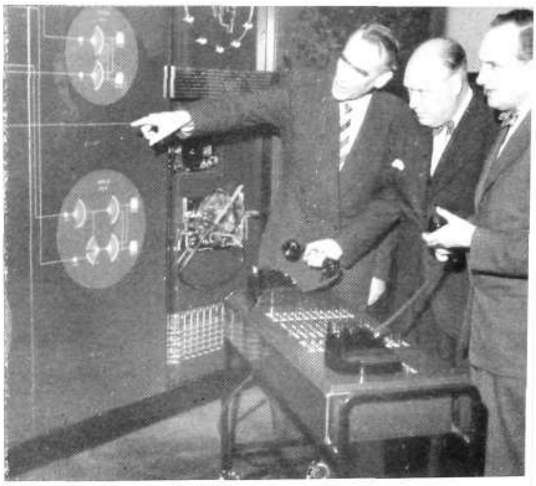
It will be seen from the type designations in the above table that the relays are manufactured both for single-phase and three-phase loads. As shown in the connection diagrams below, where instrument transformers are employed, only one current- and one potential transformer are needed for types VFA 82 and VFA 83. Type VFA 82 must be connected up with the correct phase sequence however. The relay can also be constructed for reactive power.

Fig. 9 X 4901—06

Constructional principle- and connection diagrams



Ericsson LM NEWS *from All Quarters of the World*



Messrs. H Sterky, Director-General, S Nordström, Chief Engineer of the Telegraph Administration, and M Patricks of L M Ericsson at the control desk.

100th Anniversary of Swedish Telecommunication Administration

Automatic traffic routing panel jubilee present from L M Ericsson

»By the time the next century in the history of the Swedish Telegraphs has drawn to its close, every Swedish house will no doubt possess one or more telephones. Automatic switching will bring subscribers in Sweden into touch with many hundreds of millions of subscribers in other parts of the world, on ships at sea, in aeroplanes and motor vehicles. Electric teleprinters will be the property of everyman, and letters will be received in typewritten or handwritten form at the moment in which they are written. Broadcasting and three-dimensional colour television will unite nations, races and peoples in a communion which we can now only dream of. Newspapers will be delivered to people's homes electrically at any moment they desire.

Should the layman obtain the impression that this vision of the future is child to the imaginings of Jules Verne, the technician will undoubtedly agree with me that it is painted in well-known colours. We can already convert mechanical motion, signs, sounds, and light into electric currents by means of the dial, key, microphone, and photoelectric cell; we master the technique of transmitting and amplifying telecommunication currents and we are well conversant with the ways of reconverting them to their original form by means of relays, teleprinters, telephone receivers, loudspeakers, and recorders.

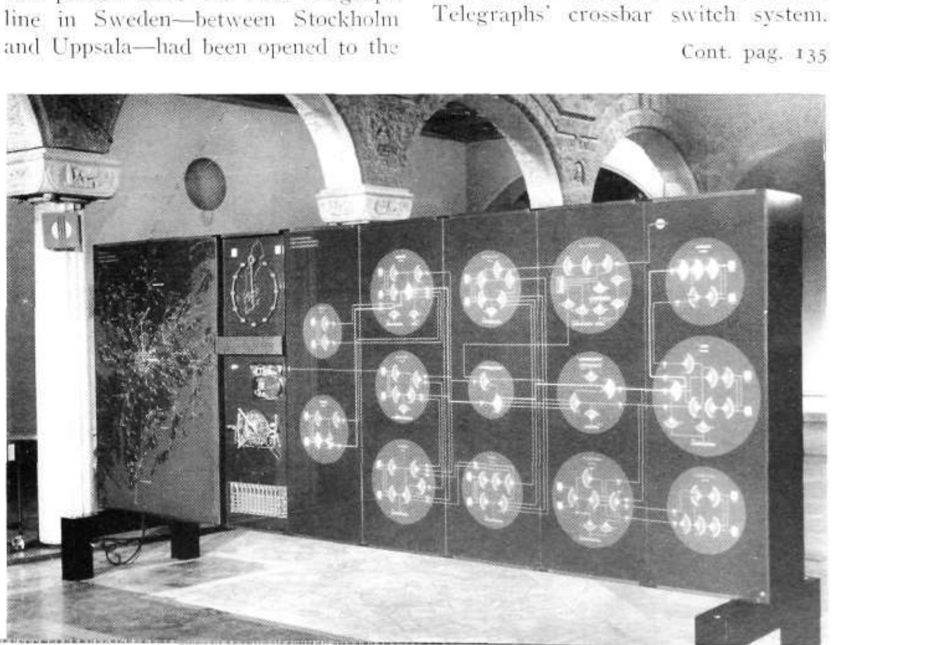
Only if I go a step further and predict that it will be possible by the agency of electricity to transmit not only sounds and light, but also the other three senses of touch, smell, and taste, am I venturing into the quagmire of unreality».

Thus did Mr. Håkan Sterky, Director General of the Swedish Telegraph Administration, sketch the future perspective of teletechnics in an address at the centenary celebrations on November 1. Exactly one hundred years had passed since the first telegraph line in Sweden—between Stockholm and Uppsala—had been opened to the public and the Swedish Telegraphs commenced their activities. The skill and initiative that have characterized this century of their labours have led to the imposing result that Sweden today is teletechnically one of the most highly developed countries in the world.

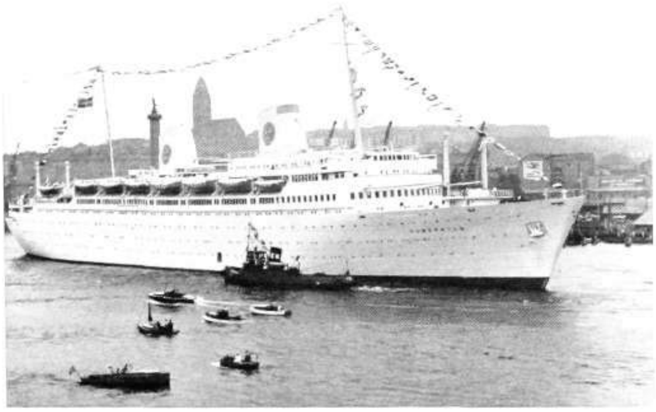
As early as the 1870s L M Ericsson were among the suppliers to the Swedish Telegraphs. The principal materials in the early days comprised Morse telegraph apparatus and instruments; later there followed telephones and from 1924 onwards automatic telephone exchange equipment. The first automatic exchange supplied to the Swedish Telegraphs in that year, Norra Vasa in Stockholm, was designed on L M Ericsson's 500-line selector system, which has since been used in the automatization of telephone service in forty-five Swedish towns. In addition, L M Ericsson have manufactured exchange equipment for a large number of Swedish localities which have been converted to automatic operation on the Swedish Telegraphs' crossbar switch system.

Cont. pag. 135

(Above) Prince Bertil conversing with Messrs. H Sterky, H Thorelli and S T Åberg (managing director of L M Ericsson) during the festivites at the Stockholm Town Hall. (Right) The panel on display in the Town Hall.



LM Ericsson Telephones on the New m/s »Kungsholm»



(Above) M/s »Kungsholm» lying at anchor in Gothenburg harbour. Princess Sibylla and the Crown Prince of Sweden accompanied the ship on her maiden voyage. (Right) The Crown Prince becomes acquainted with the L M telephone in his cabin.

The latest passenger ship of the Swedish American Line, m/s »Kungsholm» (22,000 tons), is fitted with a comprehensive system of internal communications comprising telephones and loudspeakers for passing orders and messages. It must be a rare occurrence that a 300-line automatic telephone exchange is installed on a ship purely for the comfort and convenience of the passengers. A L M Ericsson AHD 50 exchange of this capacity enables every passenger on board m/s »Kungsholm» to call his fellow passengers, the steward or service personnel, and receive radio calls on his cabin telephone. Since the telephone exchange has connections to the ship's staff in charge of the passengers' several requirements, much time and running backwards and forwards is saved. If a passenger wishes to be left in peace, he can merely disconnect his cabin telephone.

The captain's bridge is also connected to the 90-line automatic telephone exchange of type AHD 24, which serves the various officers and duty stations on board. This exchange can also be connected to the telephone systems in Gothenburg and New York for direct communication with subscribers ashore.

In the photograph below are seen the Bishop of Departamento de Narino with Messrs. Å Ohlsson and E Nilsson of L M Ericsson at the ceremonial opening of the telephone exchange in the Colombian town of Pasto. The exchange, which has a capacity of 1,500 lines, is equipped with L M Ericsson 500-line selectors.

New L M Ericsson Orders for Iceland, Turkey and South America

The automatic telephone exchange in Akureyri on the north coast of Iceland was delivered in 1950 and was for a short time the most northerly of all L M Ericsson automatic exchanges, until deprived of its record, first by Kiruna in Sweden, and then, in 1952, by Harstad in Norway on the 69th parallel. The Akureyri exchange will now be equipped for a further 1,000-lines, so doubling its capacity.

L M Ericsson's work on the automatization of the Turkish telephone network has now advanced so far that the exchanges in Adana, 3,500 lines, and Konya, 1,500 lines, have been brought into operation. An extension of Merkes Santral in Ankara by 1,000 lines has also been completed.

The exchange in Belo Horizonte, Brazil, delivered in 1950, is to be extended by 4,000 lines, so reaching a capacity of 10,000 lines. L M Ericsson are to construct an additional exchange in the town, catering for 10,000 lines.

From our Visitors' Book

L M Ericsson have been visited by the ex-President of Colombia, Dr. Alfonso Lopez, and the Colombian Ambassador in London, Dr. José Maria Villa Real, accompanied by their wives. (Above) The visitors study the lacing of cables. The photograph (below, left) was taken during the visit of an Egyptian Trade Delegation. (Below, right) The Venezuelan Chargé d'Affaires in Stockholm, Emilio Keusch Torres, is testing the first telephone made by L M Ericsson.

The managing director S T Åberg is demonstrating, below, a model of the L M Ericsson factory at Midsommarkransen to a group including the Dutch Minister of Finance, Professor Zyjlstra, and his wife.

100th Anniversary ... Cont. from pag. 133.

Both systems have been employed in the Stockholm region network, the automatization of which after nearly 30 years of work was completed in September 1953. To celebrate this event, which coincided with the centenary of the Telegraph Administration, L M Ericsson presented the Administration with a quite unusual gift —a demonstration panel, 5 × 3 metres in size, depicting schematically the Stockholm region network with its 184 local exchanges and 500,000 subscribers' telephones.

The panel is divided into three sections. The left-hand section contains a map of the Stockholm region. In the centre section are displayed the »cornerstones» on which the telephone exchanges are built: L M Ericsson's 500-line selector, used in practically all exchanges within the central Stockholm network, and the crossbar switches which are largely coming into use throughout the remainder of the network and are at present the focus of attention of teletechnicians throughout the world. In the right-hand section are portrayed schematically the various types of exchanges which have come into being during the 30 years in which conversion to automatic operation has been proceeding. Representative exchanges are shown from the centre of the city, from suburbs and from various outer areas.

Operation of the panel is arranged from a control desk fitted with two telephones by throwing down a key and dialling a number on one of the telephones. Lines of light across the panel mark the various traffic routes, and points of light the exchanges, used to establish the connection. The panel, with its 2,200 bulbs and 350 telephone relays, gives a clear picture of how the connection finds its way through the selector stages in the different exchanges until it reaches the wanted subscriber.

It is our hope that not only the public, but the expert in automatic telephony as well, will find the panel of interest. The less initiated can get an idea of how a call makes its way through the automatic network, and the technician will find subjects for discussion of intricate telephone problems.

The panel was designed and constructed in L M Ericsson's workshops in consultation with the firm of architects, Ahlgren-Olsson-Silow.

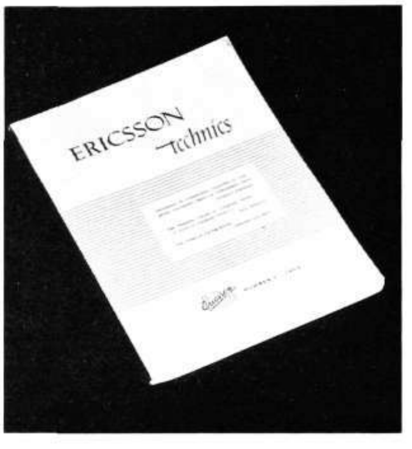
L M Ericsson Represented at Indonesian Trade Fair

At the Indonesian International Trade Fair held in Djakarta in September the display organized in the Swedish Pavilion by the local L M Ericsson representatives aroused great interest among the Indonesian public. The photograph to the right shows President Soekarno at the Fair receiving a white L M Ericsson telephone from the Swedish Minister, Malte Pripp.

Radio Salon 1953

The Radio Salon 1953, the first radio exhibition in Sweden for 25 years and the largest ever held in the country, was opened in Stockholm in October. The exhibition was jointly arranged by the Telecommunications Administration, the Swedish Broadcasting Corporation and Swedish radio manufacturers, and comprised partly a popular historical display of radio development, partly a commercial exhibition of autumn models. Svenska Radioaktiebolaget's clock-radio, »Klockett», which switches itself on at a given time and can thus be used as a tactful form of alarm clock, was a great success among the demonstrations arranged in natural settings. The photograph shows Cabinet Minister Sven Andersson, who opened the Radio Salon, examining this novel exhibit.

»Ericsson Technics» in New Form



»Ericsson Technics», the techno-scientific publication issued by L M Ericsson since 1933, has as from No. 1, 1953, assumed a new form. From 1933—1939 six numbers were issued annually. No issue was made during the first years of the war, but publication recommenced in 1943 and thereafter continued spasmodically. In 1953 »Ericsson Technics» appeared in a new format (250 × 176 mm) and a new typographical form. The purpose is that, following No. 1, 1953, »Ericsson Technics» will be issued twice a year. The first number contained the following articles: *Assessment of Transmission Properties of Telephone Instruments based on Articulation Tests* (Fr. Markman), *The Magnetic Circuit of Telephone Relays—A Study of Telephone Relays (1)* (S Ekelöf), *The Design of Zig-Zag Filters* (T Laurent).

»Ericsson Technics» is published in English only.

Stockholm District Fully Automatic

On September 9, 1953, the L M Ericsson automatic telephone exchange at Sandhamn was cut into service, the automatization of the Stockholm district being thereby completed. Automatization had commenced nearly 30 years ago when the Norra Vasa exchange was opened on January 13, 1924. The last local exchange in the inner town, Norr, was converted to automatic operation in 1938. In the intervening years automatization of suburban exchanges had commenced.

With few exceptions the central Stockholm exchanges operate on L M Ericsson's 500-line selector system. The remainder of the region, which comprises ten groups, has 44 exchanges operating on this system, the largest catering for 50,000 and the smallest for 500 lines. Other exchanges are equipped with crossbar switches of the Telecommunications Administration system.

U.D.C. 92 Cedergren

JOHANSSON, H: *H T Cedergren — a Swedish Telephone Pioneer*. Ericsson Rev. *30* (1953) No. 4 pp. 98—99.

A brief tribute to the memoary of H T Cedergren, whose birth took place 100 years ago.

U.D.C. 621.395.625.3

BLOMBERG, H & ERICSSON, O: *L M Ericsson's Telephone Answerer*. Ericsson Rev. *30* (1953) No. 4 pp. 100—105.

With the L M Ericsson telephone answerer — a new construction in a simple and reliable design — an already recorded message can be automatically transmitted from the subscriber's telephone when he was out and could not himself answer calls. In the article the design, functions and uses of the telephone answerer are described.

U.D.C. 621.395.344

STENBÆK, S: *Choice of Automatic Telephone System for Copenhagen and District*. Ericsson Rev. *30* (1953) No. 4 pp. 106—111.

The order for fully automatic exchanges of crossbar type for 82,500 lines as well as a large transit exchange and arrangements for interworking with existing demiautomatic systems, which KTAS placed with L M Ericsson was preceded by thorough investigations. The article presents an abridged translation of a paper describing the main points of this inquiry. The paper has earlier been published in the Danish periodical »Teleteknik».

U.D.C. 621.395.344

JOHANSEN, V: *The Copenhagen New Automatic Telephone System with Crossbar Switches*. Ericsson Rev. *30* (1953) No. 4 pp. 112—118.

In the article the principles are outlined for the L M Ericsson fully automatic system with crossbar switches which is being installed in Copenhagen. A description is also given of the equipment required for the interworking with existing exchanges of demi-automatic rotary system which successively are to be replaced by the new system.

U.D.C. 620.163.3

JONNERBY, E: *The Ductilometer Test — A New Method of Establishing the Ductility of Metals*. Ericsson Rev. *30* (1953) No. 4 pp. 119—127.

AB Alpha has introduced a new method of testing the ductility of materials such as wire, sheet or strip. According to this method the material is made to fracture by means of repeated carefully controlled bending operations to adjustable angles. The bending operations are carried out in a special instrument, the Ductilometer, made by AB Alpha. The design and function of the Ductilometer is described in the article. Examples of tests carried out give a picture of the application of the method.

U.D.C. 621.318.525

BAYARD, H: *A New Power Relay*. Ericsson Rev. *30* (1953) No. 4 pp. 128—132.

Ermi's new power relay assists consumers in their endeavour to utilize the subscription power in a rational manner. The power relay is simple and reliable in operation and it is found particularly serviceable for use in installations in which a part of the load may be temporarily disconnected through contactors without inconvenience, as is the case with electric heating boilers, pumps for water storage tanks and grinding machines in paper mills, for example.

The Ericsson Group

ASSOCIATED AND CO-OPERATING ENTERPRISES

EUROPE

Danmark

L M Ericsson A/S *København V*, Trommesalen 5, tel: C 3438, tgm: ericsson-københavn

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/M*, Glauburgstrasse 82, tel: 57 006, tgm: erictel-frankfurt-main

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. 1*, 329 High Holborn, tel: Holborn 1092, tgm: teleric-london

Production Control (Ericsson) Ltd. *London, W. C. 1*, 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 Appio, 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 Appio, 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: Centralbord 33 50 85, tgm: indtroll-oslo

A/S Norsk Kabelfabrik *Drammen*, P. B. 205, tel: 12 85, tgm: kabel-drammen

Portugal

Sociedade Ericsson de Portugal, Lda. *Lisboa*, 7 Rua Filipe Folque, tel: (PPC—2 Linhas) 57 193, tgm: ericsson-lisboa

Schweiz

Ericsson Telephone Sales Corp. AB, Stockholm, Zweigniederlassung Zürich *Zürich*, Stampfenbackstrasse 63, tel: 051-26 00 80

Suomi

O/Y L M Ericsson A/B *Helsinki*, Fabianinkatu 6, tel: A 8282, 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: 2135, tgm: javeric-bandung

Liban

Telefonaktiebolaget L M Ericsson, Technical Office *Beyrouth*, Rue du Parlement, Immeuble Bisharat, tel: 162, tgm: ellem-beyrouth

Türkiye

Ericsson Türk Ltd. Şirketi *Ankara*, Ziyah Gökalp Cadd. 5/2, tel: 28 379, tgm: ellem-ankara

AMERICA

Argentina

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

Canada

Ericsson Telephone Sales of Canada Ltd, *Montreal 2, Quebec*, Castle Building, 1410 Stanley Street, tel: LANcaster 8169, tgm: caneric-montreal

Chile

Cía Ericsson de Chile S. A. *Santiago*, Casilla 10143, 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*, 501 South Market Street, 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

AUSTRALIA & OCEANIA

Australia

L M Ericsson Telephone Co. Pty. Ltd. *Melbourne C 1 (Victoria)*, Kelvin Hall 55 Collins Place, tel: Cen. 5646, tgm: ericmel-melbourne

AGENCIES

EUROPE

Belgique

Électricité et Mécanique Suédoises *Bruxelles*, 56 Rue de Stassart, tel: 11 14 16, tgm: electrosuede-bruxelles

Grèce

»ETEP», S. A. Commerciale & Technique *Athènes*, 41 Rue W. Churchill, tel: 31 211, tgm: aeter-athenes

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, tel: 20 171, 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 *Baghdad*, Mustansir Street, 5A/38, tel: 8 48 19, tgm: swedeorient-baghdad

Iran

Irano Swedish Company AB *Teheran*, Khiaban Sevom Esfand 201—203, 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 No. 7, Minato-ku, tel: (43)-1847, 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: 6142, 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. R.* P. O. B. 125, tel: 3-37-53, tgm: koppelrail-manila

Saudi Arabia

Mohamed Fazil Abdullah Arab *Jeddah*, P. O. B. 39, tel: 405, tgm: arab-jeddah

Syrie

Georgiades, Moussa & Cie *Damas*, Rue Ghassan, Harika, tel: 10289, tgm: georgiades-damas

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

Transcandia Ltd. *Nairobi, Kenya*, P. O. B. 5933, tel: 3312, tgm: transcandia-nairobi

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

Ethiopia

Swedish Ethiopian Company *Addis Abeba*, P. O. B. 264, tel: 14 47, tgm: etiocomp-addisabeba

Moçambique

J. Martins Marques *Lourenço Marques*, P. O. B. 456, tel: 59 53, 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

AMERICA

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

República Do

García & Gauti
Trujillo, Apar
tel: 3645, tgm:

Ecuador

Ivan Bohman & Co. *Guayaquil*, Casilla 1317, tel: Centro 208, tgm: boman-guayaquil

Guatemala

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

Haïti

F. Georges Naudé *Port au Prince*, P. O. B. A 147, tel: 3075, tgm: nodeco-portauprince

Honduras

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

Jamaica

Morris E. Parkin *Kingston*, P. O. B. 354, tel: 4077, tgm: morrispark-kingston

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: 2541, tgm: kersten-paramaribo

AUSTRALIA & OCEANIA

New Zealand