ERICSSON Review

1
1956

ERICSSON REVIEW

Vol. XXXIII 1956

RESPONSIBLE PUBLISHER: HUGO LINDBERG
EDITOR: SIGVARD EKLUND, DHS
EDITOR'S OFFICE: STOCKHOLM 32
SUBSCRIPTIONS: ONE YEAR $ 1:50; ONE COPY $ 0:50

CONTENTS

	page
TELEPHONE EXCHANGES	
Qualitative Maintenance of Automatic Telephone Networks	34
Practical Experience in the Operation of Crossbar Exchanges in the Rotterdam Zone	74
New L M Ericsson Exchanges	27
Electronic Telephone Exchanges	2
TELEPHONE SETS	
Ericofon—The New Telephone Set	99
Ericsson Telephones	96
The Ericofon Chassis	110
Ericofon Receiver and Transmitter Insets	119
Circuit Design of Ericofon	115
Ericofon Induction Coil	122
LONG DISTANCE TELEPHONY	
Application of 8-channel Openwire Carrier Telephone Systems in Brazil	64
New 6- and 8-channel Carrier Telephone Systems for Open-Wire Lines	46
TELESIGNALLING MATERIAL	
Mains Connected Job Costers	22
Telesignalling Equipment in a Modern Hospital	81
RAILWAY INTERLOCKING PLANTS	
Reorganization of Shunting at Ånge Marshalling Yard, Swedish State Railways	15
L M Ericsson's Traingraph	52

ELECTRON TUBES

Germanium Power Rectifiers 24

MISCELLANEOUS

L M Ericsson News from All Quarters of the World 29

L M Ericsson News from All Quarters of the World 59

L M Ericsson News from All Quarters of the World 91

L M Ericsson News from All Quarters of the World 123

ERICSSON REVIEW

RESPONSIBLE PUBLISHER: HUGO LINDBERG

EDITOR: SIGVARD EKLUND, DHS

EDITOR'S OFFICE: STOCKHOLM 32

SUBSCRIPTIONS: ONE YEAR $ 1.50; ONE COPY $ 0.50

CONTENTS

	page
Electronic Telephone Exchanges	2
Reorganization of Shunting at Ånge Marshalling Yard, Swedish State Railways	15
Mains Connected Job Costers	22
Germanium Power Rectifiers	24
New L M Ericsson Exchanges	27
L M Ericsson News from All Quarters of the World	29

On cover: Point switching equipment supplied by L M Ericsson for Ånge control tower.

Electronic Telephone Exchanges

G SVALA AND W JACOB, TELEFONAKTIEBOLAGET LM ERICSSON, STOCKHOM

U.D.C. 621.389:621.395.722

Electronics have been employed for certain purposes in automatic telephone exchanges for many years. But the rapid development that electronics—and perhaps especially semiconductors—are now passing through has led telecommunication researchers and designers to consider their applicability on a broader basis. Efforts in this direction have been stimulated particularly by the advent of the electronic computers. As far as can be judged, however, the fully electronic exchange is still a long way distant. The present electromechanical exchanges are economically and operationally of such a high standard that very considerable progress in electronics must still be made before fully electronic systems become competitive.

This article presents a review of the electronic components, refers to certain applications of ordinary functional units, and describes a trial plant that has been built at the Development Department of Telefonaktiebolaget L M Ericsson.

The principal functions of an automatic telephone system may be divided into those associated with the connection, supervision and disconnection of calls, and those concerned with transmission.

These two categories of functions can be kept distinctly separate; and in introducing electronics, it has been found that electronic devices may well be used for the setting up of connections—i.e. for functions of the former type—in combination with electromechanical switches for the transmission of speech. From these, shall we say, semi-electronic systems to fully electronic systems in which all functions, including transmission, are performed by electronic equipment, the step is still a long one. It may be as well, therefore, to start by examining the possibilities of electronics in relation to the connecting functions, and thereafter study the problem of transmission.

Connecting Functions

All functions in this category may be broadly said to imply that, by means of logical circuits, new conditions are created in the system dependent upon existing conditions, received signals and built-in programme. The resemblance to automatic computing technique is striking.

In the classical systems these functions are predominantly performed by relays. Selector switches, however, will often serve for memory functions. It is of a certain fundamental interest to note that certain types of selectors, for instance rotary switches, possess the property of requiring no power while at rest but only for changes of state.

The relay has certain characteristic properties which make it well suited for all functions in the first category. It has an amplifying effect, i.e. from one of its contacts it can supply more than sufficient current to another relay winding or to its own. In the latter case it may be said, in the terminology of transmission engineering, that the relay has positive feedback.

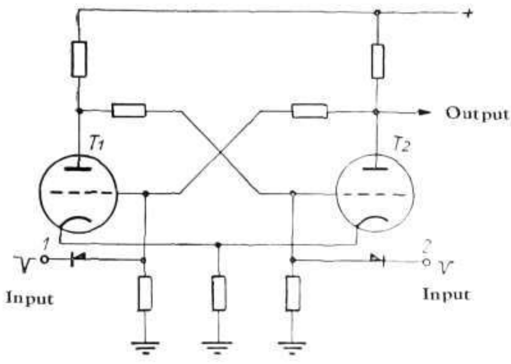


Fig. 1 X 2078

Flip-flop circuit (corresponding to a relay with holding contact)

The relay can assume distinctly separate states, normally two, depending on the magnetizing current. Its information capacity is thus 1 bit.

The relay can also be equipped with different contact combinations to suit the desired programme.

Within applied electronics there is not the same limitation to only a few fundamental structural units, but a choice can be made among a multitude of essentially distinct components which, in turn, can be combined in a great number of ways into a functional complex. This is both a strength and a weakness; a strength, in that the variety of combinations makes it easier to match the solution to the problem, but precisely on that account a weakness, since the designer is tempted to work out special solutions for each particular case, so running counter to the aim of standardized production. The rapid development of electronics, particularly in the field of semiconductors, which is constantly placing improved, or in some cases radically new, components in the hands of the designer, further accentuates the difficulty of standardizing electronic functional units. This paper, therefore, will only be able to present a few examples of how certain problems in automatic telephony can be solved by electronic means. It may be best to start by taking stock of the most important electronic components, having regard to their utilization for connecting and similar functions.

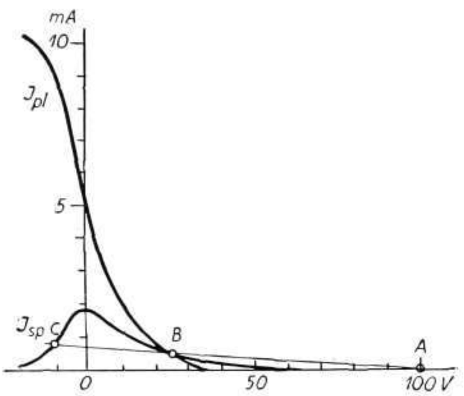


Fig. 2 X 2079

Volt-ampere characteristic of an electrode (spade) in a beam switching tube

I_{sp} spade current, I_{pl} plate current; plates and other spades at 100 V. Strength of magnetic field 350 gauss. Points *A* and *C* mark the stable conditions of operation.

Vacuum Tubes

The ordinary vacuum tube, like the relay, is an amplifier, and in suitable circuits including positive feedback two stable states are obtainable owing to saturation. But whereas the relay effects the closing or opening of a current path, with the electron tube it is usually necessary to utilize the voltage drop across a plate resistor as output signal. This illustrates a characteristic property of electronic circuits in automatic switching, namely that one often has to work with voltages rather than with currents. It is admittedly possible to imitate the contact combinations of relays by means of different configurations of rectifiers, but it is found in practice that this can only be done to a limited extent unless amplifying devices are added which can regenerate the signals.

With a normal electron tube coupled as a d.c. amplifier, positive feedback with a total loop gain greater than 1 cannot be accomplished in one stage. Thus a relay with holding contact can only be reproduced with two tubes. An example of such a coupling is the flip-flop circuit in fig. 1, which may be regarded as a two-stage resistance-coupled amplifier with powerful positive feedback. It will only be stable, therefore, in the two limit positions where the current through either tube is entirely suppressed.

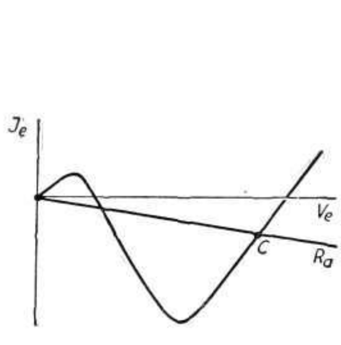


Fig. 3 X 2080

Volt-ampere characteristic of an electrode in a memory tube

with external resistance R_a. Origin and *C* mark the stable conditions of operation.

With vacuum tubes of a special design, however, such that an electrode shows a negative internal resistance, a bistable coupling can be simply arranged by connecting a usually fairly high impedance to a suitable bias voltage in the external circuit. This is the case in the beam switching tube, the characteristic of which for one electrode (the spade), fig. 2, has a negative slope within a certain region. Two stable points of operation are obtained, one with the spade non-conducting (*A*) and at a voltage equal to the feed voltage of the load resistance, the second at the point of intersection between the load line and the left flank of the characteristic (*C*), i.e. at a very low spade voltage. The point of intersection with the right flank (*B*) does not represent a stable state. (1)

Certain antiquated types of screen grid tube displayed negative internal impedance at low plate voltages owing to secondary emission from the plate. This effect has been utilized in a type of tube developed by L M Ericsson, the memory tube, which has twenty equivalent and independent electrodes with negative internal resistance. The characteristics (fig. 3) show stable points of operation at origin and *C*. Thanks to this property the tube has a memory capacity of 20 bits and is specially designed for "parallel reading". (2)

Vacuum tubes are unfortunately seldom economical in automatic switching; their chief drawbacks are their high power consumption and limited life expectancy, even though some improvement in the latter respect has been effected in recent years. They are therefore only employed for more qualified tasks.

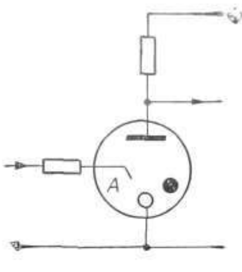


Fig. 4 X 2081

Cold cathode triode

A: starter electrode

Cold Cathode Tubes

The cold cathode gas-filled tubes, on the other hand, which neither consume current nor become worn while at rest, have proved well adapted to the requirements of automatic switching. In an elementary circuit with one cold cathode tube (fig. 4) the tube has two discharge gaps of primary interest, one between the starter electrode and cathode and one between the plate and cathode. In the former the starting voltage is purposely low, in activated tubes being in the order of 80 V, whereas the starting voltage of the main gap is made as high as possible, about 200 V, which is also the highest feed voltage that can be used. If a pulse in excess of the starting voltage is introduced into the starter gap, a discharge takes place in it and spreads to the main anode—cathode gap with a maintaining potential of about 65 V which is fairly independent of the current. The fact that the discharge sustains itself by "internal feedback", even if the current disappears in the starter gap, is of great value in most cases (cf. relay with holding contact). To extinguish the tube, on the other hand, the main circuit must be opened or the e.m.f. effective in the external circuit must be brought below the maintaining voltage at least for a brief instant, of the order of 1 ms.

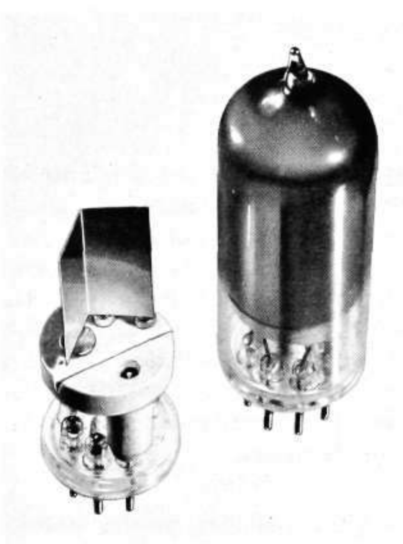


Fig. 5 X 2098

Cold cathode triode RZC 1031

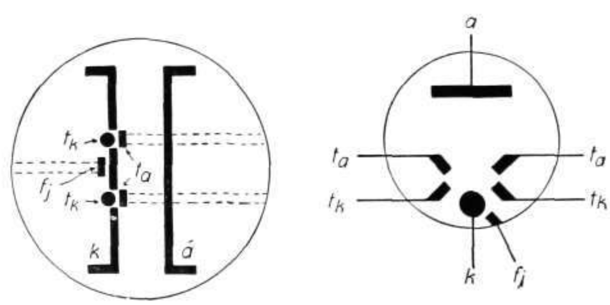
An example of the use of cold cathode triodes is the electronic identifier which has been in service in the Helsinki Centrum Exchange since 1953 (3). Since then a somewhat improved cold cathode triode has been produced in the Tube Laboratory of the Development Department. It is designated *RZC 1031* (fig. 5). Owing to, among other things, a "built-in" charge of radioactivity, in lockout circuits it can make a random selection with 100 per cent positive lock-out. One of the uses of this tube will be in the test and lock-out circuits of group selector markers.

There are thus cold cathode tubes of different designs adapted for different requirements. If extreme rapidity is needed (short ionizing and deionizing time), hydrogen or helium must be used in the tubes instead of the usual argon or neon. This unfortunately results in far higher starting and maintaining voltages, so that the feed voltage will approach 400 V. A tube of this kind (fig. 6) has been designed for an absolutely special application, and the electrode system therefore comprises two separate starter gaps with separate starter electrodes. Positive pulses are applied to one starter electrode of every pair, and negative to the other. The amplitude of the pulses should be such that the tube strikes only when there is coincidence between the pulses in either pair of electrodes.

Fig. 6 X 2082

Dual-controlled cold cathode triode with two separate starter gaps and separate starter electrodes. The tube ignites when there is coincidence between starter impulses on associated starter electrodes

a plate
k cathode
ta starter plate
tk starter cathode
fj preionization plate



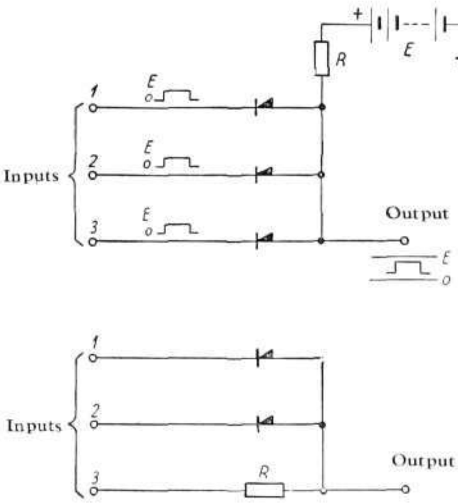


Fig. 7 X 2083

"And" circuits

An output signal is obtained only on the simultaneous appearance of signals on all inputs

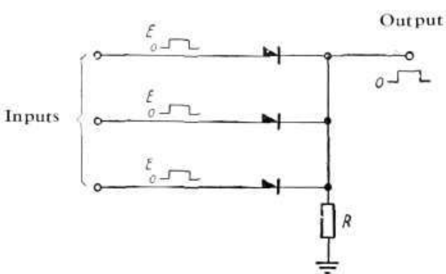


Fig. 8 X 2084

"Or" circuit

An output signal is obtained if positive is applied to one or more of the inputs

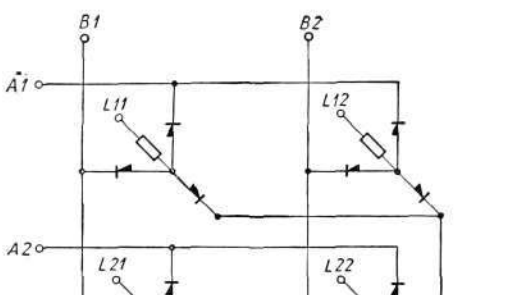


Fig. 9 X 2085

Identifier matrix

Pulses from chains of cold cathode tubes scan the horizontal wires A_1, A_2 etc. and the vertical wires B_1, B_2 etc. If a call lies in one of the line equipments L_{11}, L_{12}, L_{21}, L_{22} etc., coincidence is obtained in an "and" circuit connected with the input and the call is thus indicated on the output.

Fig. 10 X 6942

Chain of cold cathode tubes

in which the ignition proceeds from tube to tube when pulses are applied at *P*

In normal cases, however, it does not pay to manufacture special purpose tubes when the striking of a tube is to be made dependent on different conditions, but the tubes are instead combined with separate logical networks. The latter may be built up, for example, from different combinations of rectifiers and resistors, on the foundation of two simple basic circuits which, in USA, have been called "and" circuits and "or" circuits. The purpose of an "and" circuit is to make an output signal dependent on the simultaneous appearance of more than one input signal, in the illustrated example three. The corresponding relay circuit would consist of series-connected make contacts. A positive output voltage occurs only when positive voltages are applied to all inputs. The "or" circuit (fig. 8) corresponds to parallel-connected relay contacts. A positive output voltage is obtained when there is positive on any one of the inputs. The hydrogen cold cathode tube (fig. 6) may be said to have two built-in "and" circuits joined to an "or" circuit.

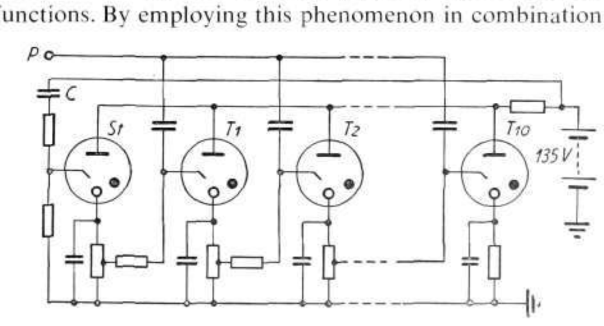
These basic circuits may now be combined in different ways. A similar arrangement (fig. 9) is used in the "identifier matrix" in the full electronic switchboard which is described in a following section. The calls are represented by positive voltage on the inputs from the line equipments L_{11}, L_{12}, L_{21} and L_{22}. The identifier continuously scans the matrix by means of positive voltage pulses from two chains of cold cathode tubes which search the horizontal wires A_1, A_2 and the vertical wires B_1, B_2 (in actual fact there are 100 inputs and consequently 10 A-wires and 10 B-wires).

The mutual phase relationship between the pulses of the two chains changes after every cycle, and in this way every call will in due course be located. When scanning pulses coincide at a crosspoint with a calling voltage, an output signal is obtained from the "and" circuit associated with the input. The outputs of the "and" circuits are gathered into a common output by means of diodes which together form an "or" circuit. The call will therefore appear on the common output at a certain moment in dependence on the scanning pulses.

Another often used circuit is the chain of cold cathode tubes (fig. 10). For counting short pulses appearing at *P*, use may here be made of a resistance-capacitance link connected to the starter electrodes in order to add bias voltage, obtained from the cathode circuit of the preceding tube, and pulse. The characteristics of the tube and the amplitude of the pulses are such that the tube will strike only if both pulse and bias voltage are present. If only one tube at a time is ignited, the next tube to strike will be the immediately succeeding one. On the application of the feed voltage the starting tube *St* will ignite in virtue of its specially designed input circuit. In the first instant the common plate resistor takes up the entire difference in voltage between the feed voltage and the maintaining voltage of the tube. Soon, however, the cathode capacitor will be charged so that a potential division occurs between the cathode resistor and the plate resistor. Thereby a positive bias voltage is applied to T_1. The first impulse ignites T_1 and, in analogy with the procedure above, the momentary increase in the voltage drop across the common plate resistor now extinguishes *St*. The following impulse ignites T_2, which in its turn extinguishes T_1, and so on.

Other Connecting Elements

The remanence of magnetic materials (fig. 11) can be used as the basis for memory functions. By employing this phenomenon in combination with the am-



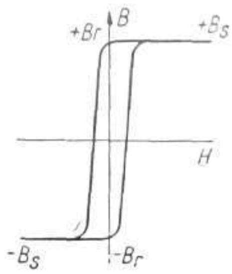


Fig. 11 X 2086

Hysteresis curve for a magnetic material suited as memory unit

plification attainable in transductor circuits, magnetic pulse chains can be built up in the same way as the cold cathode tube chain. Arbitrary logical connecting networks have also been built up by utilizing ferromagnetic materials with pronounced saturation properties. An equipment of this kind must, however, be fed with alternating current or pulse voltage.

Dielectric materials have in recent years been produced that exhibit saturation and hysterisis similarly to the ferromagnetic materials and are therefore called "ferroelectric". The applicability of these materials for the aforementioned functions has been studied with some success.

The memory function of the ferromagnetic and ferroelectric devices requires no power in the idle condition (cf. the rotary switch as memory device). Energy is only used for repolarization, i.e. mechanical work in the actual materials.

The Transistor

The greatest weakness of the vacuum tube, the heater current consumption, is entirely lacking in the transistor, which has otherwise similar properties. The possibility of driving it on low voltage, moreover, gives it a clear advantage over the cold cathode tubes. Unfortunately the methods of manufacture have only lately reached the stage at which the transistor could be considered for use in automatic switching systems, with a view both to life and stability requirements and to price. Until quite recently, moreover, two transistors in cooperation have been needed to ensure reliable bistable circuits (cf. similar electron tube circuits).

The avalanche transistor produced in USA this last year offers interesting possibilities in this respect, reminiscent of those of the cold cathode tubes, while not requiring the high feed voltage of the latter. In the long run it is probable that transistors and semiconductor diodes, in conjunction with ferromagnetic and ferroelectric materials, will become the most important elements in automatic switching.

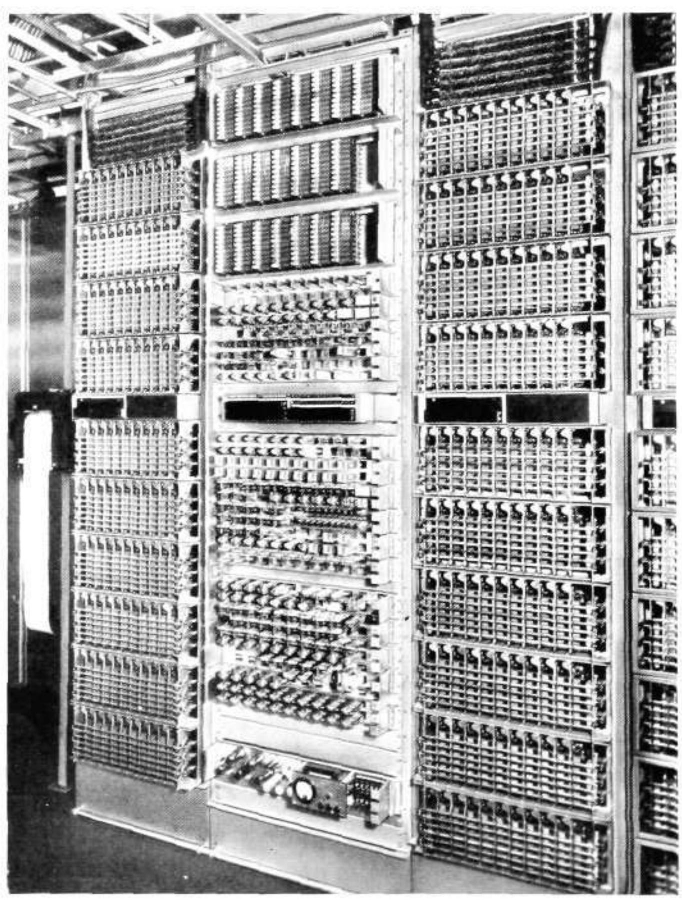


Fig. 12 X 6947

Electronic group selector marker with associated selector rack

on trial service in transit exchange at Borups Plads, Copenhagen. The actual marker occupies only a small part of the centre rack, which also accommodates comprehensive recording equipment for the provision of detailed service statistics. Apart from the connecting relays at the top, only a few relays take part in the work of the marker.

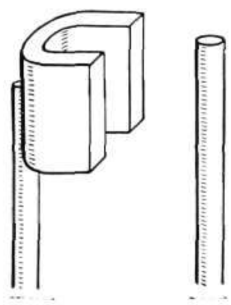


Fig. 13 X 2087

Cold cathode tube with hollow cathode

Owing to its geometric design and special filling gas the tube has a negative internal resistance of a few hundred ohms

Example of Semi-Electronic System

An example of a complete experimental system of "semi-electronic" type, i.e. with conventional equipment in the speech paths but electronic connecting devices, is the group selector marker that has been in trial service in Copenhagen since 1954 (fig. 12). The number of relays in the actual marker has been greatly reduced; those which remain are chiefly of the multicoil type and are used as connecting relays. As an alternative to random selection based on cold cathode tubes with statistically distributed time lag, a similar effect is attained in this marker with a rapid pulse scanning of the lock-out circuits. For this purpose the marker is equipped with a continuously stepping magnetic chain of the kind referred to above, driven by a normal buzzer generator. The chain, which can of course control several markers, delivers short pulses at a frequency of 90 Hz to ten output terminals at an interval of 1.1 ms between consecutive outputs.

The Problem of Transmission

Transmission circuits place entirely different demands on the switching equipment than connecting circuits. Consideration must be given to attenuation, crosstalk, distortion and noise. Economy is also a deciding factor.

Electronic Contacts

Normal electron tubes can, of course, meet the requirements as regards attenuation and noise, but transmit in one direction only. Four-wire transmission must be adopted, therefore, with its attendant complications and expense. Considerable work has been done on secondary emission tubes capable of transmission in both directions, but the results so far are not convincing.

The prospects are brighter on the cold cathode tube front. A cold cathode tube with hollow cathode (fig. 13), developed by Bell Laboratories, represents a remarkable advance. Owing to its special geometric shape and the choice of filling gas, a stable negative internal resistance has been attained in this tube of the order of a few hundred ohms, when transmitting normal voice frequencies. The noise level is satisfactorily low. Especially in small switchboards the hollow cathode tube appears to offer an attractive solution to the transmission problem. On the other hand it cannot be used in pulse systems.

A rectifier can in principle replace a selector contact, since its resistance is dependent on the intensity and direction of the current. A closed selector contact may therefore be imitated by superimposing the signal current on an auxiliary current in the forward direction of the rectifier. Owing to the curved characteristic of the rectifier, the forward resistance will be lower the greater the auxiliary or control current. The open contact is represented by giving the rectifier a negative bias so that it works in the reverse direction. The reverse resistance must obviously be as high as possible. The reverse resistance generally diminishes with rising reverse voltage, but there are exceptions.

When determining the control current and bias voltage for a rectifier used as contact (in transmission terminology known as modulator), consideration must be given to signal power and impedance. In actual fact, if the attenuation is to be kept to a minimum, there is a further relationship to be considered, viz. between the impedance and the forward and reverse resistances of the modulator at the respective points of operation. In these applications the high frequency properties of the rectifiers are of decisive importance. For this reason copper and selenium rectifiers are hardly suitable, but the main interest has been devoted to the germanium diodes which are particularly characterized by low capacitances (of an order of magnitude of 1 pF).

A comparison between semiconductor contacts and mechanical contacts (table 1) shows that each type has decided advantages in different respects. A direct price comparison, however, shows the semiconductor diode in a very unfavourable light, especially as several diodes are normally required to replace one mechanical contact.

Table 1. Comparison between semiconductor contact H and mechanical contact M. A cross indicates superiority.

	H	*M*
Forward resistance		+
Reverse resistance		+
Leakage resistance		+
Capacitances	+	
Loading capacity		+
Reproducibility	+	
Vibration sensitivity	+	
Corrosion	+	
Temperature dependence		+
Rapidity	+	
Wear	+	
Price		+

The Multiplex Principle

The use of electronics in connecting and similar equipment such as identifiers, markers and registers, is already today within the bounds of economic practicability. This is because cold cathode tubes are less expensive than relays—though even here the calculation is impaired by the need for rectifiers in the auxiliary circuits—and further because the number of devices can often be reduced thanks to the greater rapidity of electronic equipment and consequent shorter time of occupation.

As regards transmission the situation is less favourable. It can hardly be asked that subscribers shall cut down on the load simply for the pleasure of speaking through electronic switchboards. There is another possibility, however, and that is to utilize the rapidity and good high frequency properties of electronic contacts in multiplex systems. We know essentially two types of multiplex transmission systems, with frequency-division and with time-division. The first alternative, applied to an automatic switchboard with four-wire circuits, N inputs and M outputs, is illustrated in fig. 14. Only one of the outputs is drawn. If the inputs represent subscribers' circuits, each such circuit clearly has complete modulator equipments for each direction and individual carrier frequencies, f_1, f_2 etc. They are connected to the modulator equipments of the link circuits, which can be allocated arbitrary carrier frequencies f_x, via the common channels or "highways" H_1 and H_2. Contact between a given link circuit and, for example, subscriber's circuit *I* is clearly achieved by making $f_x = f_1$.

With this arrangement the number of contacts, if by contacts we mean modulator equipments, will clearly be $N + M$ instead of $N \times M$ as in normal selector systems. (5)

In practice, particularly owing to the extensive filter equipments, the frequency-division multiplex principle is found to be unfruitful. It is well known from transmission techniques that time-division multiplex can provide simpler terminal equipments. High requirements are admittedly placed on the phase distortion of the transmission circuit, but the circuits of a switchboard can be made short and kept under control in other respects. The form of time-division multiplex that can be used corresponds to the pulse amplitude modulation (PAM) of transmission systems. If the carrier frequencies f_1, f_2 to f_n and f_x in fig. 14 are replaced by pulses having the same repetition frequency but different phase positions p_1, p_2 to p_n and p_x, and if the modulators are imagined to be of such a nature that they function as contacts which are closed in the presence of a pulse but are otherwise open, it is clear that connection can be effected between an input circuit, e.g. 1, and the output circuit by allocating the phase position $p_x = p_1$ to the pulse generator of the latter. Thus the conditions will be analogous with those of frequency-division multiplex.

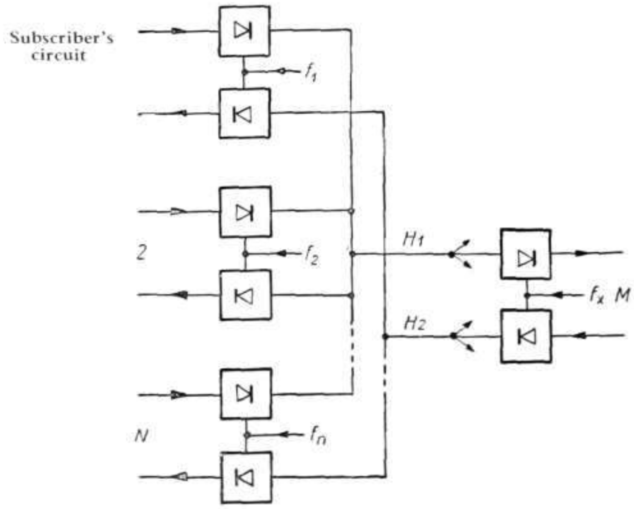


Fig. 14 X 6943

Automatic switchboard with frequency—division multiplex in four-wire circuit

Contact between subscriber's circuit 1 and the link circuit M is obtained when $f_x = f_1$

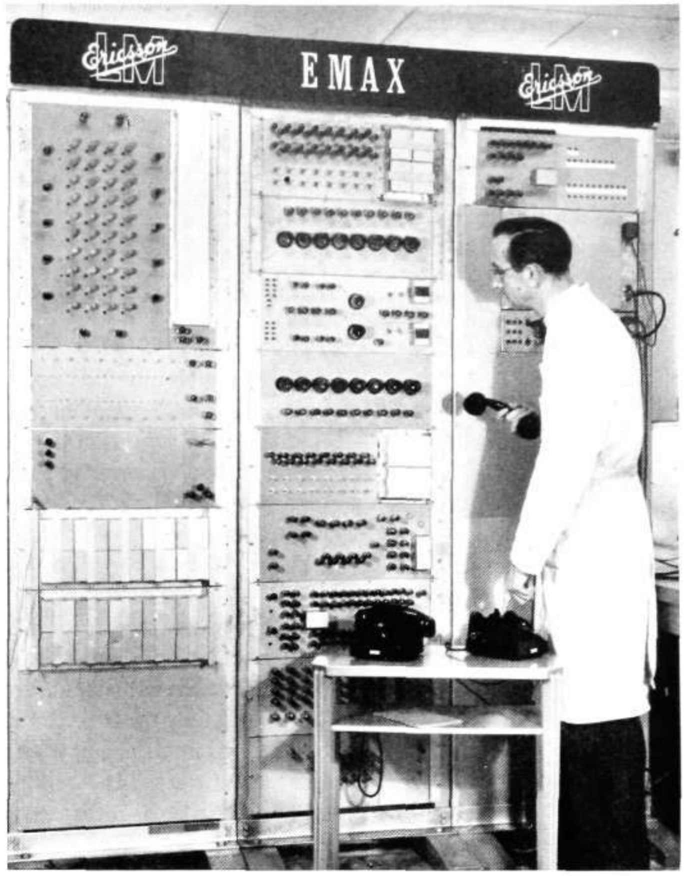


Fig. 15 X 6948

L M Ericsson's electronic automatic exchange

»EMAX»

Even if the time may still seem to be far distant when fully electronic exchanges can seriously compete with electromechanical systems, the importance of gaining early experience in this field was deemed paramount. One step in this direction is an experimental exchange, known as EMAX (electronic multiplex automatic exchange), designed and built at the Development Department. In view of the primary aim, only the fundamental functions have been included and the capacity has been limited to 100 lines in one switching stage. The principle can be developed, however, and applied to systems of any size in several switching stages.

The goal in the development of EMAX was to produce an automatic exchange with no electromechanical components (apart from the actual telephone instruments which were assumed to remain unchanged) and with as low a number of hot cathode tubes as possible. A complete departure was made from the practice in similar earlier projects of loading the subscribers' circuits with amplifier tubes which age quickly and consume heater power when non-conducting. When the exchange was planned, the transistor was not considered mature for this application and the equipment for the speech contacts had to be limited to semiconductor diodes. Cold cathode tubes could not be used for pulse operation owing, among other reasons, to their high noise.

Another requirement in the development of EMAX was to avoid the transition to "four-wire transmission" in the actual switchboard, an otherwise normal arrangement in similar designs. The semiconductor diodes proved very serviceable in this respect since they permitted bothway transmission.

Instead of allocating a pulse position to every individual subscriber in analogy with the arrangement in fig. 14, the pulse positions were reserved for the speech circuits. In this way the best use is made of the common multiplex wire (fig. 16), called speech wire, to which every subscriber has access via an electronic contact K_A. Connection between two subscribers A and B is effected by

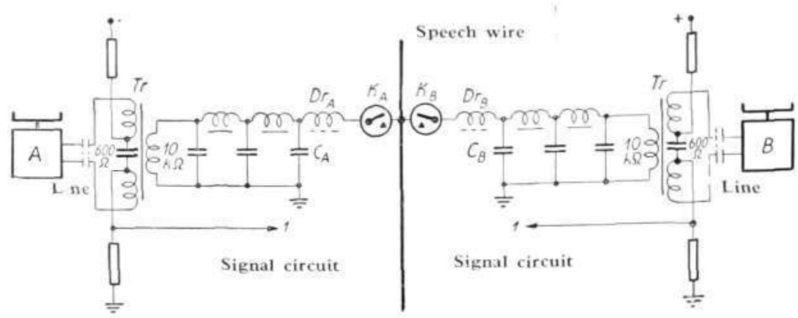


Fig. 16 X 6944

The speech transmission circuit in the fully electronic exchange with time division multiplex as illustrated in fig. 15

periodically closing their contacts in coincidence. During the pauses the speech wire is available to other conversing pairs of subscribers. It is easily shown that the pulse repetition frequency must theoretically be at least double as high as the highest transmitted speech frequency. On the basis of a cut-off frequency of 3,400 Hz and the limited steepness of the necessary subscriber filters, a pulse repetition frequency of 8,000 Hz was chosen, corresponding to a cycle of 125 μs. With 8 channels (speech circuits) the spacing will clearly be about 15.6 μs, of which the actual transmission pulse occupies 10 μs. Between the channel pulses, therefore, there is a safety interval of 5.6 μs, which has been found to keep crosstalk at an acceptable level. In spite of the reduction of the time available for transmission of each speech circuit with a factor of 12.5, caused by the time division, it has proved possible to limit the attenuation by special circuit arrangements to about 2.5 db, which in view of the circumstances must be considered a satisfactory value. When extending this principle to larger systems, measures will of course be taken to compensate for this attenuation as well.

The Speech Transmission Circuit

The relatively low speech attenuation is achieved by means of an energy storage device which is charged across a high impedance during the fairly long interval between pulses. The same energy storage device is thereafter discharged during the short pulsing time, and the charge is transferred across a low impedance to a corresponding energy storage device on the receiver side, from which it can be tapped via a high impedance circuit in the inter-pulse interval.

For this purpose the A subscriber's speech voltage is first stepped up to an impedance level of 10,000 ohms (fig. 16). Thereafter follows a low pass filter with a cut-off frequency rather below half the contact pulse frequency. The last capacitor C_A in the filter here functions as energy charging device. When the contacts K_A and K_B now close, energy begins to be transferred from C_A to C_B via the oscillating circuit formed through C_A, the chokes Dr_A and Dr_B, and C_B Nearly all the energy exists at a certain moment in the capacitor C_B, whereas C_A has been emptied. Precisely at this moment, when the energy would flow back to C_A, the contacts open again. The energy then flows instead through the receiver's low pass filter and transformer to the B instrument. The chokes play a great part in reducing the attenuation. The oscillating circuit must be designed so that the contact time of K_A and K_B corresponds to $^1/_2\,f$, where f is the natural frequency of the oscillating circuit. The electronic speech contact (fig. 17) consists essentially of two diode branches aa^1 and bb^1 which, when non-conducting, are symmetrically biassed in the reverse direction through the battery *BB*. They cannot pass any current from point *A* (the subscriber side) to the speech wire that is common to all subscribers, nor vice versa. If a pulse arrives through the pulse transformer *PT*, on the other hand, so that the diode branches become conductive, a low resistance is obtained between *A* and the speech wire, and the electronic contact is thereby closed. A third diode branch cc^1, which passes a small current in the forward direction during the inter-pulse interval, forms a low impedance leakage to earth and thus contributes to a high crosstalk attenuation.

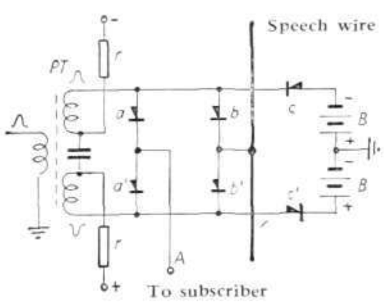


Fig. 17 X 2088

Electronic contact in speech transmission circuit

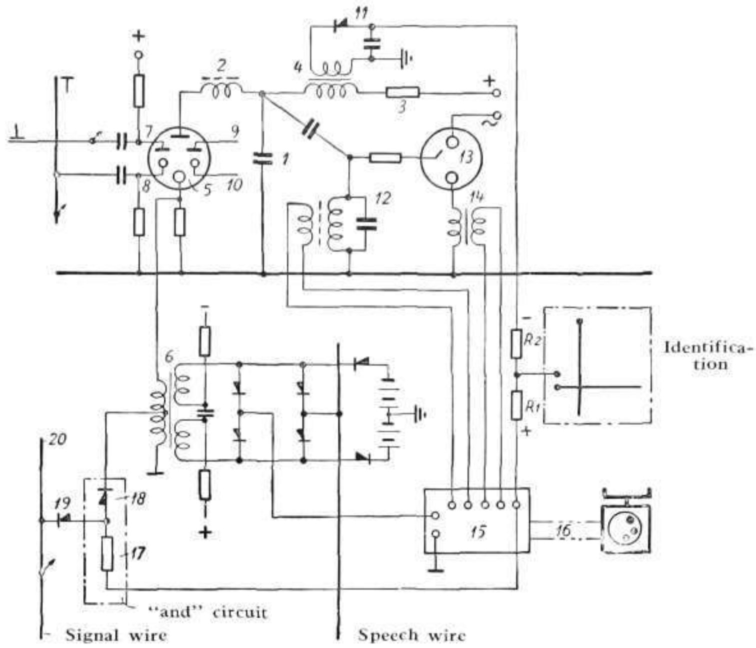


Fig. 18

X 6945

Pulse generator and part of the remaining subscriber equipment

Pulse Generators

The electronic contacts receive their current impulses each from its own pulse generator, in which use is made of the aforementioned hydrogen gas tubes built for ignition by coincident pulses (fig. 18). The starter electrodes of the tubes are connected to a system of horizontal and vertical wires, forming a matrix. The generator consists of a pulse forming circuit with a capacitor *1* and a choke *2*. The capacitor is charged through a circuit consisting of the resistor *3* and the charging coil *4*.

The pulse circuit is discharged through the tube *5* when a positive starting impulse on electrode *7* and a negative starting impulse on electrode *8* coincide. This is attained by impressing a positive and a negative impulse on the matrix wires which "point out" the tube. The discharge pulse, which is taken from the tube's cathode, is passed through a pulse transformer *6* to the subscriber's speech contact. The capacitor *1* and choke *2* are designed to produce a discharge pulse of the width necessary for the speech contact (10 μs).

The charging coil *4* has a secondary winding which generates a negative direct voltage with the assistance of a rectifier circuit *11*. This voltage neutralizes the calling voltage to the identifier and is thus used for a function corresponding to that of a cut-off relay in ordinary switchboards.

A resonance circuit *12* is also connected to the charging capacitor *1*, with a resonance frequency equal to half the pulse repetition frequency, or 4,000 Hz. For the emission of ringing signals the resonance circuit ignites a glow discharge tube *13*, which is of inverted type and passes a.c. The a.c. is transmitted through the transformer *14*, the subscriber's equipment *15* and the line *16* to ring the bell of the telephone instrument. Therefore, to produce ringing signals, it is only necessary to suppress each second impulse on either of the two starter electrodes in the pulse generator tube *5*. The pulse generator then works at a frequency of 4,000 Hz, which causes no disturbance since it only appears in the ringing tone.

When the called subscriber lifts his handset, part of the microphone current will be directed through a secondary winding of the inductor in the oscillating circuit under the action of the subscriber's equipment *15*, so powerfully damping the oscillating circuit and extinguishing the tube *13*. The ringing signal is thereby immediately interrupted. (The pulse frequency is of course restored to 8,000 Hz.)

Signalling

The switchboard is equipped with a special signalling wire *20* which, like the speech wire, is common to all subscribers.

Through a simple "and" circuit formed by the resistor *17*, which has a positive potential applied to it from the subscriber's equipment *15*, and the diode *18*, which is connected to an output terminal on the primary of the pulse transformer, the signal wire *20* receives pulses via the "or" diode *19* when the subscriber has raised his handset and his pulse generator has started.

The appearance of the pulse on a given time position of the signal wire provides information of the condition in the respective channel, and it is merely necessary to probe the channel in the proper pulse position (channel supervision) and transmit the relevant information.

If the pulse disappears, this means that both subscribers have replaced or that the caller has replaced after incompleted dialling. A clearing message is generated which restores all the equipment to its normal condition.

If the pulse receives a 4,000 Hz component by the addition of impulses from the called subscriber, it means that the called party has just raised his handset. In that case the pulse generator of the called party will immediately change to the normal frequency of 8,000 Hz so that the conversation may commence. This can be accomplished quite easily with a frequency selective circuit in the channel supervisory device.

The dial pulses periodically suppress the *A* subscriber's 8,000-cycle signal pulse. The register counts the interruptions between the trains of pulses and reads off from them the number of the called subscriber. The register is here connected to the signal wire by a gate which operates in the calling subscriber's pulse position.

The Identifier

The operation of the identifier was described in conjunction with fig. 9. An input resistor, e.g. *L11* in fig 9, corresponds to R_1 in fig. 18. Thus a positive potential is applied to the identifier through R_1 from the subscriber's line equipment *15*, when the subscriber raises his handset. As soon as the cold cathode tube chains which scan the identifier matrix—a two-dimensional coordinate system, the coordinates corresponding to the tens and units digits of the subscriber's number—have reached coincidence with the incoming positive voltage, a voltage is obtained on the output terminal of the identifier matrix and immediately stops the chains. The ignited tubes in the two chains forward information of the caller's number to a memory device which stores the number and in turn begins to excite the subscriber's tube *5* (fig. 18), which is placed in the corresponding position in the subscriber's matrix. As soon as the tube and, consequently, the pulse generator have started, circuit *11* supplies the negative voltage which via R_2 compensated the positive voltage from the line circuit, so that the identifier becomes free to deal with other calls.

The Memory Equipment

The memory or storage equipment consists of a number of memory tubes specially developed to fulfil the following requirements. Writing, or recording, and erasing must be enabled to take place at arbitrary times (a property which cannot be obtained with, for example, a magnetic drum). The device must have both parallel inputs and parallel outputs and be adapted for repeated periodical reading. Eight such memory tubes (one tube to every channel) are interconnected so that associated memory electrodes in all tubes can be actuated by "writing voltage" from the corresponding coordinates in the identifier. The elements are divided into two groups of ten elements each, like the matrix wires in the identifier, one group storing the subscriber's tens digit and the other group the units digit.

As soon as a writing voltage appears on wires corresponding to the subscriber's number and a special channel finder has selected a free memory tube, recording takes place in that tube in such a way that the element is changed over to the "locked-up" condition (point *C* in fig. 3) by suitable control of the tube's grid and cathode voltages, after which the writing voltage is no longer required.

Associated elements in the tubes also have their output terminals connected in parallel, and the outputs are connected via impulse amplifiers to the wires of the subscriber's matrix, in the points of intersection of which the hydrogen gas tubes (*5* in fig. 18) are placed. The memory tubes are periodically read one after another by the application of pulses from the common pulse generating equipment to the grids in the respective pulse positions, so that the tubes "spit" out their stored numbers at the right moments.

Similar memory devices are provided on the called subscriber's side (the *B*-side), but in this case the writing voltages come from a register which has received the called subscriber's number. The writing operation, i.e. the selection of the tube in which recording is to take place, is determined by the temporary pulse position of the register—the same pulse position or channel in which the calling subscriber has been recorded.

As soon as the writing is complete, the tube starts to transmit pulses to a subscriber's matrix similar to that described. The matrix wires are here connected to the starter electrodes *9* and *10* of the subscriber's pulse generator tube *5* in fig. 18. The tube *5* thus functions also as an "or" circuit, for it can be excited either from the *A*-matrix "or" the *B*-matrix, depending entirely on whether the particular subscriber is the calling or the called party. The connection is thereby established, and the register cuts out to take over new tasks. As was mentioned earlier, the called subscriber's pulse tube is first excited with 4,000 pulses per sec. for the ringing signal. This is arranged by a pulse frequency divider placed between one of the output groups of the *B* subscriber's memory device and the *B* subscriber's matrix.

The Register

The register receives the dialled impulses via the signalling wire. The impulses are registered by means of two cold cathode tube chains (cf. fig. 10) which record the wanted number and function as a kind of intermediate memory device. The register must of course be connected to the calling subscriber in his pulse position, i.e. a register should be connectable to any channel in the switchboard, since there are only two registers and each must function in all channels. A register must therefore have its own memory device, which remembers in which pulse position it is to work.

Here, too, memory tubes are used, one tube to every register. The requirement in this case is to store a pulse position, i.e. a time information, and the tube is connected with this aim in view. Use is made of the tube's ability to pass a signal via a "locked-up" element (point of operation at *C* in fig. 3) to the collector electrode, but not via a "locked-down" element (origin in fig. 3). A recording voltage from the corresponding output terminal in the channel finder is applied to the element in use. In addition, the elements receive each its channel pulse from the common pulse generating equipment. Thus by locking a given element the recorded pulse position will appear on the output side of the tube. The output pulse drives the register's pulse generator to excite an electronic speech contact, which in turn passes on dial tone to the calling subscriber via the speech wire; the pulse generator also excites an "and" circuit, which gates the dialled pulses from the signalling wire (*20* in fig. 18) in order to actuate the register's counting chains.

Writing and erasing are done in the same way as in the subscriber memory devices. A special register finder points out a free register and actuates its memory tube.

Between the registers and the memory equipment of the *B*-side, however, is a device which receives the messages successively (lock-out) from both registers and transfers both the number information and the pulse position information to the respective tube in the *B*-memory equipment. The busy test is also arranged in this way by means of a special busy test circuit. The busy test circuit contains a number of multiple "and" and "or" circuits which search for coincidence between the newly arriving number information and the contents of the two subscriber memory equipments. If coincidence exists, the number is engaged. In that case no recording is made in the *B*-memory equipment. Instead, a special electronic contact is actuated in the respective pulse positions and feeds the busy signal to the speech wire and on to the calling subscriber, so that the latter can hear that the number is engaged.

Bibliography

1. STERNBECK, O: *Coaxial trochotron for pulse counting*. Ericsson Rev. *31* (1954), No 1, p. 14.
2. UHLMAN W E M: *Storage tube employs secondary emission*. Electronics *28* (1955) Jan., p. 161.
3. SVALA, G: *Electronic identifier for subscriber's stage*. Ericsson Rev. *32* (1955), No 1, p. 2.
4. KEISTER, W, RITCHIE, A E & WASHBURN, S H: *The design of switching circuits*. New York 1951.
5. FLOWERS, T H: *Electronic telephone exchanges*. Proc. IEE 99 (1952) vol. 1, No 119, p. 181.

Reorganization of Shunting at Ånge Marshalling Yard, Swedish State Railways

T LUNDBERG, SWEDISH STATE RAILWAYS, STOCKHOLM

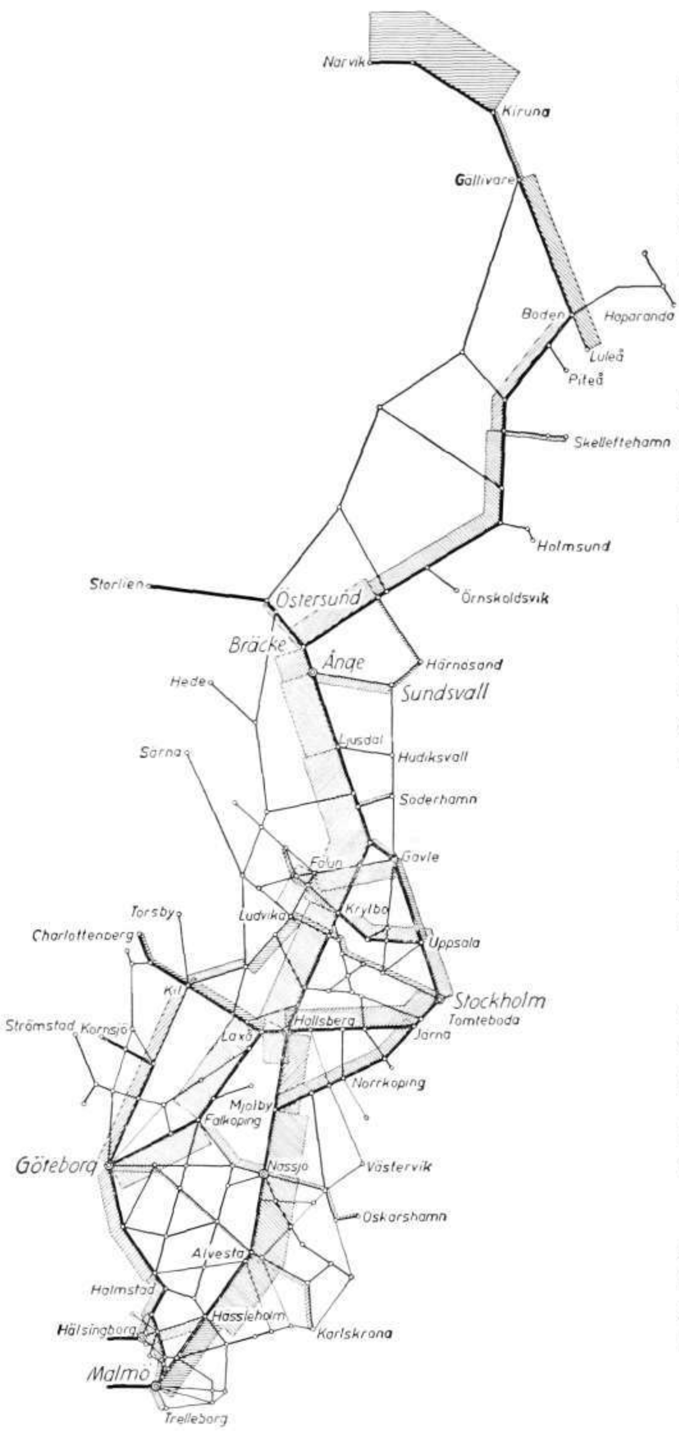


Fig. 1 X 6937

The goods traffic of the Swedish Railways is principally concentrated to the electrified main lines.

The density of goods traffic on the most important freight lines is indicated by shaded ribbons, the width of which is proportional to to the number of freight cars per day. Scale: 200 cars per mm width of ribbon.

U.D.C. 656.212.5:656.256

The Swedish State Railways have taken a big step towards the radical reorganization of freight car handling by the introduction of automatic point switching and car retarders at the Ånge marshalling yard. By the choice of the most northerly of the large marshalling yards for the first experiment in this direction, experience has also been gained of operation under difficult winter conditions.

The automatic point switching plant was constructed by L M Ericsson in intimate cooperation with the Railways Board. The material, including factory-wired relay racks and control equipment, was supplied by L M Ericsson.

Mr T. Lundberg, Assistant Chief Engineer Signals, was in charge of the planning work undertaken by Swedish State Railways and directed the work of installation. He describes in this article the equipment and operation of the Ånge yard and the results gained through the reorganization.

The bulk of Swedish goods traffic is now concentrated to the electrified main lines. The traffic density on the largest freight lines is shown in the adjacent map of the main line network (fig. 1).

The organization of goods traffic is such that a consignment is not always transported by the geographically shortest route for which the freight is calculated, but by a longer though more rapid and more economical route. This is because the break-down and build-up of the through goods trains has been concentrated to certain stations that are equipped with marshalling yards.

Marshalling yards exist at stations which are mainly of a terminal character, e.g. Malmö, Hälsingborg, Gothenburg—Sävenäs, Stockholm—Tomteboda and Gävle, and also at stations with predominantly through traffic, e.g. Nässjö, Hallsberg, Ånge.

Some General Remarks on the Ånge Yard

During recent years the Ånge yard has been substantially reconstructed and extended. The final stage of reconstruction was the provision of car retarders and automatic point switching equipment, which will be described below.

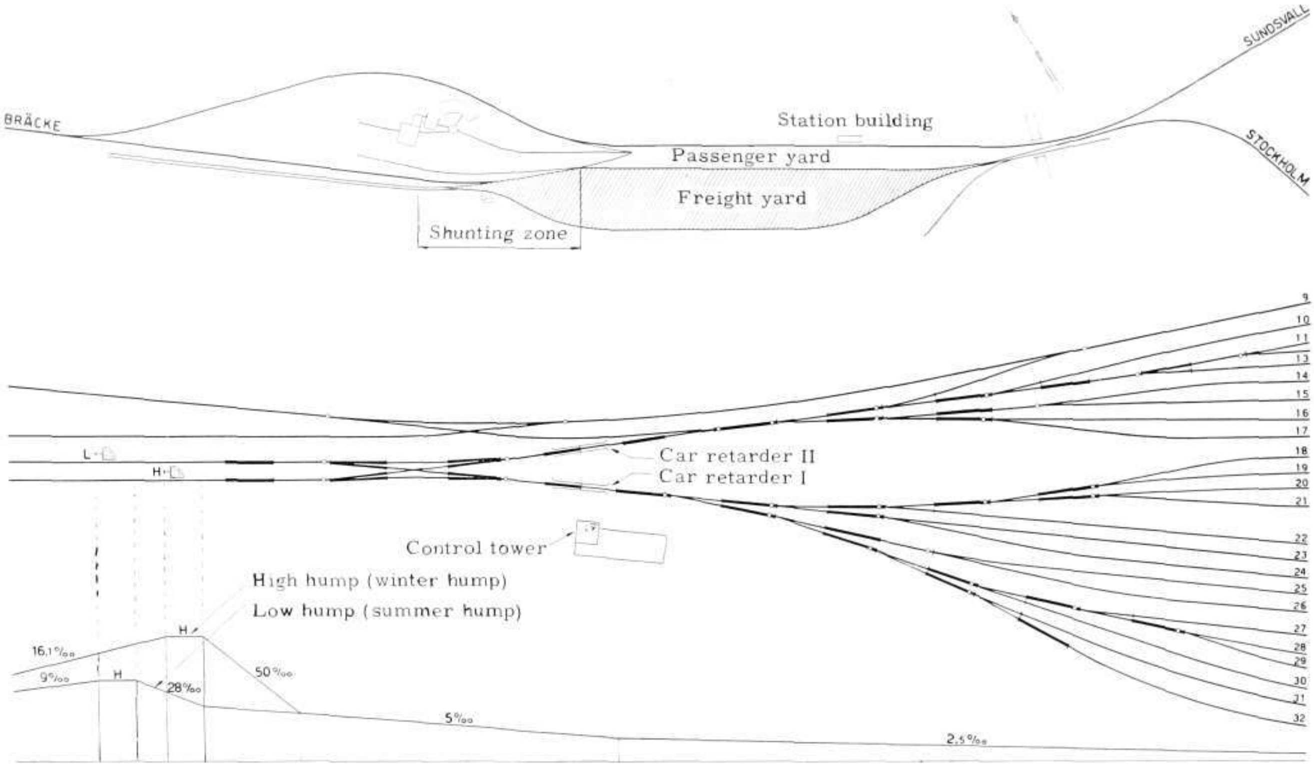


Fig. 2 X 7686

Layout of Ånge station

with connecting lines (top), shunting zone of marshalling yard (centre) and gradients of shunting zone (bottom).

Fig. 2 (top) shows the extent of the station area with connecting lines southwards to Stockholm, eastwards to Sundsvall and northwards to Bräcke. The shaded portion marks the area occupied by the marshalling yard. Fig. 2 (centre) indicates the shunting zone. The illustration shows how track circuits with different functions are located in relation to points. The car retarders are also shown. At the side of the shunting zone is a control tower from which points and retarders are operated. Fig. 2 (bottom) shows a sectional view of the humps and the gradients of the surrounding area.

The marshalling yard shares with Ånge station an automatic telephone plant, consisting of about 175 telephones, and a selective calling telephone system with 20 extensions for internal communication within the station area. There is also a loudspeaker installation consisting of about 50 loudspeakers split into 13 groups.

When a goods train arrives at Ånge station, a record is made of the destination of every car, whether it is loaded or empty, and whether it requires careful shunting. These data are handed in to a central office which forwards them by teleprinter in the form of shunting bills to the control tower, the uncouplers at the top of the hump, the receivers—whose job is to receive the shunted cars and couple them together—the yardmaster and reloading magazine.

The shunting yard has two humps of different height, one high and one low hump. The method of shunting is that the train is drawn up by a shunting engine on to one of the humps, where a cut of one or more cars is detached and pushed over the crest, whence gravity carries it down to the classification track. The speed of rolling before reaching the retarders varies between 3 and 6 yards per second. Hydraulic retarders with parallel shoe beams, 51 ft. in length, between which the rims are clasped, are located below the hump to regulate the speed of cars according to the distance they are to roll. Equalized shoe pressure is used, i.e. the retardation is proportional to the weight of the car, and the operator need only consider the oncoming speed and the desired offgoing speed of the cars. The rolling speed below the retarders is 2—3 yards per second.

The rate at which cars are supplied to the hump is regulated by orders from the control tower in the form of light signals to the engine driver—push slowly, push quicker, stop and pull.

Immediately below the humps are the first points, which distribute the cars to the north and south groups of tracks in the yard. The two retarders are located below the first points, and thereafter are the points for the 24 tracks in the groups. All 27 points have electrical high speed point machines with a switch-over time of about 0.5 secs. The tracks in the shunting zone are divided into track circuits with d.c. relays which are operated when the track circuits are free from vehicles. It has not been found advisable, however, to insulate the rails on the car retarders, and therefore so-called optical track circuits have been installed, consisting of flood lights on one side of the track and photocells on the other. The beam is screened by the cars as they pass, and the automatic mechanism operates in the same manner as on ordinary track circuits.

To guarantee the operation of points under snow, all points are electrically heated by resistance coils screwed to the stock rails. To avoid the formation of ice round and under the points, other coils are dug down into the ballast to allow the water to run off. The pressure cylinders in the retarders are also electrically heated. The heat is regulated from an instrument panel in the control tower.

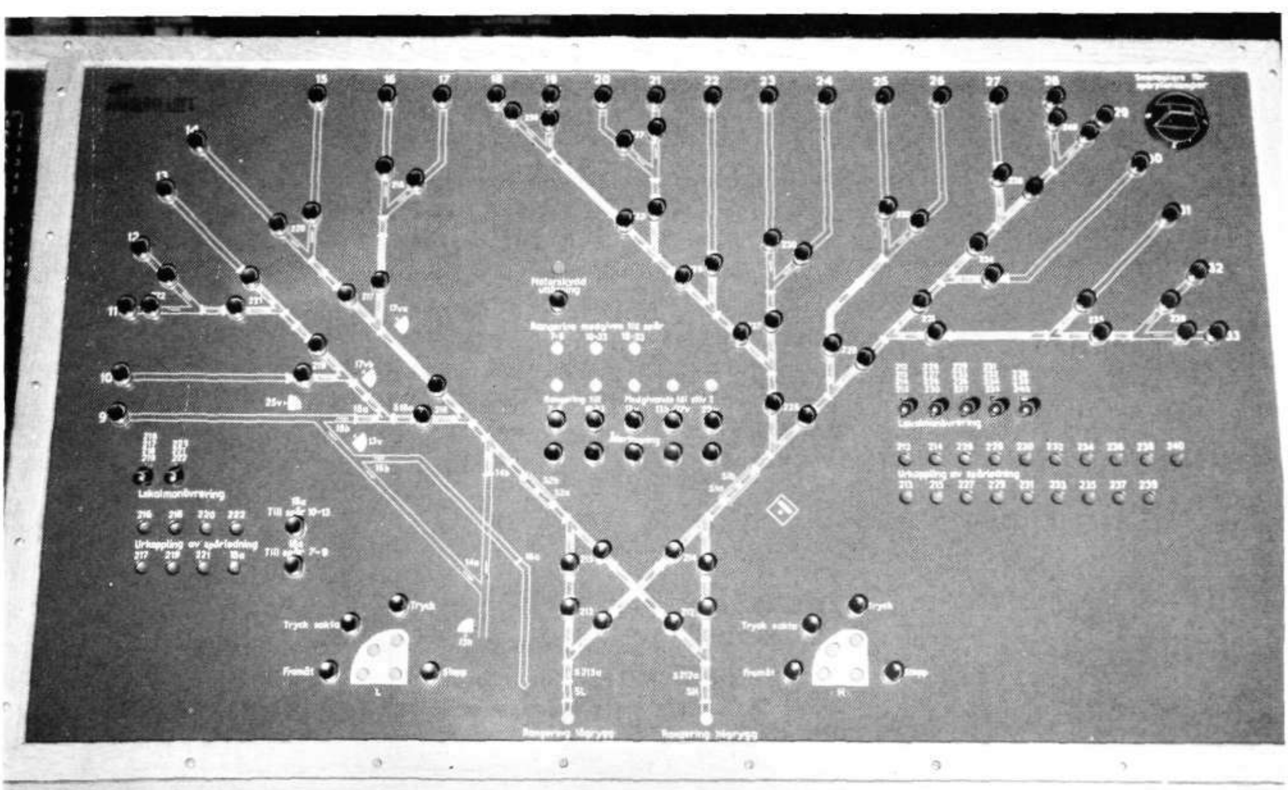


Fig. 3 X 7685

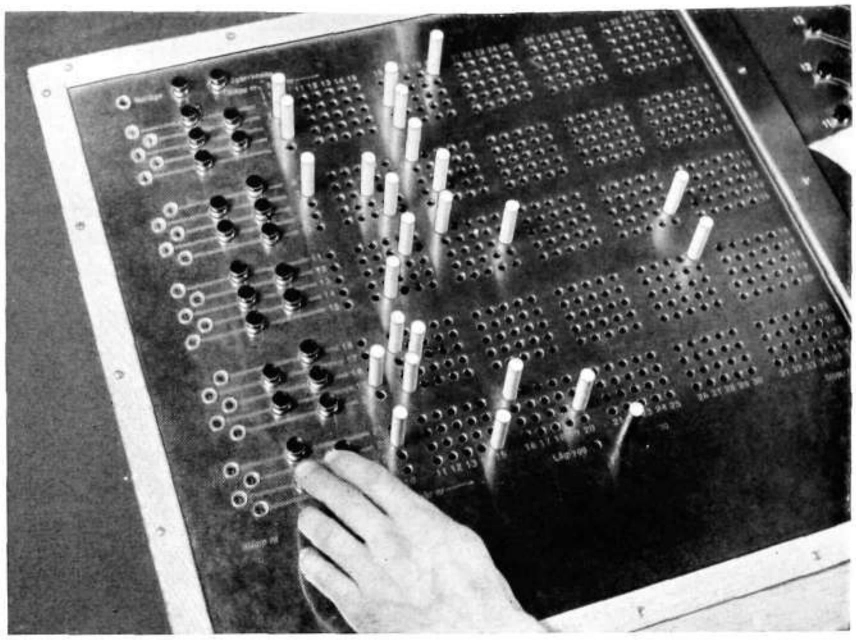
The track diagram section of the control machine

has press buttons for semi-automatic shunting, individual point operation and signalling to the shunting driver, and keys to permit local operation of switches. It also accommodates lamps for indication of car positions, state of points etc.

Fig. 4 X 6940

The shunting program operating panel on the control machine

has plug holes for the selection of high or low hump and of classification track. The panel is also fitted with correction buttons and indication lamps.



Control Tower Equipment

The control tower is equipped with a control machine divided into two sections—the track diagram and shunting program operating panel—for the control of points and signals, blocking of adjacent tracks and indication of the state of points and track circuits.

The track diagram (fig. 3) is a representation of the track system in the shunting zone. It has push buttons at the end of the semi-automatic shunting tracks and at the individual branching points. Toggles are used to permit local operation of points. In addition, there are push buttons for signal operation and other buttons, communicating with the interlocking plant in the passenger yard, for closing and opening train and shunting routes connecting with the shunting zone. Indication lamps show the state of points, track circuits etc.

The shunting program operating panel (fig. 4) is used for automatic shunting. It contains a number of holes, each vertical row of holes corresponding to one track in the yard and each horizontal row to a cut of cars. One plug for every cut is placed in the hole marking the position of the cut in the train and its destination track. The positions of the plugs are registered in the apparatus by means of impulses which are generated as a cut rolls over the track circuits and successively switch the points to the correct positions. The various cuts are marked on the program panel by indication lamps. Other push buttons are provided for correcting the position of the rotary selector which records the advance of the cuts. There are two plug holes for selection of high or low hump.

Automatic Shunting Circuits

The equipment incorporates safety relays for functions on which the safety of train movements depends, and telephone relays and a 25-point rotary selector for functions which do not affect the safety. The former group comprises track relays, point operating relays etc., while the latter group comprises relays for automatic shunting. The telephone relays have reinforced insulation and withstand a test voltage of 2,000 V.

Fig. 5 shows, on the left, a section of a shunting zone. The track circuits are designated *SH, SL, S1, S2, S3* etc., and the points *1, 2, 3 . . .* Track circuit *SH* lies below the high hump and track circuit *SL* below the low hump.

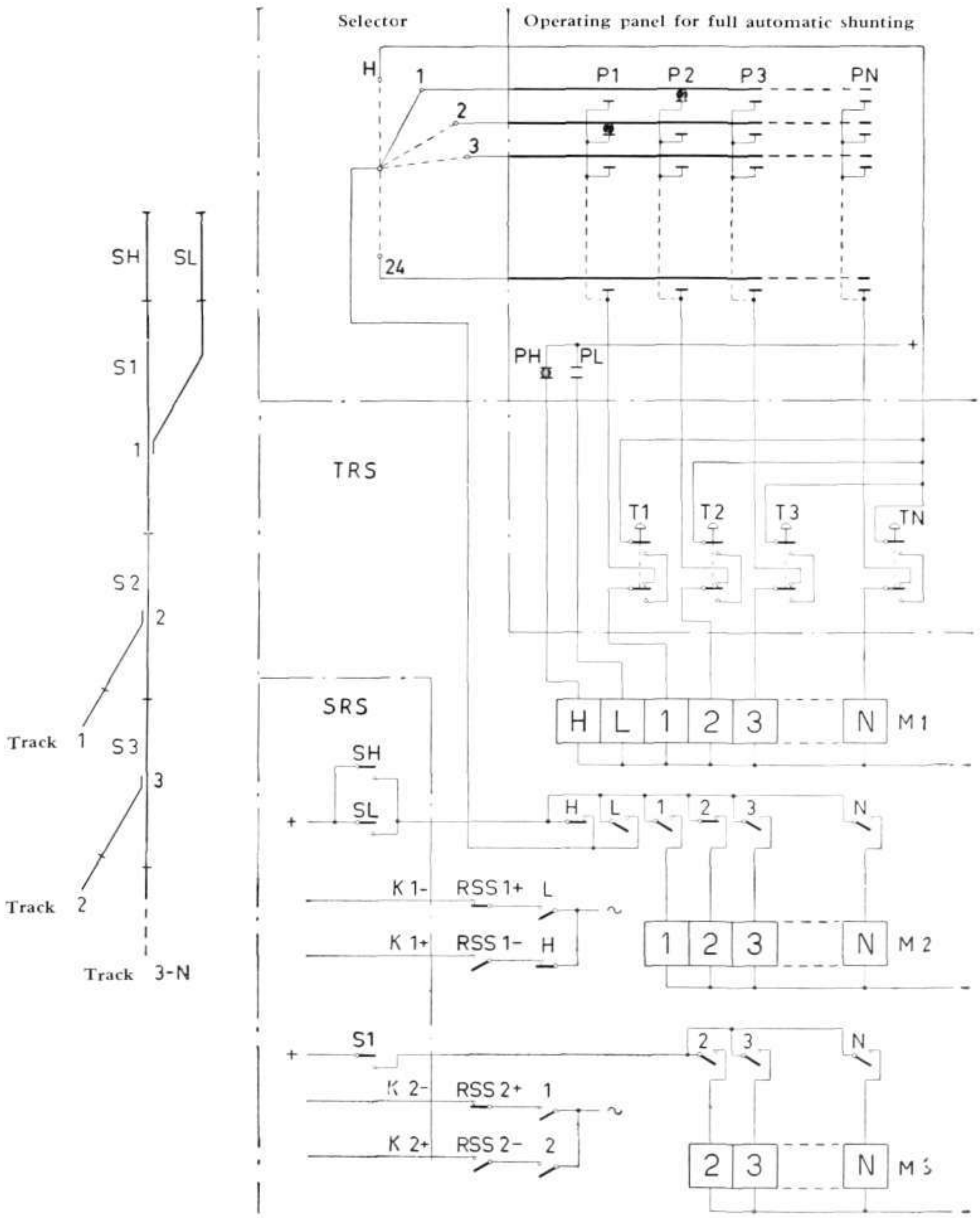
The general principle of the automatic shunting equipment is shown on the right hand side of fig. 5, the designations referring to the shunting zone on the left of the figure. It is assumed that shunting shall take place from the high hump and that the first cut will proceed to track *2* and the second to track *1*. Plugs are therefore inserted in the operating panel in hole *PH* for selection of the high hump, and in the second hole of the first row and first hole of the second row for selection of tracks for the first two cuts.

Relay *H* is operated and point *1* switched to positive. The automatic equipment is started by setting the selector to position *1*. When the first cut passes track circuit *SH*, relay *2* in magazine *1* operates. Relay *2* in magazine *3* operates and point *2* is switched to positive, if not already in this position.

Fig. 5 X 7684

Section of a shunting zone (left) and extremely simplified diagram of automatic shunting equipment

SH, SL, S1, S2, S3 etc.	track circuits
PH, PL, P1, P2, P3 etc.	plugs
TRS	telephone relay rack
H, L, 1, 2, . . . N	relays
SRS	safety relay rack
K	contactor
M	magazine
RSS	points indication relay



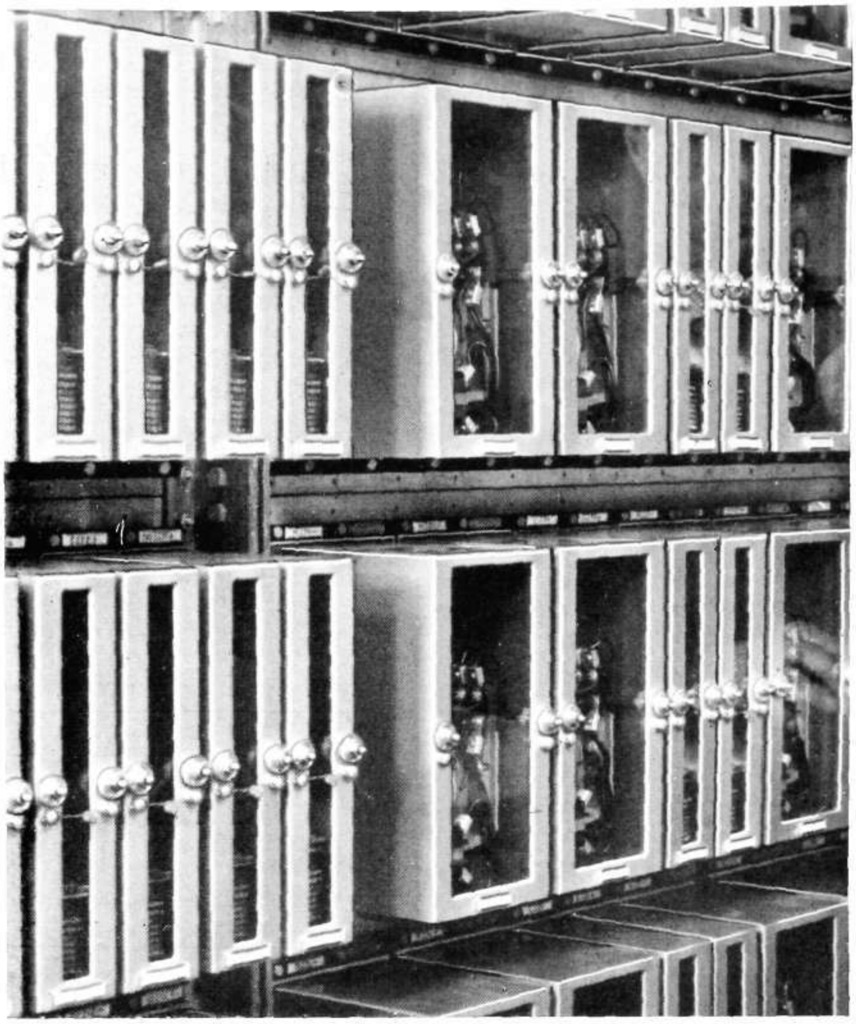


Fig. 6

Part of safety relay rack

with relays of plug-in type

X 6960

When the first cut left track circuit *SH*, the selector advanced to position *2*. The process is thereafter repeated with the exception that the points for the second cut are switched for track *1*.

Semi-automatic shunting is done by operating one of the buttons *T1*, *T2* . . . at the end of the respective track on the track diagram. The operation of the equipment for this purpose will be apparent from fig. 5.

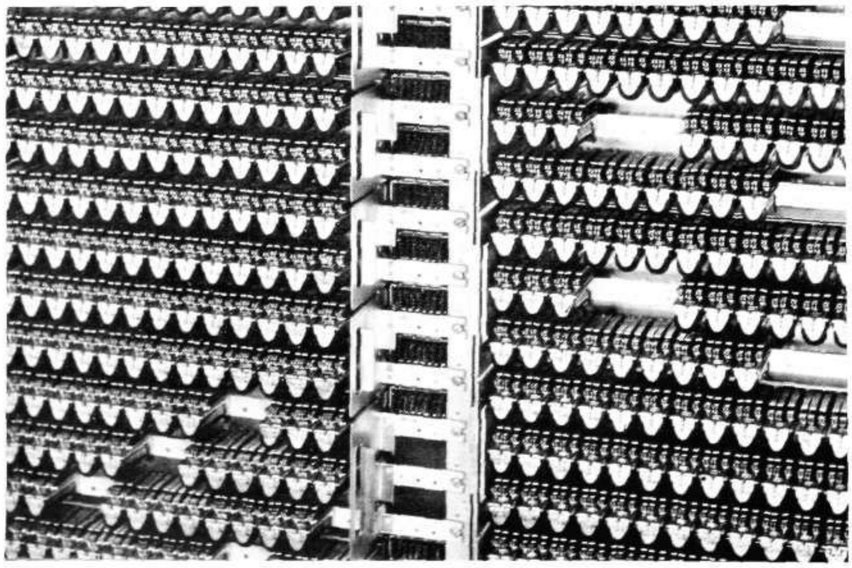


Fig. 7

Part of telephone relay rack

with plug-in type relay groups

X 6938

Fig. 8 X 6939

Automatic shunting from the high hump

Result of Reorganization

The introduction of automatic point operation and car retarders at the Ånge yard has meant primarily that the station crew has been reduced by 10 men. It has been found, moreover, that the number and extent of accidents to cars and goods has been heavily reduced. This is primarily due to the fact that the retarders assist in adjusting the speed of cars to the distance they are to roll, so avoiding violent collisions with stationary wagons.

The system has only been operating for a few months, but a quicker handling of goods trains is already noticeable. When crews and equipment have been brought fully up to scratch, it is estimated that a 50 car train consisting of about 35 cuts will be shunted in 10 minutes. Heavy snowfall and temperatures down to — 40° F have not affected the efficiency of the system.

Mains Connected Job Costers

F AHLBERG, TELEFONAKTIEBOLAGET L M ERICSSON, DIVISION ERGA

U.D.C. 681.175.5

The frequency in the electrical A.C. mains supply has for a long time been used as reference in clock systems where occasional irregularities due to cuts and frequency variations can be tolerated. Such systems can be arranged with a mains operated impulse transmitter providing ¹/₁ minute impulses to clocks and other equipment or with the clocks designed in such a way that they can be connected direct to the mains. Up to now L M Ericsson has applied the first mentioned method exclusively but development has for some time been in progress on time recorders for direct mains connection. Engineering has just been completed on mains connected time recorders of desk type, job costers and time and date recorders, and mains connected machines of this type have now been included in the production program.

The job costers and time and date recorders, which so far have been marketed by L M Ericsson, have only been made for operation from master clock impulses. In small systems the cost of a master clock together with power supply and wiring is very high in relation to the recorders themselves. Where A.C. mains with controlled frequency and few interruptions are available, the master clock has, therefore, often been replaced by a synchronous motor driven impulse transmitter. With this arrangement several machines may be operated from the same transmitter (ensuring absolute synchronism) and in the case of the mains supply deteriorating it is possible to alter the system to master clock operation without modifying the time recorders.

In this connection it should be pointed out that the suppliers of electric power as a rule do not guarantee constant frequency although they endevour to maintain a reasonably accurate mean value. At peak load periods the frequency may be slightly below normal and this is compensated during slack periods by a frequency higher than the nominal value. A mains connected clock will, therefore, have a tendency to be fast in the morning and slow in the afternoon, a fact which may be embarrasing if the clock is used for attendance recording.

In many countries the frequency variations are, however, nowadays insignificant and mains failures very rare. The deviations over a day on a mains connected clock are as a rule well inside 30 secs. There is, consequently, now less reason than in the past to anticipate modification of a clock system from mains connection to master clock operation and this fact has created a definite demand for time recorders and similar equipment which can be connected to the A.C. mains without an intermediary impulse transmitter.

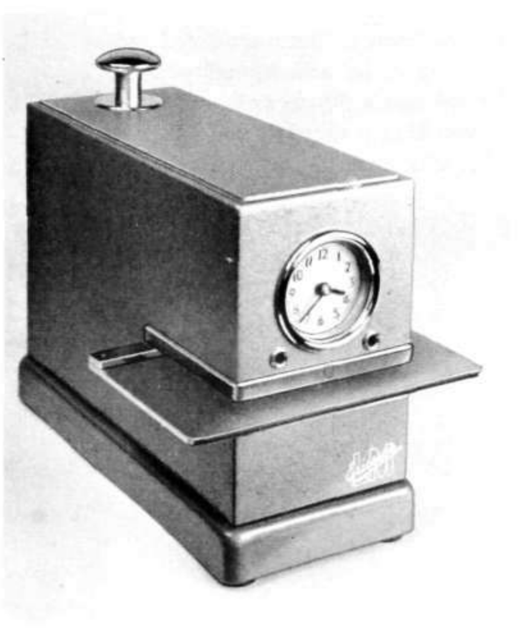


Fig. 1 X 2094

Job coster KCB 2233

for direct connection to mains supply 220 V, 50 c/s

A mains connected time recorder is a self-contained unit and is, therefore, cheaper to produce and above all easier to install than an impulse machine with added auxiliary equipment. In addition there has always been a demand for time recorders which can be moved from one place to another with a minimum of wiring and connection work. This applies particularly to machines of desk type, job costers which are used in factories for time recording on works orders etc., and time and date recorders which are used in offices for time recording on mail and other documents. For such purposes slight deviations in the time keeping and occasional mains failures are of minor importance.

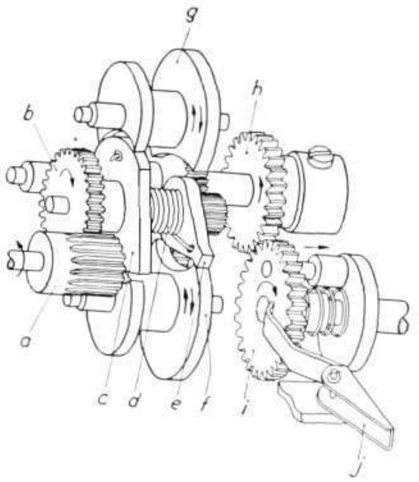


Fig. 2 X 2095

Schematic view of driving mechanism

- a motor pinion
- b driving wheel solidly attached to c
- c release cam
- d driving spring, fixed between c and e
- e catch lever, free from b and c, resting on f and g alternatingly
- f, g latching wheel, f and g are operated by c alternatingly once every minute
- h transfer gear wheel to printing unit
- i driving wheel on printing unit, slidable sideways on the spindle
- j clutch lever

It has, therefore, been decided to market mains connected variations of the L M Ericsson time and date recorders *KCB 11—14* and job costers *KCB 21—24* (fig. 1). These recorders, which have now been put in production, are identical with the impulse operated machines with the exception of the driving mechanism. This consists of a synchronous motor and a mechanism transforming the continuous rotary movement from the motor to the step-by-step movement required for the operation of the type wheels in the printing unit.

The available space in the recorders is very limited and it has, therefore, been necessary to use a motor with small dimensions. A synchronous motor of hysterisis type has been considered most suitable for the purpose. As the torque from such a motor is comparatively low the transfer mechanism must utilize the torque from the motor over the full cycle of the rotary movement and otherwise run with smallest possible losses.

The construction of the mechanism is shown in fig. 2. In principle the motor is continuously loading up a spiral spring (*d*) which is released once every minute. The energy stored in the spring is transferred, almost momentarily, to the type wheels in the printing unit which are advanced one step. The printing unit receives its movement over a driving gear wheel (*i*) which can be moved laterally on the spindle in order to disengage it from the driving mechanism when the recorder is to be set manually. This lateral movement is produced by means of a lever (*j*).

As shown in fig. 3 the mains connected driving mechanism is mounted in the same manner as the impulse driven mechanism. It is, therefore, easy to alter a mains connected machine to impulse operation by replacing the driving mechanism. The reversed alteration, from impulse operation to mains connection, requires, however, certain workshop operations.

The power consumption of the motor is very low, 5 VA approx. The machines are supplied for 220 V, 50 c/s, 110 V, 50 c/s or 110 V, 60 c/s alternatively.

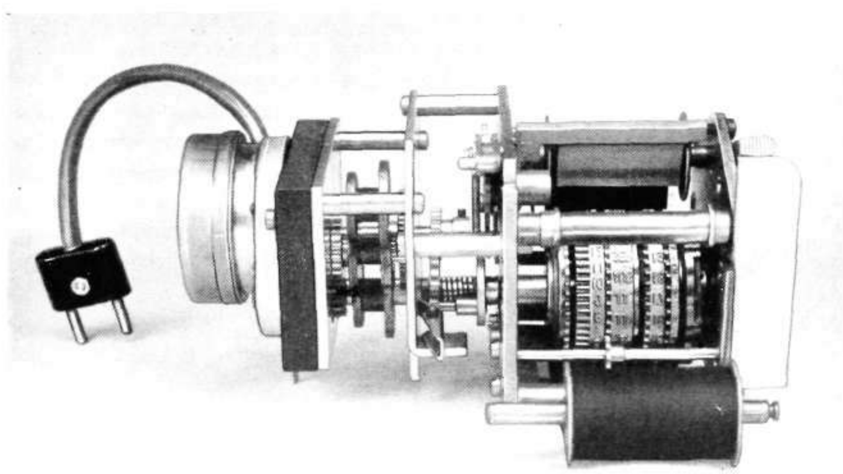


Fig. 3 X 694

Mains connected driving mechanism, mounted on a printing unit

Germanium Power Rectifiers

S. ÖVERBY, AB SVENSKA ELEKTRONRÖR, STOCKHOLM

U.D.C. 621.314.7

SER is now manufacturing power rectifiers on the basis of germanium. They are produced in three types for 1 A rectified current, low forward voltage drop and 100—300 V peak inverse voltage. The units are of small size in comparison with conventional copper and selenium type rectifiers. With the new elements it is possible to design rectifier units of smaller dimensions and higher efficiency than earlier.

The last ten years have seen an unusually rapid development in the sphere of semiconductors. This applies equally to their general theory and to the technical methods for producing them. Some years ago SER started work on the development of certain types of semiconductors for L M Ericsson. This work proceeded concurrently with the normal manufacture of tubes and had in view the fact that rectifiers and transistors, based on germanium or silicon, both implement and replace certain types of vacuum tube.

The main work hitherto has been done on germanium products, of which the first can now be presented in the form of three power diodes with the provisional designations *1N151X, 1N152X, 1N153X*. These diodes are designed for maximum 1 A rectified current and 100, 200 and 300 V max. peak inverse voltage at 2.4, 1.9 and 1.2 mA peak current respectively. The rectifier element is enclosed in a small metal can which stands on a square-shaped cooling fin measuring 40 × 40 mm. The top of the can terminates in a glass bushing. There is a hole in the cooling fin for mounting a number of rectifiers on a single insulated bolt.

Owing to their small dimensions and good electrical data these rectifiers can be used to advantage in place of selenium and copper rectifiers, especially as germanium diodes are virtually free from aging.

The active element of the rectifiers is a thin square-shaped bit of monocrystalline germanium metal having an area of about two square millimetres, which is attached directly to the cooling fin. On the other side of the crystal element, part of the surface is alloyed with metallic indium by means of a special heat treating process. An electrode, which fits through the glass bushing, functions as current lead to the indium. The actual rectifier action takes place in the interface or junction between the germanium and indium, the thickness of which is only about one thousandth of a millimetre.

Fig. 1 X 2076

Volt-ampere characteristic of power diodes 1N151X—1N153X in forward direction

Fig. 2 X 2077

Volt-ampere characteristic of power diodes 1N151X-1N153X in reverse direction

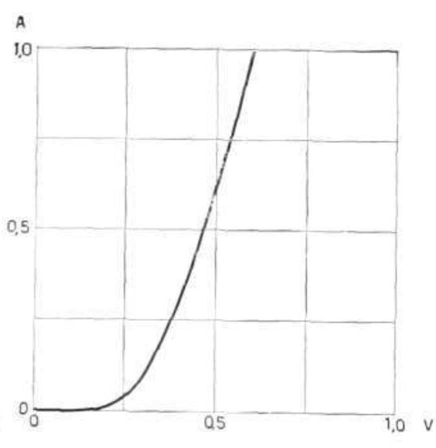


Fig. 1

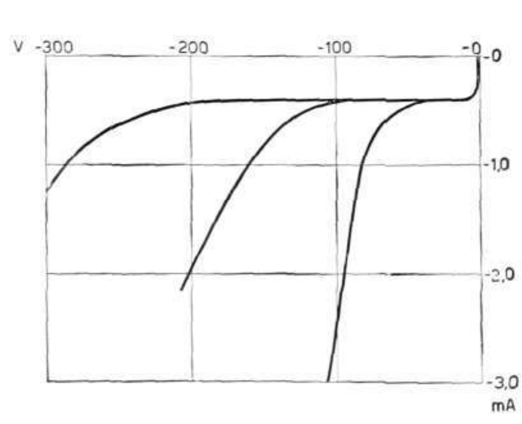


Fig. 2

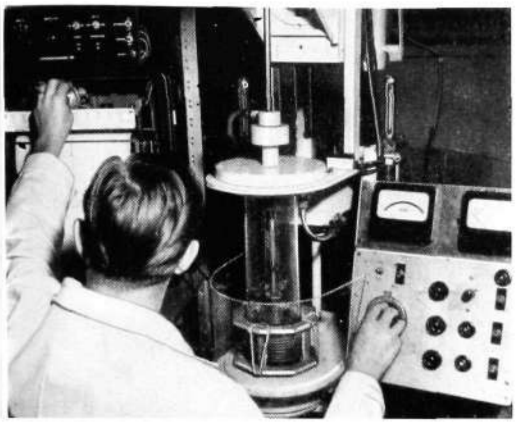


Fig. 3 X 2091

Pulling of germanium crystals in a vertical machine

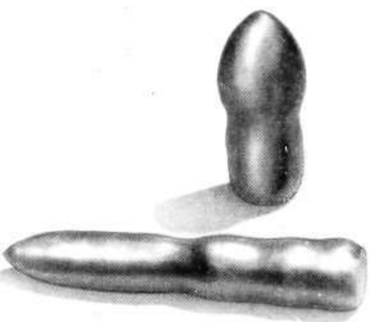


Fig. 4 X 2090

Germanium crystals

Fig. 5 X 2092 X 2130

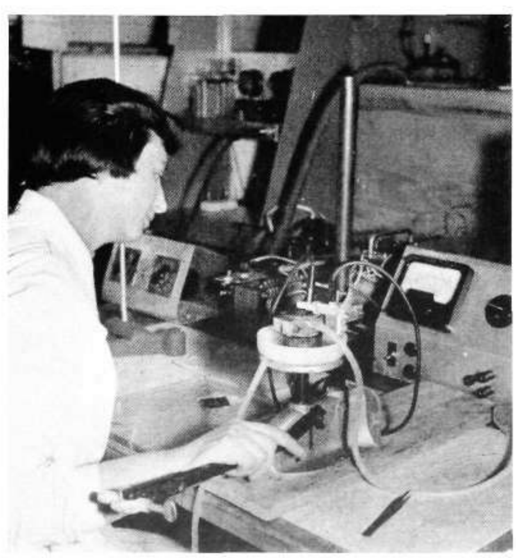
Assembly in a dry box

All three types have the same size of crystal element and, in fact, differ solely in the method of manufacture and, to a small extent, in the choice of basic material.

Volt-ampere curves in the forward and reverse directions are given in figs. 1 and 2, which indicate the relation between the peak values of the associated current and voltage values at 50 c/s, with the rectifiers in a stationary ambient at 55° C. A very characteristic feature is that the current remains practically constant over a section of the reverse voltage range. This is called the diode reverse saturation current. This reverse current rises roughly exponentially with the temperature and is, in fact, a primary factor which places a definitive upper limit on the rectified current under normal conditions of operation.

The crystal element of the rectifier is in intimate thermal contact with the cooling fin in order to rapidly carry off the heat generated by inherent losses. This heat derives from resistance losses in the germanium and indium parts of the crystal element during the forward current period, and in the junction and germanium surface during the reverse current period. If the rectifier is heavily loaded, so that the total losses in the crystal element are high, local temperature "run away" may occur as a result of the strong dependence of temperature on the saturation current. This is caused by the fact that the dissipation power increases the temperature of the junction, which increases the current, i.e. the dissipation power rises still further, and so on—a mechanism analogous with the thermal breakdown in certain dielectrics. The three types of rectifier are designed with safe margins against this phenomenon as long as the nominal ratings are not exceeded. The rectifier can be driven with a higher rectified current than the nominal if the cooling is improved by the use of a fan or by increasing the area of the fins, especially if the rectifier is not at the same time forced to supply full output in the reverse direction. Owing to the drop in the reverse current with falling temperature, there is no lower temperature limit for the use of the rectifier.

The can enclosing the crystal element is welded to the cooling fin. The seal is carefully tested for tightness. The can is degassed in the course of manufacture and thereafter filled with inert gas, so that the crystal element is enclosed in a permanent and safe environment. Owing to the efficiency of the hermetic seal the rectifier is not readily affected by moisture. No stepping up of the conductivity occurs until the humidity of the environment is so high that condensation takes place on the outside surface of the glass bushing, and it is then noticed principally in the reverse current. The three types will stand storage up to a temperature of about 85° C.



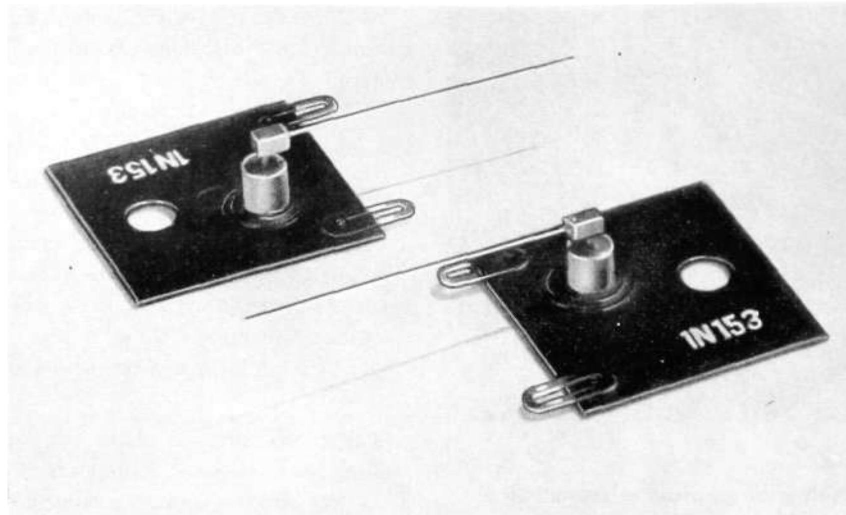


Fig. 6 X 6964
Completed power rectifiers 1N153X

The low reverse current, the very small drop in forward voltage and the absence of heater power in these power diodes makes it possible to design rectifier equipment of very high efficiency. The low forward voltage at high amperage can also be utilized in special applications, as in rectifier circuits with low internal resistance, as well as for the rectification of an a.c. supply for operating d.c. motors where a large range of speed regulation is desired. The small size permits the design of very compact mains power rectifiers, since in the majority of cases the germanium diodes will occupy less space than the associated transformers.

The manufacture of the crystal element for rectifiers is a delicate process; among other things, the germanium material must contain a degree of impurity less than 1: 50,000,000. The photographs show some characteristic views of the manufacture of germanium rectifiers at SER.

L M Ericsson Exchanges Cut into Service 1955

Exchanges with 500-line selectors

Town	Exchange		Number of lines
Brazil			
Acesita	1 PABX		500
Aquidauna			200
Carangola			330
Fortaleza	Centro	(extension)	2000
Fortaleza	Parangaba		300
Goiânia	Centro	(extension)	1000
Goiânia	Campinas		500
Itajaí		(extension)	200
Maringá			500
Volta Redonda			1000
Colombia			
Bogotá	Centro	(extension)	1000
Bogotá	Chapinero	(extension)	4000
Bogotá	Las Cruces	(extension)	2000
Bogotá	Ricaurte	(extension)	1000
Bogotá	Teusaquillo	(extension)	1000
Cartagena	Centro		3500
Cartagena	Central Bosque		500
Fontibón			500
Medellín	America	(extension)	500
Medellín	Bosque		2000
Medellín	Poplado		1000
Denmark			
Copenhagen	1 PABX		440
Ecuador			
Cuenca		(extension)	1000
Guayaquil			7000
Ethiopia			
Addis Abeba	Centro		2000
Addis Abeba	Filwoha		900
Gondar			200
Finland			
Karhula		(extension)	500
Turku		(extension)	3000
Vaajakoski			400
Iceland			
Akureyri		(extension)	500
Italy			
North Italy			
Adria			800
Bergamo		(extension)	3500
Brescia		(extension)	4000
Chioggia			1200
Cittadella			1000
Cremona		(extension)	1000
Este		(extension)	100
Iesolo		(extension)	200
Mantova		(extension)	1000
Mogliano		(extension)	100
Padova		(extension)	2600
Padova	1 PABX		250
Portogruaro			1500
Rovigo		(extension)	600
Salo		(extension)	200
Sarezzo		(extension)	300
S. Bonifacio			500
S. Dona di Piave		(extension)	200
Schio		(extension)	500
Torino	1 PABX		250
Treviso		(extension)	1500
Valdagno		(extension)	100
Venezia	Lido	(extension)	400
Venezia	Mestre	(extension)	1600
Verona		(extension)	2000
Vicenza		(extension)	2000
South Italy			
Alcamo			600
Bari		(extension)	1500
Caltanisetta		(extension)	500
Capri		(extension)	500
Catania		(extension)	2000
Enna		(extension)	100
Gela		(extension)	200
Giarre Riposto			600
Napoli	Chiaia	(extension)	2000
Napoli	Museo	(extension)	2000
Napoli	Portici	(extension)	500
Roma	1 PABX		180
Salerno		(extension)	200
Taranto		(extension)	700
Trani		(extension)	200
Mexico			
Mécico DF	Apartado	(extension)	500
México DF	Chapultepec	(extension)	1500
México DF	Roma	(extension)	2000
México DF	Saro		6000
México DF	Valle	(extension)	1000
México DF	Victoria	(extension)	800
México DF	1 PABX		600
Netherlands			
Rotterdam	Centrum II		2500
Rotterdam	Zuid II		4000
Rotterdam	4 PABX	(extension)	340
Rotterdam	1 PABX		280
Netherlands West Indies			
Mahaai		(extension)	500
Rio Canario			500
New Zealand			
Marton		(extension)	450
Whangarei		(extension)	1300

Town	Exchange		Number of lines
Norway			
Eidanger	1 PABX	(extension)	80
Gjövik			2000
Haugesund		(extension)	2000
Kristiansand S		(extension)	1000
Mo i Rana	1 PABX		240
Moss		(extension)	1000
Moss	1 PABX		260
Sandnes		(extension)	500
Sarpsborg			3700
Stavanger		(extension)	1000
Panama			
Panamá City	Panamá III	(extension)	1500
David			800
Spain			
San Sebastián		(extension)	5000
Sweden			
Eskilstuna	1 PABX		200
Gävle		(extension)	1000
Gävle	2 PABX		680
Göteborg	Kortedala	(extension)	1000
Göteborg	1 PABX		1000
Göteborg	3 PABX	(extension)	160
Hallstahammar	1 PABX		250
Halmstad			13000
Jönköping	1 PABX	(extension)	60
Karlskoga		(extension)	1500
Karlskoga	3 PABX	(extension)	100
Kiruna	1 PABX		400
Köping		(extension)	500
Malmberget	1 PABX		260
Malmö	2 PABX	(extension)	60
Norrköping		(extension)	2000
Norrköping	1 PABX		180
Nässjö		(extension)	1000
Perstorp	1 PABX	(extension)	40
Skellefteå		(extension)	2000
Stockholm	Gruppstationer	(extension)	4000
Stockholm	Östermalm	(extension)	1000
Stockholm	Aspudden	(extension)	3000
Stockholm	Djursholm	(extension)	500
Stockholm	Hässelby	(extension)	2000
Stockholm	Tureberg	(extension)	1000
Stockholm	Ängby	(extension)	500
Stockholm	Örby	(extension)	1500
Stockholm	7 PABX		2080
Stockholm	5 PABX	(extension)	340
Södertälje		(extension)	1000
Uddeholm	1 PABX		260
Uddevalla		(extension)	500
Umeå	1 PABX		360
Uppsala		(extension)	3000
Uppsala	1 PABX		140
Övriga Sverige	PABX:s	(extension)	2660
Turkey			
Ankara	Keciören		300
Ankara	Yenimahalle		1500
Izmir	Bornova	(extension)	200
Izmir	Buca	(extension)	200
Izmir	Merkez Santral	(extension)	3000
Venezuela			
Carúpano			600
Cumaná			850
El Tocuyo			300
Porlamar			300
		Total	176480

Exchanges with crossbar switches

Town	Exchange		Number of lines
Denmark			
Helsingør			4000
Copenhagen	Bagsvaerd		5000
Copenhagen	Rødovre		6000
Copenhagen	Yrsa		5000
Nykøping F			4000
Finland			
Helsinki	Kottby		1000
Helsinki	Sörnäs	(extension)	1000
Jugoslavia			
Zagreb	Peščenica		1000
Sweden			
Nyköping			8000
Ystad			4000
		Total	39000

Exchanges with crossbar switches, with relay selectors and with 100-, 25- and 12-line selectors. (Extensions to existing plants are not included in the figures.)

	Number	Number of lines
Exchanges with crossbar switches, system ARK	110	17960
Exchanges with relay selectors	99	794
Exchanges with 100-line selectors, system ARD	190	18695
Exchanges with 25- and 12-line selectors, system OL	507	12550
Total	906	49999

Ericsson LM NEWS *from All Quarters of the World*

The members of the new research committee are seen in the adjacent photograph. From left to right are Gunnar Sparrendahl, Bertil Bjurel and Sven Nordström (chairman) from the Board of Telecommunications; and, from LME, Christian Jacobæus and Gunnar Svala (sitting).

The electronic switching elements, some of which are seen in the photo below grouped around the head of a match, will play a decisive part in the development of telecommunications.

Swedish Cooperation in Electronics

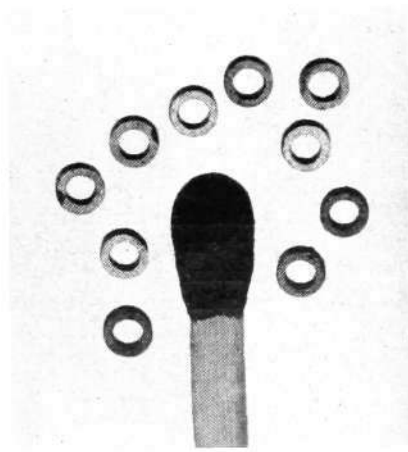
The Swedish Board of Telecommunications and Telefonaktiebolaget L M Ericsson have concluded an agreement for cooperation in electronic research and development. The background to this agreement is the immense future importance of electronics in automatic exchange techniques. It was considered that effective work in this field calls for an effort that is too great for either party to carry alone. The shortage of competent technicians is another factor that necessitates the coordination of resources.

Each party will contribute the experience of their already existing sections for the development of electronic systems. In addition, L M Ericsson will provide the services of their component technicians, as required, both from the parent and subsidiary companies. The Board of Telecommunications will make available their operational experts and will run field tests.

The coordination of the work will be in the hands of a committee consisting of two persons from each organization, with a chairman appointed alternately by each party for two-year periods. The representatives appointed by the Board of Telecommunications are Bertil Bjurel, Director of Division, and Gunnar Sparrendahl, Director of Section; representing L M Ericsson are Christian Jacobaeus, Technical Director, and Gunnar Svala, Head of Section. The chairman for the first two-year period will be Sven Nordström, Engineer-in-chief of the Board of Telecommunications.

Electronic inventions and designs etc. produced by either party will be pooled. L M Ericsson will thus manufacture and sell equipment designed under the cooperative agreement.

The coming into being of this agreement must be considered a matter for great satisfaction. Our country holds a very advanced position as regards automatic telephone exchanges —from the technical, productional and operational aspects alike. To maintain and improve this position when technique takes a new turn, the resources of the country must be rationally exploited. For L M Ericsson as large-scale importer of telephone exchanges, it is essential to keep in the forefront of technical developments. The cooperation with the Board of Telecommunications is regarded as an extremely important milestone on the road of technical progress.



Portuguese State Railways Order Telephone Equipment

(Above) Avenida de Liberdade, Lisbon.

(Below) An example of modern Lebanese architecture: the fine station building of the Beyrouth air port.

The Portuguese State Railways recently ordered complete telephone equipment from L M Ericsson, consisting of cable, line material, automatic switchboards and selective calling systems for two railroad sections, viz. Lisbon—Sintra and Lisbon—Entroncamento.

These two sections constitute the first stage in the electrification of the Portuguese Railway System. The Lisbon—Sintra section, 23 miles, comprises 15 stations, being essentially a surburban railway with high train density. The Lisbon—Entroncamento section, 67 miles, has 21 stations and is Portugal's most important railroad, carrying the traffic to Oporto, Portugal's second largest city, and on to Spain and the continent. This line, too, carries a heavy traffic.

L M Ericsson's undertakings include the delivery, laying, splicing and connection of two parallel armoured cables, one for short-distance and the other for long-distance calls; also the delivery and installation of three selective calling plants made with a. c. impulsing and intended primarily for train control from Lisbon; and, finally, four automatic switchboards for certain main stations.

Installation is to start in the summer of 1956.

Lebanon Quickly Changing Over to Dial Telephones

Among the quick succession of orders recently received by L M Ericsson from the Lebanese Telephone Administration is one for urban rural exchanges covering 12,500 lines. Transit exchanges have also been ordered for fully automatic trunk traffic in Beyrouth, Tripoli, Saide and Zahlé, main centres in Lebanon's four telephone districts.

Of the exchanges on order, which at present total about 60,000 lines, the 15,000-line exchange in Beyrouth has been in service since 1954. All exchanges are expected to be in service by 1960, when subscriber-dialled trunk traffic will also be established over almost the entire country.

Large Telephone Installations on the New m/s »Gripsholm»

The Swedish America Line's new m/s "Gripsholm", of 23,500 gross register tons, at present under construction, will be equipped with a comprehensive telephone system for both internal and external traffic.

An automatic L M Ericsson switchboard of type AHD 50 for 300 lines and for 30 simultaneous calls provides the 840 passengers with the facility of communicating with one another and with the ship's staff. The ivory-white telephones in the cabins are connected by plug and jack, and can easily be jacked out if the passenger does not wish to be disturbed.

A second automatic switchboard, type AHD 24, will be used for the ship's officers. It is equipped for 90 internal lines and 10 simultaneous calls. Another 10 lines are provided for connecting with the New York and Gothenburg public telephone networks.

Both switchboards are also connected to the ship's radio equipment, permitting communication with land from all instruments.

A delegation from the Turkish P.T.T. visited Midsommarkransen in March. The visitors are seen (right) around the model of the head factory in the Demonstration Room. On the extreme left is the leader of the delegation, Necmi Özgür, assistant to the Director General of the P.T.T.

The British Ambassador to Sweden, Sir Robert Hankey, visited the head factory in the middle of January. He was received by the President, Mr Sven T Åberg, who showed the Ambassador some LM products of earlier and more recent date. The photographer has here caught host and guest in front of some wall type telephones.

A visitor from Thailand is Mr. P Thavisin, the chairman of Vichien Radio & Television Co., Bangkok (centre in photo above).

At an international fair at Djakarta, capital of Indonesia, one of the main attractions was a domestic telephone connected to L M Ericsson's Telephone Answerer. All day long, during the entire run of the fair, people queued up to listen to the telephone answerer which made LM publicity in Indonesian. It worked continuously for six weeks without supervision. Here is a little Indonesian girl listening in, when visiting the fair with father, mother and her small brother.

Since 1954 the Ericorder has been manufactured at L M Ericsson's factory in Örebro—the only Swedish factory specializing in tape recorders. The premises have now become inadequate, and a new modern and far more spacious factory has therefore been purchased (photo right). The new building, which has a floor area of about 17 500 sq.ft., will be taken over by L M Ericsson on May 1.

L M Ericsson Helps Argentine Combat Polio Epidemic

To help in the severe polio epidemic which was raging for some time in Argentine, L M Ericsson purchased and despatched a respirator of the Engström Universal type, reckoned as one of the best for treating polio patients. A gift from L M Ericsson to the Argentine Republic, the respirator was particularly appreciated in view of the shortage of such equipment. S.A.S. contributed to the gift by flying the respirator free of charge to Buenos Aires.

The loading of L M Ericsson's gift respirator into a S.A.S. plane.

Glass Producing District of Småland becomes Automatic

Fully automatic telephone traffic started in the Nybro group area, Småland, in the middle of January. Automatic connection was thereby established also with the neighbouring Kalmar area and, via Kalmar, with the Mörbylånga group in Öland. Following the conversion of the Nybro group, a good half of Småland's 120 000 subscribers now have dial telephones.

Nybro group consists of 13 exchanges with some 3,000 subscribers. The junction centre in Orrefors, serving 400 lines, and the 2,000-line group centre in Nybro itself were manufactured and installed by L M Ericsson. They are designed to the Swedish Telecommunications Administration's crossbar system ART 204.

The exchange building of the new group centre in Nybro.

Within the geographical area served by the comparatively small Nybro group is located a considerable part of the Småland glass industry. Apart from the Orrefors Glassworks, of world-wide reputation, six other glassworks are situated in the area—Boda, Gullaskruv, Flerohopp, Flygsfors, Pukeberg and Gadderås.

New Cable Catalogue

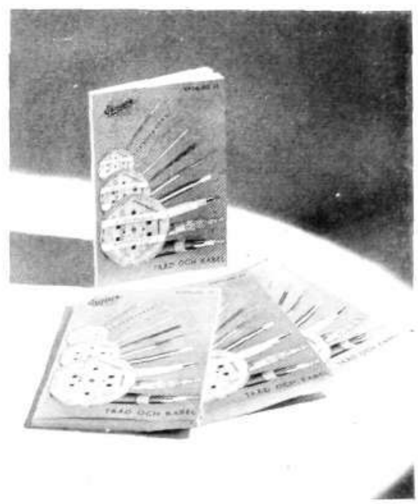
L M Ericsson's Cable Works, Älvsjö, has issued catalogue no 32, "Tråd och Kabel" (Wire and Cable).

The catalogue is richly illustrated and comprises many new types of telephone and signal cables etc. A large number of these cables are plastic insulated.

An instructive description is given of the properties and usages of various plastic materials in order to assist customers in the choice of the correct type for their particular applications.

The catalogue thus presents a greatly extended range of manufacture and, with its technical directions, tables and diagrams, will be a valuable aid in planning and purchasing.

At present catalogue no. 32 exists in a Swedish edition only.



U.D.C. 621.389: 621.395.722

SVALA, G: *Electronic Telephone Exchanges.* Ericsson Rev. *33* (1956) No. 1, pp. 2—14.

The application of electronics in automatic telephone exchanges is increasingly engaging the attention of telecommunication researchers and designers. As far as can be judged, considerable further progress must be made before fully electronic telephone systems become competivite. The article presents a review of the electronic components, including certain applications of ordinary functional units, and describes a trial plant built at the Development Dept. of L M Ericsson.

U.D.C. 656.212.5: 656.256

LUNDBERG, T: *Reorganization of Shunting at Ånge Marshalling Yard, Swedish State Railways.* Ericsson Rev. *33* (1956) No. 1, pp. 15—21.

The Swedish State Railways have taken a big step towards the radical reorganization of freight car handling by the introduction of automatic point switching and car retarders at the Ånge marshalling yard. The automatic point switching plant was constructed by L M Ericsson in cooperation with the Railways Board. The material, including ready-wired relay racks and control equipment, was supplied by L M Ericsson. The article describes the equipment and operation of the Ånge yard and the results gained through the reorganization.

U.D.C. 681.175.5

AHLBERG, F: *Mains Connected Job Costers.* Ericsson Rev. *33* (1956) No. 1, pp. 22—23.

For some time development has been in progress on time recorders for direct mains connection. Engineering has been completed on desk type recorders—job costers and time and date recorders—and machines of this type have now been included in the production program.

U.D.C. 621.314.7

ÖVERBY, S: *Germanium Power Rectifiers.* Ericsson Rev. *33* (1956) No. 1, pp. 24—25.

SER is now manufacturing power rectifiers on the basis of germanium. The units are of small size in comparison with conventional copper and selenium type rectifiers. With the new elements it is possible to design rectifier units of smaller dimensions and higher efficiency than earlier.

The Ericsson Group

Associated and co-operating enterprises

• EUROPE •

Danmark

L M Ericsson A/S *København F*, Finsens Vej 78, Tel: Fa 6868, tgm: ericsson

Telefon Fabrik Automatic A/S *København K*, Amaliegade 7, tel: C 5188, tgm: automatic

Dansk Signal Industri A/S *København F*, Finsens Vej 78, tel: Fa 6767, tgm: signaler

Deutschland

Ericsson Verkaufsgesellschaft m. b. H. *Düsseldorf 1*, Worringer Strasse 109, tel: 84 461, tgm: erictel

España

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

France

Société des Téléphones Ericsson *Colombes (Seine)*, Boulevard de la Finlande, tel: CHA 35-00, tgm: ericsson

Paris 17e, 147 Rue de Courcelles, tel: Carnot 95-30, tgm: eric

Société Cinéric *Paris 20e*, 111 Rue Villiers de l'Isle Adam, tel: Ménilmontant 87-51, tgm: cinericsson

Great Britain

Swedish Ericsson Company Ltd. *London, W. C. 1*, 329 High Holborn, tel: Holborn 1092, tgm: teleric

Production Control (Ericsson) Ltd. *London, W. C. 1*, 329 High Holborn, tel: Holborn 1092, tgm: productrol holb

Italia

Setemer, Soc. per Az. *Milano*, Via dei Giardini 7, tel: 662241, tgm: setemer

SIELTE, Soc. per Az. — Società Impianti Elettrici e Telefonici Sistema Ericsson *Roma*, C. P. 4024 Appio, tel: 78 02 21, tgm: sielte

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

S.E.T. Soc. per Az. — Società Esercizi Telefonici *Napoli*, Via Roberto Bracco 20, tel: 50 000, tgm: set

Nederland

Ericsson Telefoon-Maatschappij, N.V. *Rijen (N. Br.)*, tel: 01692-555 tgm: erictel

den Haag—Scheveningen, Gevers Deynootplein 30, Kurhaus, tel: 55 55 00, tgm: erictel-haag

Norge

A/S Elektrisk Bureau *Oslo*, P. B. 5055, tel: Centralbord 461820, tgm: elektriken

A/S Industrikontroll *Oslo*, Teatergaten 12, tel: Centralbord 335085, tgm: indtroll

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

A/S Norsk Signalindustri *Oslo*, P.B. Mj 2214, tel: Centralbord 56 53 54

Portugal

Sociedade Ericsson de Portugal, Lda. *Lisboa* 7, Rua Filipe Folque, tel: 57193, tgm: ericsson

Schweiz

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

Suomi

O/Y L M Ericsson A/B *Helsinki*, Fabianinkatu 6, tel: A 8282, tgm: ericssons

Sverige

Telefonaktiebolaget L M Ericsson *Stockholm 32*, tel: 19 00 00, tgm: telefonbolaget

AB Alpha *Sundbyberg*, tel: 28 26 00, tgm: aktiealpha-stockholm

AB Ermex *Solna*, tel: 82 01 00, tgm: elock-stockholm

AB Ermi *Ulvsunda 1*, tel: 26 26 00, tgm: ermibolag-stockholm

AB Rifa *Ulvsunda*, tel: 26 26 10, tgm: elrifa-stockholm

AB Svenska Elektronrör *Stockholm 20*, tel: 44 03 05, tgm: electronics

L M Ericssons Driftkontrollaktiebolag *Solna*, tel: 27 27 25, tgm: powers-stockholm

L M Ericssons Svenska Försäljningsaktiebolag *Stockholm*, Kungsgatan 33, tel: 22 31 00, tgm: ellem

L M Ericssons Signalaktiebolag *Stockholm Sv*, tel: 19 01 20, tgm: signalbolaget

Mexikanska Telefonaktiebolaget Ericsson *Stockholm 32*, tel: 190000, tgm: mexikan

Sieverts Kabelverk *Sundbyberg*, tel: 28 28 60, tgm: sievertsfabrik-stockholm

Svenska Radioaktiebolaget *Stockholm*, Alströmergatan 12, tel: 22 31 40, tgm: svenskradio

• ASIA •

India and Ceylon

Ericsson Telephone Sales Corporation AB *Calcutta*, P. O. B. 2324, reg. mail: *Calcutta 22*, 5 Commissariat Road, P. O. Hastings, tel: Alipore 2951/2952, tgm: inderic

New Delhi, 45, Indra Palace, Connaught Place, tel: 44490, tgm: inderic

Indonesia

Ericsson Telephone Sales Corporation AB *Bandung*, Djalan Dago 151, tel: 2135, tgm: javeric

Liban

Telefonaktiebolaget L M Ericsson, Technical Office *Beyrouth*, Rue du Parlement, Immeuble Bisharat, tel: 33555, tgm: ellem

Türkiye

Ericsson Türk Ltd. Şirketi *Ankara*, Ādil Han, Zafer Meydani, Yenişehir, tel: 28379, tgm: ellem

• AMERICA •

Argentina

Cía Sudamericana de Teléfonos L M Ericsson S. A. *Buenos Aires*, Belgrano 894, tel: 332071, tgm: ericsson

Corp. Sudamericana de Teléfonos y Telégrafos S. A. *Buenos Aires*, Belgrano 894, tel: 332071, tgm: cartefe

Cía Argentina de Teléfonos S. A. *Buenos Aires*, Perú 263, tel: 305011, tgm: cecea

Cía Entrerriana de Teléfonos S. A. *Buenos Aires*, Perú 263, tel: 305011, tgm: cecea

Cía Comercial de Administración S. A. *Buenos Aires*, Perú 263, tel: 305011, tgm: cecea

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

São Paulo C. P. 5677, tgm: ericsson

Empresa Sul Americana de Telefones S. A. *Rio de Janeiro*, C. P. 4684, tel: 43-0990, tgm: emsulatel

Canada

Ericsson Telephone Sales of Canada Ltd. *Montreal 2, Quebec*, Castle Building, 1410 Stanley Street, tel: AVenue 8-8169, tgm: caneric

Toronto, 18, Ontario, P.O.B. 161, tel: BElmont 1-1306

Chile

Cía Ericsson de Chile S. A. *Santiago*, Casilla 10143, tel: 82555, tgm: ericsson-santiagodechile

Colombia

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

México

Cía Comercial Ericsson S. A. *México D., F.*, Apartado 9958, tel: 35-95-88 tgm: coeric-mexico

Teléfonos de México S. A. *México D. F.*, Paseo de la Reforma 107 tel: 21-91-00, tgm: elmex-mexico

Perú

Cía Ericsson S. A. *Lima*, Apartado 2982, tel: 34941, tgm: ericsson

Soc. Telefónica del Perú, S. A. *Arequipa*, Casilla de Correo 112, tgm: telefonica

Uruguay

Cía Ericsson S. A. *Montevideo*, Casilla de Correo 575, tel: 84433, tgm: ericsson

United States of America

The Ericsson Corporation *New York 17, N. Y.*, 100 Park Avenue, tel: Murray Hill 5-4030, tgm: erictel

North Electric Co. *Galion, Ohio*, P. O. B. 417, tel: 24201, tgm: northphone-galion-ohio

Venezuela

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

Teléfonos Ericsson C.A. *Caracas*, Apartado 3548, tel: 57467, tgm: ericsson

• AUSTRALIA & OCEANIA •

Australia

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

Agencies

• EUROPE •

Belgique

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

Greece

»ETEP», S. A. Commerciale & Technique *Athens*, 1, Stadiou Street, tel: 31 211, tgm: aeter

Ireland

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

Island

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

Yougoslavie

Merkantile Inozemma Zastupetva *Zagreb*, P. O. B. 23, tel: 25—222, tgm: merkantile

Österreich

Inglomark, Industrie-Beliefe-*rungs-Gesellschaft* Markowitsch & Co. *Wien XV*, Maria Hilferstrasse 133, tel: R 32-0-11, tgm: inglomark

• ASIA •

Burma

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

China

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

Hongkong

The Swedish Trading Co. Ltd. *Hongkong*, Prince's Building, Ice House Street, tel: 20 171, tgm: swedetrade

Iran

Irano Swedish Company AB *Teheran*, Khiaban Sevom Esfand 201-203, tel: 36761, tgm: iranoswede

Iraq

Swedish Oriental Company AB *Baghdad*, Mustansir Street, 5 A/38, tel: 848 19, tgm: swedeorient

Israel

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

Japan

Gadelius Co. Ltd. *Tokyo*, Shiba Park No. 7 Minato-ku, tel: (43)-1847, tgm: goticus

Jordan

H. L. Larsson & Sons Ltd. Levant *Amman*, P. O. B. 647, tgm: larsonhus

Liban

Swedish Levant Trading *Beyrouth*, P. O. B. 931, tel: 31624, tgm: skefko

Malaya

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

North Borneo

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

Pakistan

Vulcan Trading Co. (Pakistan) Ltd. *Karachi City*, P. O. B. 4776, tel: 32506, tgm: vulcan

Philippines

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

Saudi Arabia

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

Syrie

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

Thailand

The Vichien Radio & Television Co., Ltd. *Bangkok*, 299-301, Prasitsin Bldg, Suriwongse Road, tel: 318 69, tgm: vision

Viet-Nam

Compagnie Internationale de Commerce *Saigon*, P. O. B. 204, tel: 20253, tgm: intercom

• AFRICA •

British East Africa

Transcandia Ltd. *Nairobi, Kenya*, P. O. B. 5933, tel: 3312, tgm: transcanda

Congo Belge

Société Anonyme Internationale de Télégraphie sans Fil (SAIT) *Bruxelles (Belgique)*, 25, Boulevard de Régent, tel: 12 50 70, tgm: wireless

Egypt

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

Ethiopia

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

Moçambique

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

Nigeria

Scan African Trading Co. *Yaba Lagos* 32, P. O. B. 1, tgm: swedafrica

Tangier

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

Union of South Africa and Rhodesia

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

• AMERICA •

Bolivia

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

Costa Rica

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

Cuba

Mc Avoy y Cía *Habana*, Apartado 2379, tel: U-2527, tgm: macavoy

Curaçao N. W. I.

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

República Dominicana

García & Gautier, C. por A. *Ciudad Trujillo*, Apartado 771, tel: 3645, tgm: gartier

Ecuador

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

Guatemala

Nils Pira *Ciudad de Guatemala*, Apartado 36, tel: 3311, tgm: nilspira-guatemala

Haïti

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

Honduras

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

Jamaica and Brit. Honduras

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

Nicaragua

J. R. E. Tefel & Co. Ltd. *Managua*, Apartado 24, tel: 387-1169, tgm: tefelto

Panama

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

Paraguay

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

El Salvador

Dada-Dada & Co. *San Salvador*, Apartado 274, tel: 4860, tgm: dada

Surinam

C. Kersten & Co. N. V. *Paramaribo*, P. O. B. 216, tel: 2541, tgm: kersten

• AUSTRALIA & OCEANIA •

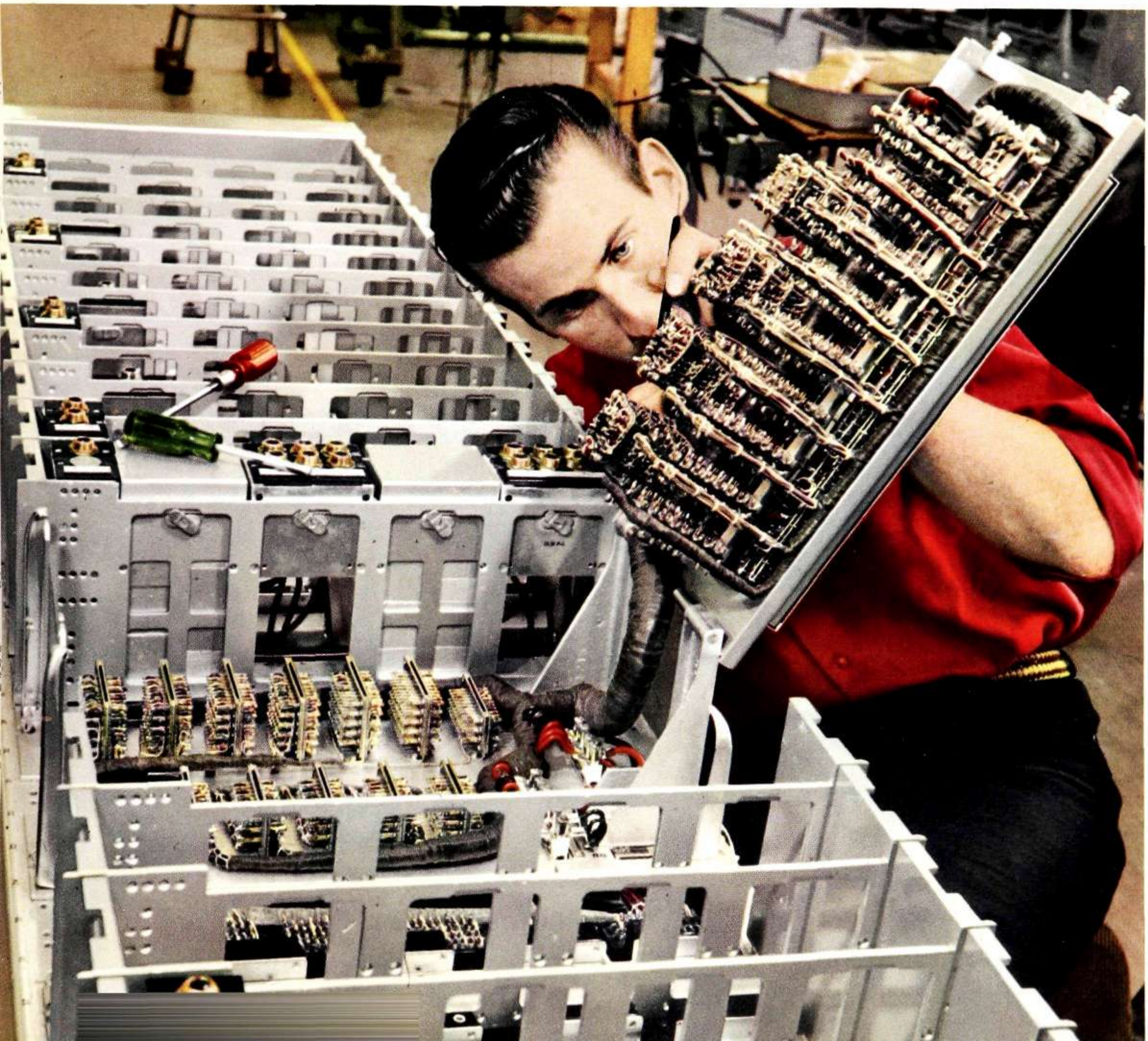
New Zealand

ASEA Electric (N Z) Ltd. *Wellington C 1.*, Huddart Parker Building, Post Office Square, tel: 70-614 tgm: aseaburd

ESSELTE, STHLM 56

ERICSSON Review

2
1956



ERICSSON REVIEW

RESPONSIBLE PUBLISHER: HUGO LINDBERG

EDITOR: SIGVARD EKLUND, DHS

EDITOR'S OFFICE: STOCKHOLM 32

SUBSCRIPTIONS: ONE YEAR $ 1.50; ONE COPY $ 0.50

CONTENTS

	page
Qualitative Maintenance of Automatic Telephone Networks	34
New 6- and 8-channel Carrier Telephone Systems for Open-Wire Lines	46
L M Ericsson's Traingraph	52
L M Ericsson News from All Quarters of the World	59

On cover: Connection work on a 60-channel carrier frequency bay

Qualitative Maintenance of Automatic Telephone Networks

HANS S ANDERSSON, TELEFONAKTIEBOLAGET LM ERICSSON, STOCKHOLM

U.D.C. 621.395.722.004.5

The new deal in regard to maintenance practice, which was discussed in its main aspects in Ericsson Review No. 4, 1955 (K. G. Hansson: "Economic Maintenance of L M Ericsson's Automatic Telephone Exchanges"), assumes a stringent form of maintenance control. The fundamental principles of the new policy are further emphasized in the present article.

The traditional and predominating opinion held by telephone administrations is that preventive maintenance pays. The rise in wages all over the world, however, and the high reliability with which Ericsson exchanges operate, has necessitated a reconsideration of the current attitude. To make a costly test of 1,000 switches, for example, to find that a fault exists in only one of them is poor economy. It is quite obviously sound economy, on the contrary, to test solely the one faulty unit in the group and eliminate the other tests. A system of methods and aids for locating a faulty unit instantaneously, without debasing the service rendered to the customer, is what this article aims briefly to present.

Economics of Maintenance Service

The goal in the development of a telephone administration's maintenance service may be characterized by the diagram in fig. 1.

Every telephone administration, so closely engaged as it is in the life of the individual and of the community as a whole, must be constantly awake to the demand for improved service as expressed by public opinion. The same opinion, however, also keeps a good watch that this improved service is offered at an unchanged or even at a reduced charge. The maintenance item is a large and, in the case of some telephone systems, predominant factor in the calculation of the present value of an installation. It can be proved that the minor differences in initial cost as between one telephone system and another are as a rule negligible in relation to the annual charges for the system over a period of years.

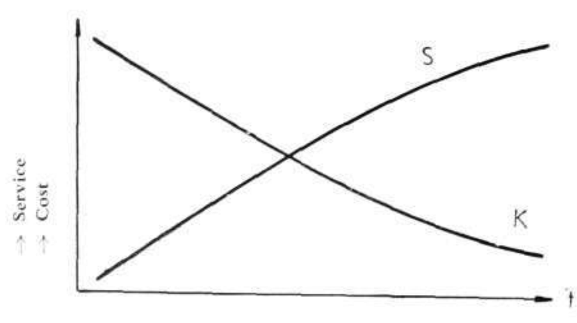


Fig. 1 X 2137

The desired relationship between quality of service S and costs K in the development of a telephone maintenance service

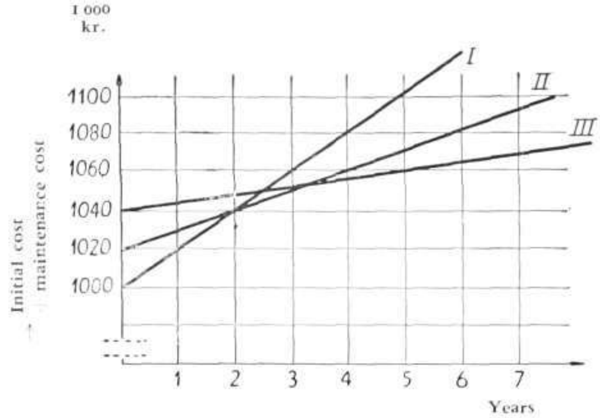


Fig. 2 X 6952

Annual charges of three telephone systems with varying maintenance costs

Fig. 2 illustrates the build-up of annual charges for three different telephone systems, in which the annual maintenance cost for system I is five times that for system II and twice that for system III.

Quality of Service versus Economy

The traditional attitude to the problem of quality of service versus economy has been to achieve a stable and constant quality of service at the cost of a high maintenance effort. This principle, which we may call *preventive maintenance*, is illustrated graphically in fig. 3. The opposite of preventive maintenance is *corrective maintenance*, which implies the attainment of a greatly varying quality of service by a temporary concentration of effort (fig. 4).

There are manifest weaknesses in both methods: when carried to an extreme, preventive maintenance is too expensive and corrective maintenance gives rise to unacceptably great variations in quality of service.

The method of maintenance recommended in this article may be characterized as *controlled corrective maintenance*. Its product is a slightly varying quality of service for a comparatively small maintenance effort (fig. 5).

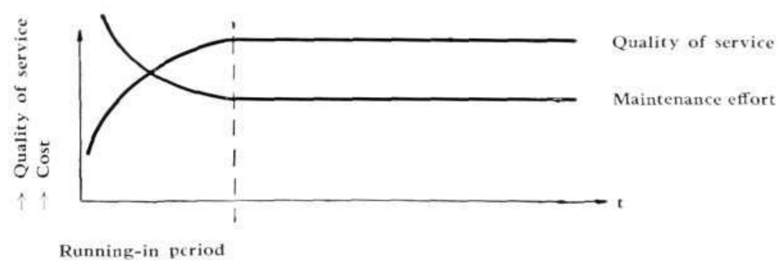


Fig. 3 X 6953

Preventive maintenance

Constant quality of service. High maintenance effort

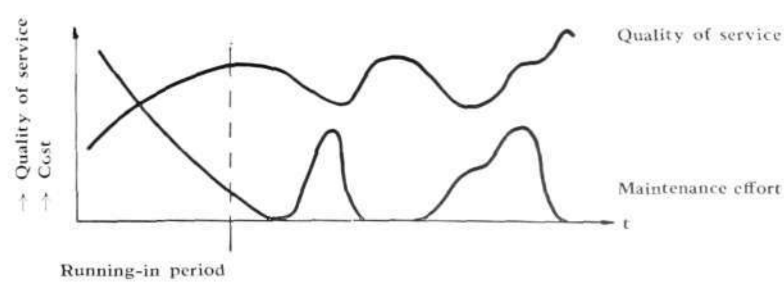


Fig. 4 X 6954

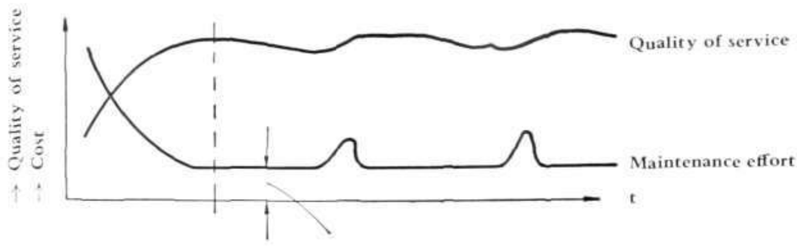
Corrective maintenance

Greatly varying quality of service. Temporary concentration of effort

Fig. 5 X 6955

Controlled corrective maintenance

Slightly varying quality of service. Low maintenance effort.



Principles of Maintenance Control

It should first be made perfectly clear that every reduction in preventive maintenance postulates a corresponding tightening up of maintenance control. Maintenance control may assume two forms:

a statistical analysis

b instantaneous indications

Although statistical analysis should, of course, be kept as up-to-date as possible, there is in all analytical work a certain lapse of time between the receipt of the primary material and the ultimate diagnosis, and more comprehensive means for instantaneous indication of faults must therefore be provided. LME have lately developed, and are still working on, methods for rendering the statistical analysis still more efficient and up-to-the-minute, while at the same time adding extensive fault indicating devices to the switching equipment.

Statistical Analysis

Control of the quality of service by means of statistical analysis is exercised by two essentially different methods:

statistical quality control

analysis of fault and operating statistics.

Statistical Quality Control

During the war years 1940—1945 a new technique was developed, especially in USA, for supervising mass production in the engineering industry. This technique, known as statistical quality control, led to substantial improvement in quality without adding to the costs of production, and has increasingly gained ground in different areas of administration and manufacture. Statistical quality control, in brief, implies the systematic and mathematically based sampling of production units and the determination of the quality of production from, among other things, the number of defective units found on inspection. Quality control brought with it not only guarantees for the consumer; it also indicated an analytical means of discovering troubles in the production process. The rapid indication and location of troubles is effected by a continuous system of snap checks. Statistical quality control is today a generally accepted and highly estimated aid to industry throughout the world. What is a telephone exchange other than a machine engaged on gigantic mass production, in which the production unit is called the telephone call? Some of the control methods now widely employed in industry should therefore be readily usable for keeping a watch on the switching quality of an automatic telephone exchange.

The conditions for successful quality control in industry are immediately applicable to telephone traffic. They are as follows:

1 The methods for measuring the properties of the product must be simple and indisputable. This also applies to the measuring instruments required.

2 The time from sampling to analysis must be as short as possible.

3 The indications obtained from statistical analysis must be such as to provoke immediate action where required.

Retrospective Statistics

Far-reaching conclusions can be drawn regarding organizational and equipment efficiency by a post-analysis of faults and trouble encountered in relation to the maintenance effort and subscribers' reactions. This statistic is of particular value to the manufacturer of telephone equipment, since it points to the "trouble carriers" in the system and so reveals the weak points in design. To the telephone administration the great value of comparative retrospective statistics is that they indicate the quality of service offered to subscribers in different areas or show up the efficiency, or lack of efficiency, of the maintenance staff.

A few examples follow of how both statistical quality control and retrospective statistics can be applied to practical objectives.

Qualitative Service Control

Statistical quality control, which we prefer hereafter to call qualitative service control, may be exercised alternatively by

a. end-to-end test connections

b. monitoring and recording of actual traffic.

Test connections may be set up manually by calling from one station to another; or they may be arranged automatically with the equipment provided in Ericsson exchanges, such as exchange testers, automatic device testers etc. As mentioned in the reference to Ericsson Review No. 4/1955 above, a tester has been developed that is directly adapted to qualitative service control, known as the Traffic Route Tester. This apparatus, which is specially applicable for measuring the quality of local traffic in the modern by-path systems, corresponds to twenty subscribers whose calls can be distributed over desired routes and whose reactions during the setting up of the connection, conversation and disconnection can be accurately recorded in detail.

The sampling rate will vary according to the type of information required:

a. 250—400 connections per hour, especially for determining the quality of switching

b. 15—20 connections per hour, permitting control also of metering and quality of transmission.

The two rates correspond to what, in industrial quality control terminology, is known as Tightened and Reduced Inspection.

Whether tightened inspection is carried out during the busy hour or in a slack period will depend on whether congestion is present and to what extent. A case of congestion may be regarded as a fault caused by the traffic conditions, and if the inspection is to be entirely objective and to reproduce realistically the quality of service offered to the subscriber, congestion should

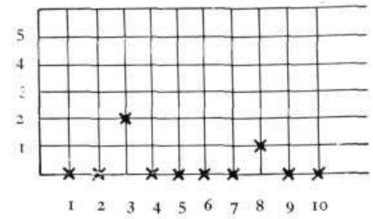


Fig. 6 X 2131
Sampling card

be included in the qualitative service control program. In such case it appears best to make the inspection both during busy and slack periods; in the former case to measure the frequency of faults both dependent on and independent of the traffic conditions, and in the latter solely the frequency of faults that are independent of the traffic intensity.

The reduced inspection rate sets up only a small quantity of traffic and may well be applied during busy periods, even if there is a tendency to congestion. The tester circuits should be so arranged that faulty connections are locked and that visual or audible alarm is given by the tester.

In order to calculate the required number of test connections, it is first necessary to establish the desired or anticipated quality of service in terms of number of faults per connection. An example is given below of how the fault liability, and thereby the quality of service, can be determined by statistical analysis of the information recorded by the tester.

Example 1

In a certain ARF-10 exchange of 20,000 lines, 75 per cent of the capacity of the subscriber multiple is utilized and traffic measurements have shown that there is no noticeable congestion. Between 100,000 and 200,000 connections are effected daily. Manual testing over a lengthy period has revealed that one out of 1,000 connections in the exchange and the surrounding automatic area are defective (connection faults, congestion, transmission faults) under the existing conditions of traffic. The fault liability is therefore anticipated to be 0.001 (number of faults per attempted connection). It is therefore decided that corrective action shall not be initiated unless the fault

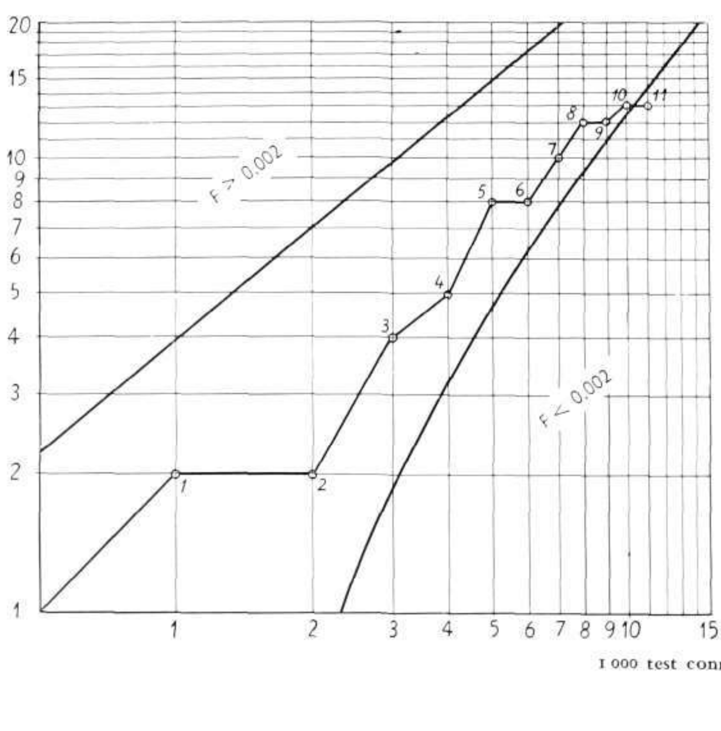


Fig. 7 X 6957
Qualitative service control graph
F = fault liability

liability exceeds 0.002. It is now our intention to investigate whether the fault liability is above or below this value. Sampling is to be done on weekdays during periods of average traffic, 12 a.m.—3 p.m., with about 1.000 connections on each occasion. Readings are made after each 100th connection, and the result is entered on a sampling card as shown in fig. 6.

From the fault distribution on the sampling card, the maintenance staff can draw certain immediate conclusions regarding the occurrence of congestion or other temporary failures. The values obtained from 1,000 connections are continuously plotted day by day on a prepared chart as in fig. 7. This chart is used for statistical sequence analysis of the sampling results. Sequence analysis implies the possibility of establishing on the basis of the sampling results, during the progress of the test and after each day's testing, whether

1 the fault liability is below 0.002. If so, sampling need not be continued, since the question to decide was whether the fault liability was lower than the maximum permissible value of 0.002;

2 the fault liability is greater than 0.002. In such case sampling is interrupted and corrective measures are taken.

If the results are within the tolerance limits, sampling is continued until a definite statement can be made. The tolerance range must be chosen according to the accuracy desired in assessing the results. The limits shown in fig. 7 allow for a 5 % risk of error in either direction.

The following results were recorded during 11 days of sampling:

Day	Sum of connec-tions	Expected no. faults at 2 ‰	No. faults observed each day	Sum of faults observed
1	1,000	2	2	2
2	2,000	4	0	2
3	3,000	6	2	4
4	4,000	8	1	5
5	5,000	10	3	8
6	6,000	12	0	8
7	7,000	14	2	10
8	8,000	16	2	12
9	9,000	18	0	12
10	10,000	20	1	13
11	11,000	22	0	13

After the 11th day of testing it can be established from the tabulated results with 95 % certainty that the fault liability is lower than 0.002.

Apart from an assessment of the results of sampling on the principle "go or not go", the administration may make a detailed analysis of the different types of fault. If the faults found in the sample traffic are distributed in an empirically "normal" manner, samplings may be accepted that are on the level of or outside the tolerance limit (max. permissible faults per test). On the other hand, results within the tolerance limit may also necessitate corrective measures if the distribution of faults is empirically unsymmetrical. There is accordingly reason to maintain a running control of the frequency of the different types of fault.

The action to be taken on indications from the traffic tester will depend on whether the information is directly indicative or is suggestive of slow changes in the quality of service. In the former case attention may be directed to a particular item of equipment or to the need for intensive testing with other aids (automatic register tester, automatic device tester, control register etc.). In the latter case the traffic route tester should be employed for a tightened inspection, group by group, until the sources of weakness have been ringed in and delimited. As a rule the test traffic can be quickly directed

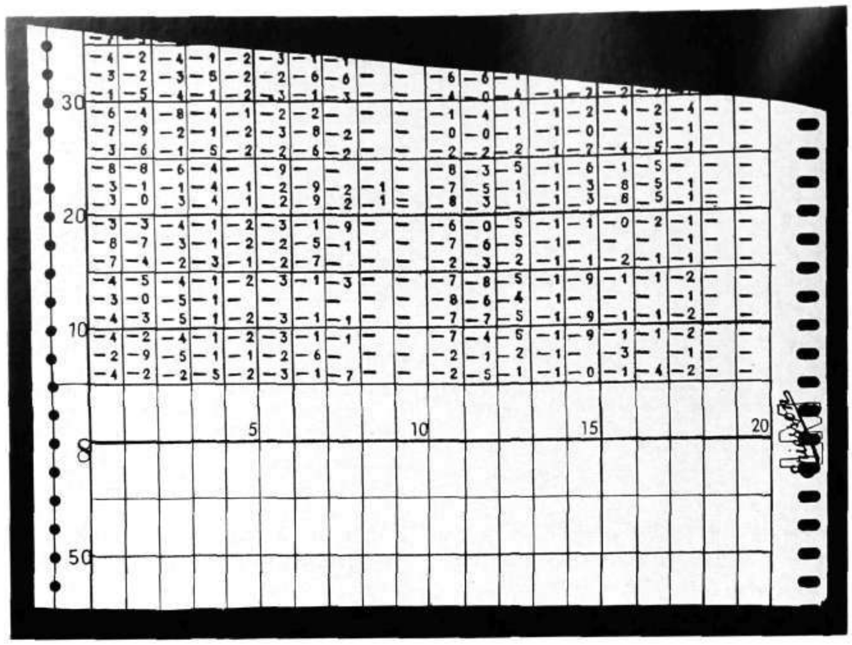


Fig. 8 X 6958
Centralograph chart

to the suspected parts of the exchange, guided by the instantaneous indications that are available (alarm, fault meter, congestion meter etc.). The number of traffic route testers required, if this form of maintenance control is chosen, may be said to be one tester per 20,000 lines. In automatic areas the testers should be located in the central exchange, with remote control of the outer exchanges on temporarily loaned or permanent control circuits. Small portable units are available for this purpose, intended for distribution of calls among the various groups of equipment at the outer exchanges, but with recording and indication at the main exchange.

Monitoring of Actual Traffic

The second method of qualitative service control, which consists in the monitoring and recording of actual traffic, has been widely adopted by the telephone administrations. Monitoring is done automatically, and recording either manually or automatically. In telephone systems manufactured by L M Ericsson, monitoring is effected by control registers (systems AGF and ARF) or by centralograph (systems ARM and ART). In the latter systems both monitoring and recording are fully automatic. If the administration wishes, the information supplied by the control registers can, of course, be automatically recorded by simple means.

The methods indicated do not entirely cover the traffic routes, but the few stages that are neglected are of little importance. Thus the control register does not provide a gauge of the quality of service before the connection reaches a register. But since only 1 per cent or so of the total quantity of faults in an ARF exchange occurs prior to that point, the method is fully dependable. In earlier articles in Ericsson Review No. 3/1954, reprinted from TELE No. 2/1954, examples were given of how control register statistics can be utilized for AGF systems. Illustrations of the use of the monitoring method for maintenance control and qualitative service control will in this instance, therefore, be drawn from L M Ericsson's crossbar trunk exchanges.

In these exchanges a marker is engaged for directing the connection from inlet to outlet. Its work can therefore be followed by supervisory circuits and, if trouble is encountered, the entire route is recorded in a centralograph by means of the unit digits 0—9 placed in 20 different columns (fig. 8). The data can now be used both for direct correction of faults and for qualitative service control.

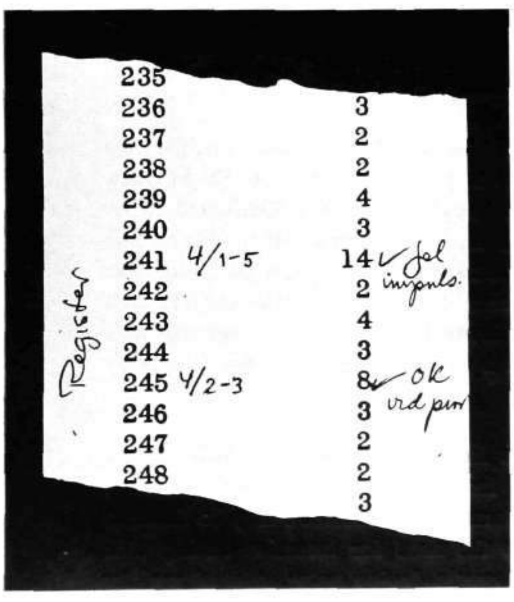


Fig. 9 X 2113
Analysis of centralograph record by punch card machine

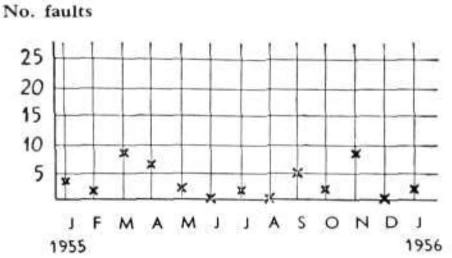


Fig. 10 X 2114

Fault distribution statistics

Burnt or dirty contacts per month

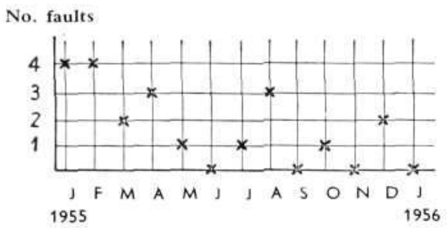


Fig. 11 X 2114

Fault distribution statistics

Functional faults in crossbar switches per month

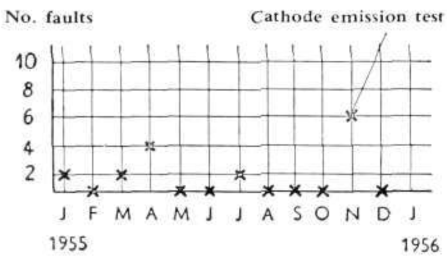


Fig. 12 X 2114

Fault distribution statistics

Electron tube replacements in audio frequency equipments per month

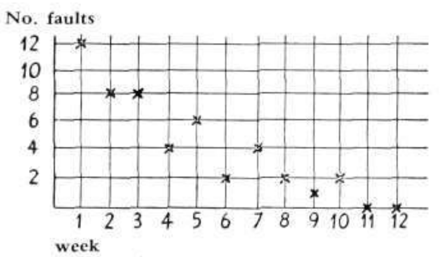


Fig. 13 X 2114

Fault distribution statistics

Wiring and installation faults (during run-in period) per week

The centralograph may be assumed to record all failures known to the marker. Even if it takes very much longer to record a faulty connection than to switch the connection through the exchange, the probability of two successive faults, with a fault liability of 1 : 1,000, is remarkably small. As, at the same time, the number of connections through the exchange is known from the occupation meters, it is a simple matter to establish the fault liability on the basis of the number of recorded faults.

Another possibility offered by centralograph recording is the statistical tracing of the causes of faults. An advanced fault in an exchange is often easily located, since it causes a high degree of traffic interference and thus provides the maintenance staff with the required information. More difficult, but essential, to trace if a high quality of service is to be maintained, are the sporadic and rarely occurring faults. The data obtained from the centralograph must therefore be analysed and the faults allocated to the various units engaged on the faulty connections. This work can be done by manual methods, but where punch card machines are available the accuracy and efficiency of analyses is greatly improved and the maintenance staff benefit by the greater speed with which the data are supplied to them. The procedure in practice is that the data from the centralograph chart are tabulated on punch cards, after which the punch card machine allocates the faults encountered to the various registers, links, repeaters etc. that were engaged on the faulty connection (fig. 9). Since the switching elements are called upon in rotation, the faulty connections will be evenly distributed among the non-faulty units, whereas the concentration of faulty connections to individual units points to the latter as the source of error.

The tests can thereafter be concentrated to these units and the source of error eliminated. Even faults of very rare occurrence can be efficiently tracked down in this way.

Retrospective Statistical Analysis

The second method of statistical analysis, retrospective statistics, has been not infrequently misused by telephone administrations in the sense that the compiling of figures has become an end in itself. One result has been that maintenance staff often become sceptical to the whole idea of statistics. An absolute requirement, therefore, is that the aim of the statistical operations is decided before the collection of figures is started upon.

Retrospective statistics may be subdivided into

fault distribution statistics
service statistics
operation statistics

The aim of the *fault distribution statistic* is to determine changes of behaviour in equipments. This statistic is indispensable especially in the case of equipments in which life factors are beginning to affect the quality of service. Examples of various kinds of fault distribution statistics for automatic equipment are shown in figs. 10—13.

The fault distribution statistic should also comprise the retrospective control of the function of different units, consisting of booking of located faults against the units concerned, e.g. repeaters, registers, link relay sets, etc. As soon as the conditions have become stable, an analysis should be made of the faults encountered per item of equipment and these values can then be taken as the "normal" rates for subsequent statistical work. Assume, for example, that there are 100 registers in an exchange and that they are found to be the cause of 50 of the 400 faults located in the exchange during one year. This means that every register is responsible for 0.5 faults per annum, or 0.04 faults per month. The *normal fault rate* for a register is then 0.04, and the effect of every maintenance effort can be assessed against this figure. An alteration in the design of registers, for example, or readjustments as a result of thorough visual inspection, should show up in the fault distribution statistic. If there is no improvement, it means that the action taken was either wrong or unnecessary—a conclusion which can seldom be reached if the effect of an action is judged on a chance basis and subjectively. The example is illustrated graphically in fig. 14.

By grouping together the normal fault rates of different types of unit from several exchanges, it is possible to keep a watch on the fault distribution in whole groups of exchanges or, if required, whole administrative areas. It is, of course, a general rule that the larger the material, the more reliable will be the statistical result. If this statistic is desired in a simpler form for analysis at a higher administrative level, the faults in crossbar systems, for example, may be limited to the vertical unit and relay alone.

These two components form the backbone of the exchanges, and the fault liability may generally be said to be directly related to the quantity of these components. To assess the deterioration or improvement in the functioning of exchanges, the determination of the normal fault rates for these components will therefore suffice.

Example 2

A 20,000-line local exchange ARF has 22,710 vertical units and 75,388 relays. Assume that there are 300 faults per annum and that studies have shown that the vertical unit with its multiple field and access leads carries 2 $^1/_2$ times as many faults as the relay and its leads. As factor in the calculation we may now employ the expression *trouble unit*, comprising 100 relays or 40 verticals. This particular exchange, therefore, has 1,322 trouble units. This means that the exchange is burdened with a normal fault rate per trouble unit and year of $\frac{300}{1{,}322} = 0.226$, or of 0.019 per month. As will be understood, this method of calculation can be generally applied to large and small exchanges or areas employing the same switching system. If careful recalculations are made, it can also be applied to the supervision of areas in which different kinds of equipment and switching systems occur.

The *service statistic* is aimed at illustrating how the administration handles its subscribers. The primary material for this assessment is the *service complaint*. Even if the patience of subscribers may vary greatly from one individual to another, valuable comparative conclusions may nevertheless be drawn from the time-distribution and area-distribution of service complaints. The time that elapses from the complaint being received by the administration until the fault has been located and remedied is another valuable gauge in the service statistic. The statistics should preferably be made up on an hour-basis, but in such case, of course, only the time during which the maintenance staff are on duty can be taken into account.

Other examples of service statistics are

check of answering times at trunk positions (snap checks),

check of answering times at enquiries and complaints offices,

supervision of repeated complaints from same subscriber, supervision of the number of complaints in which fault is not located.

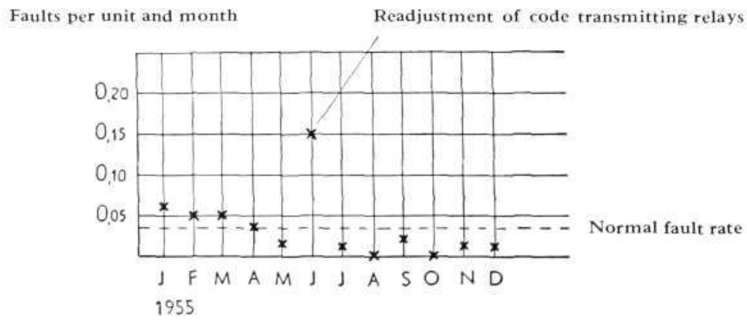


Fig. 14
Fault distribution
Registers

X 2115

The *operation statistic* is a cost and performance statistic. Its purpose is to maintain a check on the distribution of maintenance costs (wages represent the major part of the maintenance effort) and the performance of the maintenance staff. It assists in the planning and follow-up of staffing requirements and training programs. It should be preceded by thorough and careful studies of the maintenance effort and level of performance; an important condition is that the study should not be made until the state of the automatic network has become stabilized.

Prolonged observation of the work at representative exchanges with normally qualified staff will enable the normal times for different items of maintenance to be fixed. Here again, the statistical work can be greatly simplified if evaluations are based solely on the main components of the equipments.

Example 3

We assume that an ARF 10 exchange of 20,000 lines has 22,710 vertical units and 75,388 relays. A prolonged study of the work of the maintenance staff and of the fault records shows that the work required on the different racks is in direct proportion to the number of relays and verticals mounted in them. It has also been found from an analysis of the work on racks incorporating solely relays, or solely crossbar switches, that work on relays and verticals respectively is in the ratio 2 : 5. Assume, further, that the total effective effort at the exchange during one year is made up as follows:

	Hours work
Correction of faults and investigations	2,643
Maintenance control and direction of work	2,400
Non-specified work	400

The two latter items are bound up with the form of maintenance organization and the nature of the exchange equipment. They are thus not affected by the quantity of equipment but, in calculations of staff requirements, must be determined from case to case. The time spent on corrective measures, on the other hand, states that the effort needed for maintenance of a crossbar vertical is 0.05 hours per annum and of a relay 0.02 hours per annum.

To render the calculations more manageable, it is best—in the present example—to combine 50 relays, and likewise 20 crossbar verticals, into a *labour unit*, which will thus correspond to the hours of work per annum. A basis for calculating the maintenance staff requirements can be obtained by adding the work units for an exchange or group of exchanges. The method is of general applicability and may be used, for example, in areas with small exchanges in which both internal and external plants are maintained by the same personnel. In this case the work unit for outside work must, of course, be determined in addition.

The successive effect of improvements in working methods, routines and tools can be followed by comparing the actual expenditure of time with the basic values. Temporary local deteriorations in working efficiency can be likewise traced and the causes eliminated. An indication will be obtained of whether a deficiency exists in the training and instruction of personnel. Not the least important consideration is the control of costs that the method makes possible.

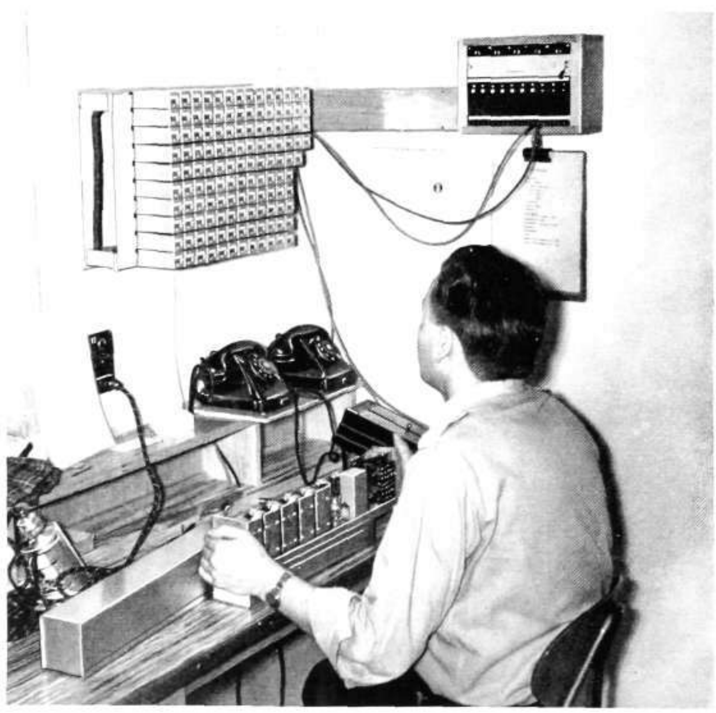
Statistical analyses of quality of service represent a profitable and effective aid to telephone administrations. Space does not allow an exhaustive description of all the possibilities and methods available, but the aim has been to provide a general orientation in regard to the ends and means of qualitative service statistics.

Instantaneous Indications

As stated earlier, it is essential that instantaneous indications of plant faults should also be obtainable. The development by L M Ericsson of a wider range of fault indicating equipment is still going on, but the majority of failures are already covered by the existing devices. Some of them, which serve the purposes of qualitative service control and fault indication alike, have been referred to above. The centralograph in the trunk exchanges is constantly hunting for failures and indicates them with great sureness. The traffic route tester can, as an alternative, be switched over to what is known in maintenance terminology as "fishing", which means that, in the course of constant testing, it hauls in and locks up any existent failures. The service observation desks in the AGF systems permit rapid action when failures occur. Exchange alarm systems point instantaneously to the more serious and disturbing causes of failure. Fault meters and congestion meters provide a series of data on the handling of traffic by different items of equipment. Particularly in the case of these meters, however, it is essential that the indications should be up-to-the-moment. The normal routine, unfortunately, is that the meters are read, for instance, once a day whereas the records are not scrutinized by the responsible person until the day following. This long interval between indication and action destroys the effect of the instantaneous indication and results in a serious lowering of the quality of service. Fault and congestion meters should be located in a control room outside the switch-room and be supplemented by visual or audible signals. The best procedure is to place them in front of the repairman's working position and make him responsible for their supervision (fig. 15).

Maintenance of Outside Plant

It is not the purpose of this article to deal in detail with the methods and aids for maintenance of the circuits and apparatus of the outside plant. But in view of the large proportion of traffic failures that are caused by the outside plant, an analysis of maintenance control problems should not neglect the line side, where considerable improvements in service are possible at the cost of little effort. Technical aids for supervising the quality of line operation do not exist to the same extent as for the supervision of exchanges. The electrical characteristics of the lines, however, can be kept under control by gas pressure protection of cable sections and by rapid automatic or manual testing of subscribers' lines. Continuous testing of subscribers' lines enables the administration not only to discover and locate a cause of failure before



X 6961

Fig. 15
Supervision of fault indication

the subscriber becomes aware of it, but also brings about a considerably more uniform and more tranquil distribution of work and planning in the maintenance of external plant. The catastrophic peaks in the spring thaw and rainy periods, with their resulting heavy load on the entire maintenance organization, can thereby be wholly or partly eliminated.

More difficult to control is the last link in the telephone network, the telephone set itself, which is an important source of trouble. Probably the only available means of achieving a reduction in faults in telephone instruments is by periodic overhaul and compulsory replacement of regularly troublesome components. Here again, statistical analysis is an extremely valuable aid in the planning of maintenance activities.

The Role of Unlocated Faults

A complaint from a subscriber involves an expense for the administration irrespective of whether a fault is located or not. And even if no fault is located, it is probable that the complaint was in fact occasioned by some service failure. The unlocated fault may therefore give rise to repeated complaints until it has been tracked down and remedied. It can also be proved that the unlocated fault is more costly to the administration than the located and repaired fault. In certain administrations the proportion of unlocated faults is very high, with substantial costs as a result.

Provided that the number of unlocated faults is kept within reasonable limits (20—25 per cent), their distribution among different parts of the network may be assumed to be largely similar to that of located faults. When above this level, the reason is usually the inferior quality of the external plant or extremely high congestion in the switching equipment.

It is obvious that an efficient maintenance control of all the different stages in a telephone network will diminish the number and the effect of unlocated faults. Those which still remain offer a promising material for thorough *fault analysis*. In such analyses the first action should be to *group* the unlocated faults. An examination of their grouping may suggest weaknesses in a certain subscribers' group, a traffic route, a selector stage or a cable section. If fault analysis is performed thoroughly and systematically, it will sooner or later bring positive results.

Conclusion

A modern telephone exchange employs a highly developed technique, and its components are the outcome of many years of purposeful research. To allow these components to work under the most favourable possible circumstances and under conditions of maximum efficiency is not a mere question of paying tribute to the researchers and designers, it is also sound business on the part of telephone administrations. It has been the author's aim to attempt to give a few views on the problems facing the maintenance control force in a modern telephone administration and to associate them with the equipments produced by L M Ericsson.

New 6- and 8-channel Carrier Telephone Systems for Open-Wire Lines

H J B NEVITT & P H ODLAND, TELEFONAKTIEBOLAGET L M ERICSSON, STOCKHOLM

U.D.C. 621.395.44

For expansion of long distance telephony networks, Telefonaktiebolaget L M Ericsson has constructed long haul systems ZAA 6 and ZAA 8 för 6- and 8-channel carrier telephony. The latter system is already in use to a large extent, among other countries in Latin America, and has made large economic savings possible, with regard to installation and maintenance costs compared with the costs which otherwise would have been incurred for an equivalent service. In the article, a short description of the construction and applications of these carrier frequency equipments is given.

When it becomes necessary to increase the number of telephone circuits on an open-wire line on which only the physical circuits are utilized, carrier systems can be applied instead of stringing new wires. This method has been employed in stages following the development of carrier equipment. When the 3-channel system of the conventional type came into wider use, it soon became necessary to build especially transposed lines for frequencies up to about 30 kc/s in order to make the best possible use of the lines. The next stage was the development of 12-channel systems, which for the same reasons required transposed lines, in this case suitable for operation with frequencies up to about 150 kc/s. The latter type of lines are expensive, and, moreover, difficulty is encountered in their construction and maintenance if every phase of the work is not under the constant supervision of experienced technical staff. Experience with various types of open-wire lines transposed for 3-channel systems indicates that several pairs can usually be found where excessive absorption peaks do not occur for frequencies below 80 kc/s.

With this situation in view, L M Ericsson began some time ago to produce their types ZAA 6 and ZAA 8 long-haul, 6- and 8-channel carrier telephone systems, utilizing the frequency range 20–77 kc/s. These are intended to

Fig. 1 X 2165

a Three 0.2—3.4 kc/s speech channels form one subgroup, 6—18 kc/s.

b Four 0.2—2.7 kc/s speech channels form one subgroup, 6—18 kc/s.

Fig. 2 X 2166

Two sub-groups form one intermediate group, 84—108 kc/s.

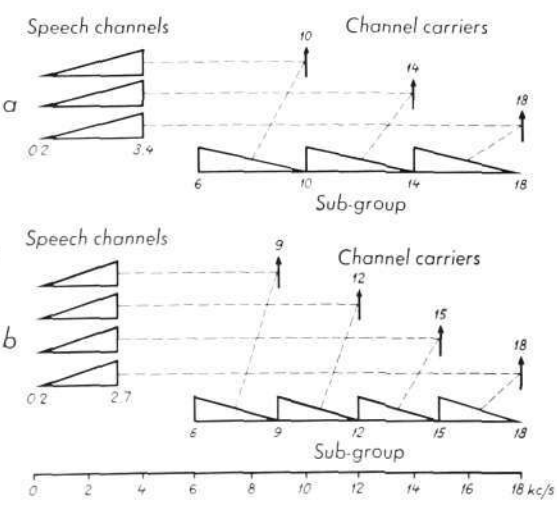


Fig. 1

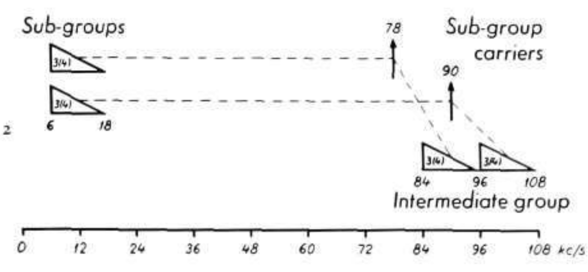


Fig. 2

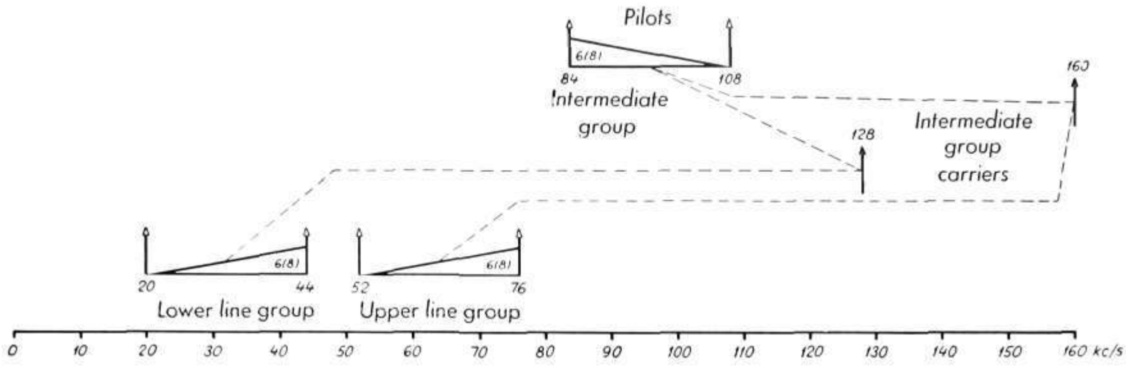


Fig. 3 X 7700

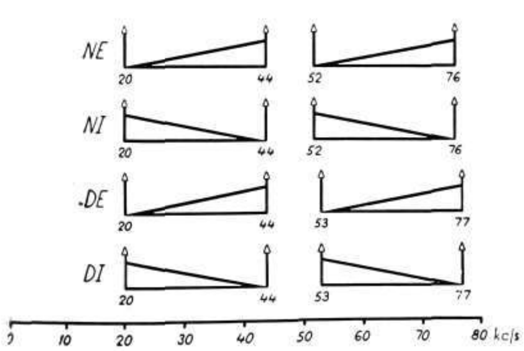
Translation of intermediate group to form line groups. Frequencies shown refer to line group combination NE.

coordinate with, but gradually replace, existing 3-channel carrier telephone facilities on certain open wire routes, while permitting the derivation of at least one additional carrier telephone and a physical circuit below 20 kc/s. They also ensure more reliable service under icing conditions than systems using higher frequencies. The ZAA 6 and ZAA 8 systems require no major line reconstruction and can often retain the original 3-channel carrier repeater spacings by application of compandors and auxiliary line equipment where crosstalk and noise conditions demand. Large economies in both first cost and annual charges are thus made possible by the correct use of this equipment in expansion of the long distance telephone plant.

Electrical Design

In accordance with L M Ericsson unified carrier equipment design practice, the ZAA 6 and ZAA 8 satisfy all major CCIF and Bell System performance requirements. Subgroups consisting of either 3-channels of 4 kc/s separation, for the ZAA 6, or 4-channels of 3 kc/s spacing, for the ZAA 8, are group-modulated to form the required line groups as shown in Figs. 1–4. "Erect" and "inverted", "straight" and "shifted" allocations are available for crosstalk coordination. All required modulation and carrier frequencies are derived through harmonic generation from a crystalcontrolled oscillator and are kept within stability limits such as to ensure that no voice channel can drift more than ± 1 c/s over long periods of time.

The ZAA 6 and ZAA 8 systems are identical except for their individual channel bandwidths of 200–3,400 c/s and 200–2,700 c/s, respectively, and therefore utilize the same repeaters and line equipment. The block schematic of a ZAA 6 and ZAA 8 terminal is outlined in Fig. 5, while that of a repeater appears in Fig. 6. Plug-in compandors are optional as well as a large variety of single and two-frequency signalling arrangements described elsewhere. Equipment required for routine testing and supervision is built into each terminal and repeater.



The intermediate group 84—108 kc/s can be through-connected to other carrier systems operating with the CCIF primary group B, 60—108 kc/s.

If the subgroup which falls within the 84–96 kc/s range of the intermediate group is omitted, the CCIF recommended program carrier channel may be transmitted together with the remaining subgroup falling in the 96–108 kc/s range.

Fig. 4 X 2111

Line group combinations

A highly stable, all electronic automatic level regulator, employing two pilots for independent control of "flat" and "slope" variations, keeps levels

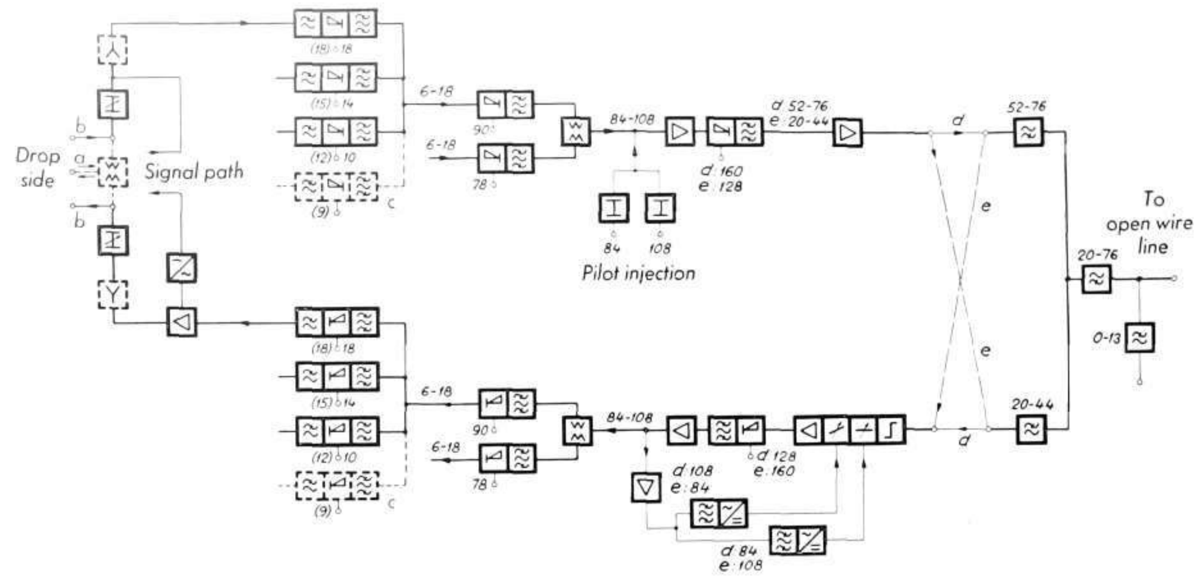


Fig. 5 X 7701 X 9137

Block schematic of a terminal station. (For symbols used, see below.) Frequencies shown are for line group combination NE. All frequencies are given in kc/s. Figures for channel carriers without brackets refer to a 6-channel system; those in brackets refer to an 8-channel system. Dotted lines refer to optional or alternative arrangements.

a Two-wire operation
b Four-wire operation
c Included in the 8-channel system only
d Terminal station transmitting higher line group and receiving lower line group
e Terminal station transmitting lower line group and receiving higher line group

- Amplifier
- Modulator or demodulator
- Hybrid
- Flat level regulator
- Slope level regulator
- Compressor
- Expander
- High-pass filter
- Low-pass filter
- Band-pass filter
- Signal receiver
- Pilot receiver
- Equalizer
- Pad

within close limits. In case of pilot failure, the regulator automatically brings the level to a predetermined safe value, actuating an alarm, until the pilot is reestablished.

Vacuum tubes equivalent to the L M Ericsson long life types 2C51L, 403 B and 6AQ5L with other expendable components, are obtainable both from European and North American sources. The chapter on Technical Data summarizes the main electrical characteristics and indicates the power supply requirements of the ZAA 8 carrier telephone system.

Mechanical Design

Equipment is mounted on both sides of standard 19-inch (514 mm) relay racks with connecting blocks on top and interpanel wiring down the bay center. ZZA 8 terminal and repeater equipment arrangements are illustrated in Fig. 7 and Fig. 8, respectively.

Special aluminium alloy panels 3½ inches (88 mm) high, divided into five compartments, and equipped with female multi-laminar plugs connected to bay wiring at the rear, are normally used for plug-in units such as amplifiers, oscillators, modulators and filters. Conventional fixed or hinged panels are used for large units such as the power supply. All main components are hermetically sealed and suitable for tropical use. These mechanical design

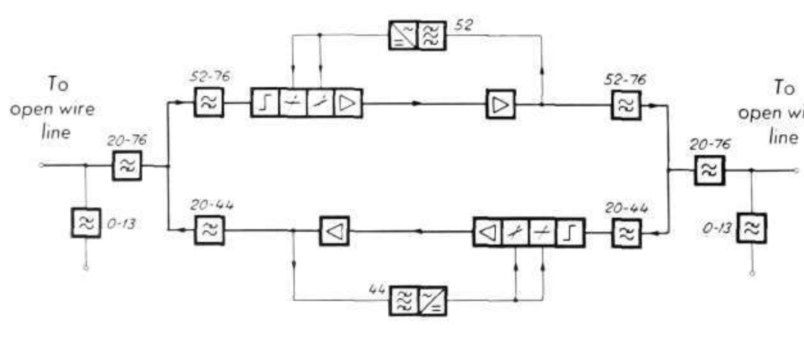


Fig. 6 X 6935

Block schematic of an intermediate repeater. Frequencies are in kc/s and refer to line group combination NE or NI.

features result in maximum accessibility, and ease of maintenance while permitting full utilization of available space as in all L M Ericsson transmission equipment.

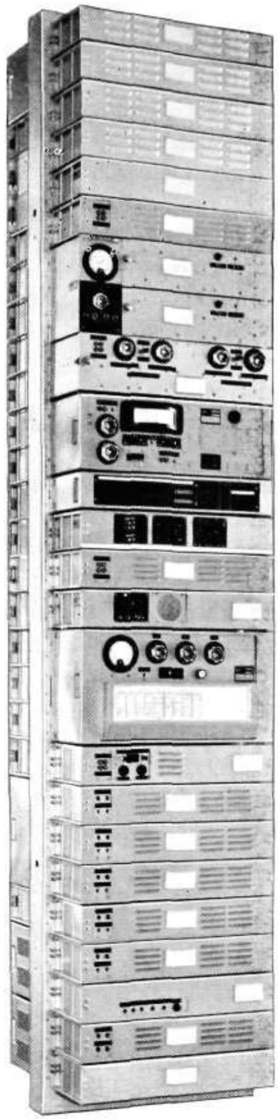


Fig. 7 X 2098

Terminal bay

Auxiliary Equipment

The terminal bays are normally supplied with mounting shelves containing female plugs wired so that any channel may be equipped with a plug-in compressor and expander, each using only one vacuum tube. The combination of a compressor on the sending side at one terminal, with an expander on the receiving side of the opposite terminal, is known as a compandor and makes improvements possible, in voice to noise plus crosstalk ratios, amounting in some cases to as much as 20 db. Such equipment should be applied, however, only on circuits which would otherwise fail to meet overall system noise and crosstalk performance requirements. Compandors of various types have already been described in the literature.

Standard carrier telephone channels are equipped with single frequency (2,400 c/s) signal receivers, but may be supplied for any frequency within the voice band. They are arranged for a large variety of ringing and dialling applications. If signalling codes are required, which cannot be readily handled by means of a single frequency, space is available for mounting two-frequency (2,040 c/s and 2,400 c/s) receivers. All signal receivers contain guard circuits to minimize signal imitation during conversation.

In general, matching arrangements for ZAA 6 and ZAA 8 systems required to reduce attenuation and reflections caused by open wire and cable junctions follow normal 3-channel carrier system practice. Matching transformers or loading coils may be employed as required by the circumstances.

For long entrance cables, however, line filters for separating high and low pass circuits, equipped with suitable matching transformers, may be pole-mounted at the open wire junctions.

For the purpose of dropping the lower frequency range, and by-passing the higher frequencies at intermediate offices where this is desired, by-passing equipment is available. Either the physical channel up to 2.7 kc/s may be dropped and frequencies above 3.6 kc/s by-passed, or by choosing a different filter, the whole range below the frequencies used in the 6- and 8-channel system may be dropped and frequencies above 20 kc/s by-passed. These filters may also be pole-mounted.

Where several carrier repeaters are located at the same point, some form of crosstalk suppression may be necessary. For example, non-carrier pairs on the open wire route may act as feedback paths across a carrier repeater and thereby produce crosstalk in other systems or even cause repeater instability. Various types of crosstalk suppression units have been designed for reducing this coupling in the metallic and longitudinal circuits. Each unit has its specific application depending on the facilities planned. Crosstalk techniques have been widely used for open wire carrier systems employing frequencies above 30 kc/s and are already well known.

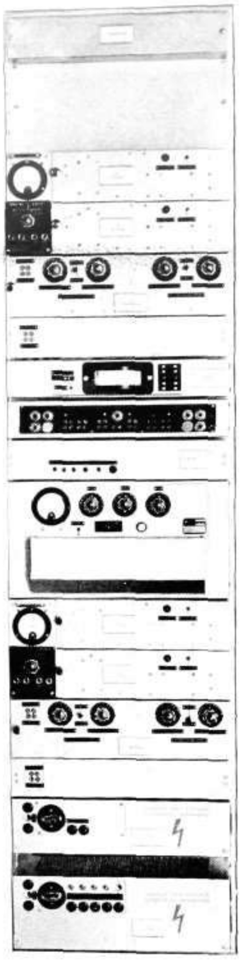
Conclusions

The ZAA 8 carrier telephone system has already found a wide field of application in Latin America and has shown great promise in other parts of the world also. Considerable economies have been made possible, both in overall system first cost and annual expenses, compared with alternative means of providing equivalent service. This has been most clearly demonstrated in the case of 3-channel systems, where carrier facilities have often been tripled by merely replacing 3-channel terminals and repeaters with ZAA 8 equipment and adding single channel carrier below 20 kc/s.

Optimum utilization of spectrum is attained consistent with simplicity of equipment design. Moreover the option of either two 3-channel subgroups with 4 kc/s channel separation, of two 4-channel groups with 3 kc/s spacing, both employing the same repeaters and common line equipment, achieves the flexibility required to meet local transmission standards, and frequently permits large savings by allowing maximum exploitation of existing lines. In exceptional cases where the same route must be shared with 12 or 16-channel carrier telephone systems, such as L M Ericsson types ZAA 12 and ZAA 16, only the lower 3 or 4-channel group of these need be sacrificed for directional coordination.

Practical application of the ZAA 6 and ZAA 8 facilities, which combine the transmission performance and other characteristic features of long haul carrier with frequency assignments normally used for short haul, is gradually removing the artificial distinction between short and long haul, particularly where these terms refer to single sideband, suppressed carrier telephone systems. L M Ericssons short haul equipment of this type is now becoming merely a simplified version of long haul, since greater overall economies can be achieved by volume production of long haul carrier equipment units than by producing special short haul designs. This leads to more flexibility in providing special carrier system arrangements for unusual applications.

It also reduces training and maintenance problems. Above all, however, the ZAA 6 and ZAA 8 carrier systems enable large increases in operating revenue with comparatively small investment for new plant.



X 2097

Fig. 8
Intermediate repeater

Synopsis

The L M Ericsson types ZAA 6 and ZAA 8 open wire line carrier telephone systems provide 6 or 8 high quality telephone channels having 4 or 3 kc/s separation, respectively. While meeting CCIF transmission standards, they utilize the frequency range 20—77 kc/s, but coordinate with normal 3-channel carrier assignments, and permit derivation of one additional carrier with associated physical telephone circuit below 20 kc/s. When need arises to extend facilities beyond 3-channel limits, the new equipment frequently makes great economies possible, since existing line transpositions and repeater spacings can usually be retained.

Technical Data

Channel Performance

Bandwidth, 6-channel system	200—3,400 c/s
8-channel system	200—2,700 c/s
Input level at four-wire test point	—14 dbr
Output level at four-wire test point	+ 9 dbr max.
Adjustable range of input and output level	15 × 1 db
Hybrid loss in two-wire operation	4 db
Voice frequency equipment impedance	600 ohms nominal

Other performance data, e.g. level- and frequency-stability, crosstalk, noise, non-linear distortion, carrier leaks etc., meet the recommendations of the CCIF for systems of this kind.

High Frequency Performance

Nominal channel output level to HF-line	+ 17 dbr
Pilot level	— 20 dbm0
Channel input level from HF-line,	
at 77 kc/s	— 48 dbr min.
at 44 kc/s	— 28 dbr min.
Intermediate group sending level	— 47 dbr
Intermediate group receiving level	— 10 dbr
Maximum terminal and repeater gain at 77 kc/s ..	65 db
Flat level regulation range	35 db
Slope level regulation range	20 db
Level stability at regulator output	± 0.5 db
Impedance to open wire line	530 to 620 ohms
Frequency range available on physical line	0—13 kc/s

Power Supply

Mains voltage	110, 127, 150, 220, or 240 volts a.c.
Frequency	45—65 c/s
Power consumption per bay:	
Terminal bay	330 watts
Repeater bay	150 watts

L M Ericsson's Traingraph

I BOBERG, TELEFONAKTIEBOLAGET LM ERICSSON, STOCKHOLM

U.D.C. 654.939:656.2.021

L M Ericsson's C.T.C. system was described in an article in Ericsson Review No. 4, 1954. One of the items of indicating equipment referred to in a C.T.C. office was the traingraph. The present article deals with L M Ericsson's traingraph, which admittedly was designed primarily for use with C.T.C. but can also be employed for the recording of train movements in other connections.

Introductory Remarks

The recording of train arrival and departure times at the various stations is considered a necessity in most forms of railway operation. The usual method of recording is to make a written note of "Train Arrived" and "Train Left" in the station's trainbook and, where a train despatcher's office exists, of delays, laying on and cancellation of trains etc. on graphic time tables. These records form a general part of the safety program and are an aid to train despatchers. They also enable conclusions to be drawn regarding the regularity of train movements.

When a railroad is equipped with centralized traffic control–which implies that all orders to trains are given by signals which, like the rest of the signalling system, are remote controlled and indicated in a C.T.C. office—the need still exists for recording of train movements. In fact, the need may even be said to be greater, since the C.T.C. operator requires not only a visual picture of the present positions of trains but must also have a knowledge of train movements during the hours immediately preceding—not to mention movements that are planned for the hours that follow. This visual picture of present train positions is obtained on the C.T.C. indication panel. Recording of train movements could, of course, be done by hand, but this would obviously be extremely impractical. Nor would manual recording give

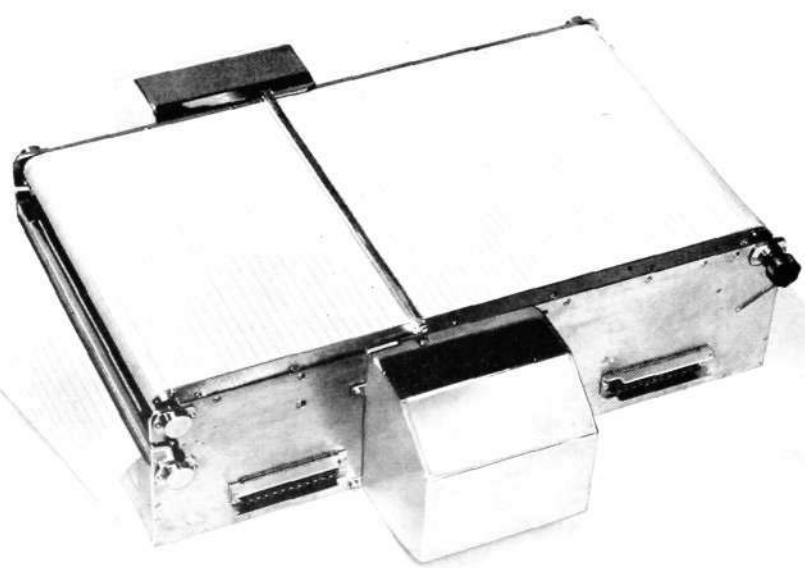


Fig. 1 X 6966

L M Ericsson's traingraph with guide and driving rolls at ends, colour ribbons in magazines under covers on the sides, and a rule running between the covers.

The chart, which runs from right to left, is 352 mm wide

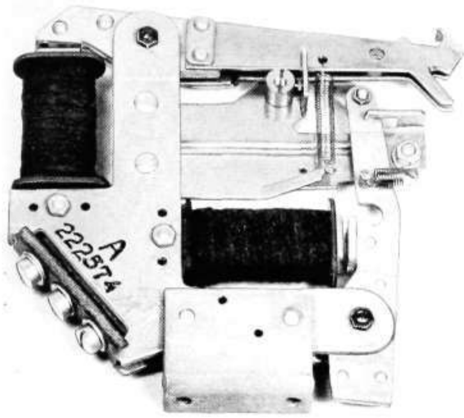


Fig. 2 X 2134

Stamping unit with two hammers (top right) and two control coils

the clear picture that is needed in the C.T.C. office. Fortunately, the data normally received in the C.T.C. office can simultaneously be utilized for automatic recording of train movements in a simple way by means of a traingraph. An apparatus of this kind, designed by L M Ericsson, has a number of new features that should prove of great value under operating conditions.

It should be emphasized that the use of a traingraph is not limited to the recording of train movements in conjunction with C.T.C. It can be used for recording the passage of trains at single or a number of consecutive stations, provided that line wires exist between the traingraph and the respective stations. Nor, of course, is it necessary that the impulses to the traingraph should come from track circuits. Any form of device that can give a remote indication of the passage of trains can be used equally well.

Description of Traingraph

The dimensions of L M Ericsson's traingraph are: length 660 mm, width 640 mm and height 182 mm (fig. 1). The width of the chart is 352 mm.

The traingraph consists of an aluminium frame in which are mounted rolls, magazines and feed mechanism for the chart, electromagnetic stamps, and arrangements for feeding the colour ribbons and changing from one colour to another. An impulse generator and one or more relay sets are required for operation of the traingraph.

Chart Feed

The chart is carried across the traingraph from a magazine on the right-hand side via a number of guide and driving rolls. The upper rolls are equipped with teeth which coincide with the perforations along the edge of the chart. The right-hand roll is driven from an impulse motor which, in normal coupling, gives the roll a peripheral speed of exactly 1 mm per min. The left-hand roll rotates freely. The chart thereafter runs between two rolls, of which one rotates freely and the other is driven from an impulse motor which normally gives the roll a peripheral speed of 3 mm per min. The chart is thereby held under tension across the recording surface of the traingraph with a force of about 200 p. If the chart should curl up, the slack is quickly taken up by the rapidly rotating left-hand rolls. The paper may tend to bend up when an adjustment is made in the timing of the chart by means of the knob on the right-hand roll, or if the normal tension of the chart is disturbed—by its being temporarily pressed against the recording surface, as in the writing of notes. Two springs, which press the paper against the roll at the right-hand end of the traingraph, thereby prevent it from sliding over the guide pin on the roll.

The chart magazine is secured in such a way that the perforations are kept in the proper position relative to the guide tooth of the feed roll, even if the width of the paper should extend by up to 3 mm owing to an increase in humidity.

Station Designations etc.

Immediately under the chart are two white enamelled cover plates–one to the left and one to the right of a *rule* which serves as countercheck for the hammers. The cover plates are marked with the designations of the stations in the form of black lines and letters. The station designations can be read through the transparent chart. The rule, which is made to fold up, is placed so that the visible stamped portion of paper on the left of the rule represents the four preceding hours and the unstamped paper on its right the six succeeding hours.

To facilitate the reading of the timing of the chart, a red arrow is marked on the cover plate 60 mm to the left of the rule at the perforated edge of the chart. The chart should thus be adjusted so that the red arrow is exactly opposite a point on the paper which–at normal paper speeds–is precisely 1 hour in advance of the stamping time.

Stamping

Stamping is done with electromagnetic stamps of the type that has been used in L M Ericsson's centralographs for many years (fig. 2). Every stamping unit comprises two hammers, each with its control coil. The traingraph can be equipped with a maximum of 56 stamping units, and thus 112 hammers.

The stamping units are placed on rails across the traingraph under the cover plates and opposite the rule (fig. 3). Thus stamping is done on the underside of the chart but is readily visible on its upper side.

Feed of Colour Ribbons and Change of Colour

The colour ribbon in the traingraph is fed automatically forwards and backwards between two magazines placed on the sides of the traingraph. The magazines are continuously driven, each by its impulse motor, in a direction such that both magazines tend to wind up the ribbon. The transmission between the motor and each magazine includes a friction clutch. One or the other of these friction clutches is replaced by a fixed coupling and the change-over takes place when a magazine has become full. The magazine that is coupled to the motor at that time via the friction clutch slips and so causes the ribbon to be kept under proper tension.

The ribbon magazines and their reeling arrangements (fig. 4) are placed on the ends of a spindle running straight through the traingraph. The energization of a colour-change magnet causes the spindle to rotate through a few degrees; the spindle is restored to normal by a helical spring. The rotation of the spindle causes the ribbon to be moved sideways across the hammers of the stamping units. If a two-colour ribbon is used, the same hammer can be employed for stamping with the two colours alternately.

The ribbon does not run parallel with the row of hammers, but slightly oblique to it. By this means the entire width of the ribbon is utilized.

Care and Maintenance

Normal care and maintenance of the traingraph comprises changing of charts and ribbons and certain lubrication.

One reel contains about 47 metres of paper which–at a normal paper speed of 1 mm per min.—suffices for one month of continuous operation. Change of paper is done by folding up the rule, turning the spring arms on the right-hand toothed roll downwards towards one another, and removing the right-hand magazine and the centre roll on the left. After a new chart has been inserted in the magazine and the traingraph has been reassembled, the fine adjustment of the timing of the chart is effected by rotating the right-hand toothed roll and possibly the left-hand centre roll as well.

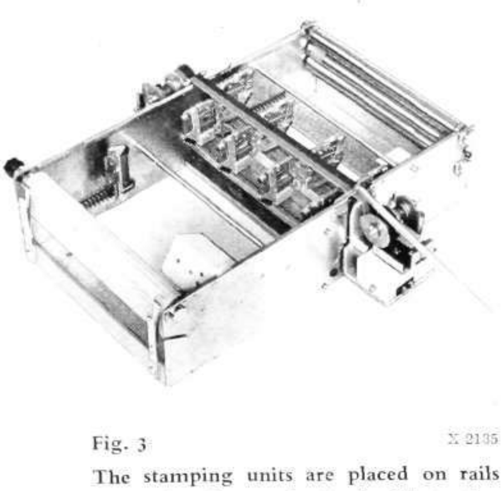


Fig. 3 X 2135

The stamping units are placed on rails across the timegraph. In the illustration only eight stamping units are mounted.

Since the wear on ribbon is proportional to the frequency of stamping, which in turn is dependent on the number of hammers and the headway, it cannot be stated definitely how often ribbons should be changed. Even with the maximum number of hammers and close headways, however, it should not be necessary to change more often than roughly every third month, when operating at normal paper speed. To change a ribbon, the rule is folded

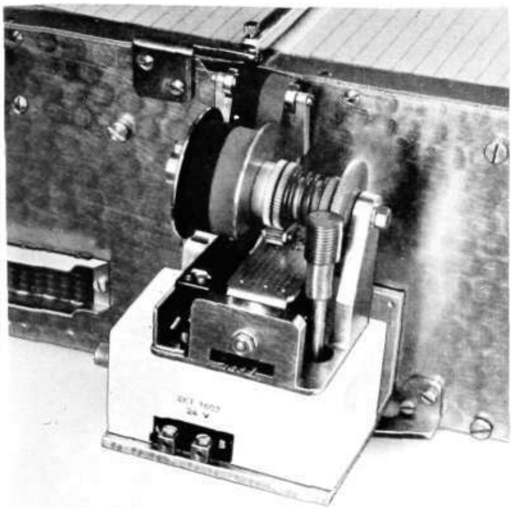


Fig. 4 X 2136

The colour ribbon magazines, which are driven from impulse motors, are mounted on the ends of the spindle. The spindle can be revolved a few degrees, so that either the red or the blue part of the ribbon comes above the hammers.

up and the magazine covers are removed, after which the magazines can be released. Change of ribbon is best done in connection with the insertion of a new chart.

Every third year, and preferably in conjunction with the changing of a ribbon, the worm gears of the colour-change mechanisms should be cleaned and oiled.

Impulse Generator and Relay Set

The impulse motors of the traingraph are driven by external impulses. At normal paper speeds one impulse per second is required, which is supplied from an impulse generator, for example an L M Ericsson master clock.

If there is a master clock installation providing second impulses in the vicinity of the C.T.C. office or other position at which the traingraph is installed, the impulses can be utilized for the traingraph. If a master clock installation only provides minute impulses, it can be arranged that the impulse transmitter of the traingraph is automatically regulated by the master clock installation. If a higher paper speed than normal is desired, the impulse frequency should be increased by means of an intermediate relay set.

To avoid exactly simultaneous stamping by too many hammers, which would place too heavy a load on the relay contacts, the incoming stamping impulses are stored in the relay set and spaced in time so that a maximum of five hammers strike simultaneously. When using two-colour ribbon, the relay set must also ensure that stamping takes place during the correct colour period. At normal paper speeds the colour is changed every fifteenth second.

Accuracy of Stamping etc.

At normal paper speeds–1 mm per minute–the interval between two stampings with the same colour is about 30 secs. (The interval may vary between 15 and 45 secs. owing to the spacing in time described in the preceding paragraph.) This accuracy of time indication should be entirely satisfactory for practical purposes. In fact, when employed with C.T.C., a higher accuracy would be pointless in view of the fact that the impulses from the line may be delayed owing to the line being busy. Such delays should admittedly not be more than a few seconds in normal cases, but may occasionally amount to as much as half a minute. The normal paper speed should be suitable for all kinds of railroad traffic, even with very close headways. Headways up to 10–15 trains per hour and direction will thus be clearly recorded.

If the traingraph is used on suburban underground railways, where the headway may be as close as 40 trains per hour, the paper speed must be trebled or quadrupled. A higher accuracy in time indication will likewise be required, and at the increased speed of recording the accuracy will rise proportionately.

Irrespective of the paper speed, the stamping on the chart will be so clear and so "continuous" that the resulting graphic train movement diagrams need not in any way be supplemented by pencil notes or the like.

The best way of using the two colours of the traingraph is to reserve a given colour for a given track. On a single-track line all stampings between stations will then be blue (or all red). Trains passing stations on the main

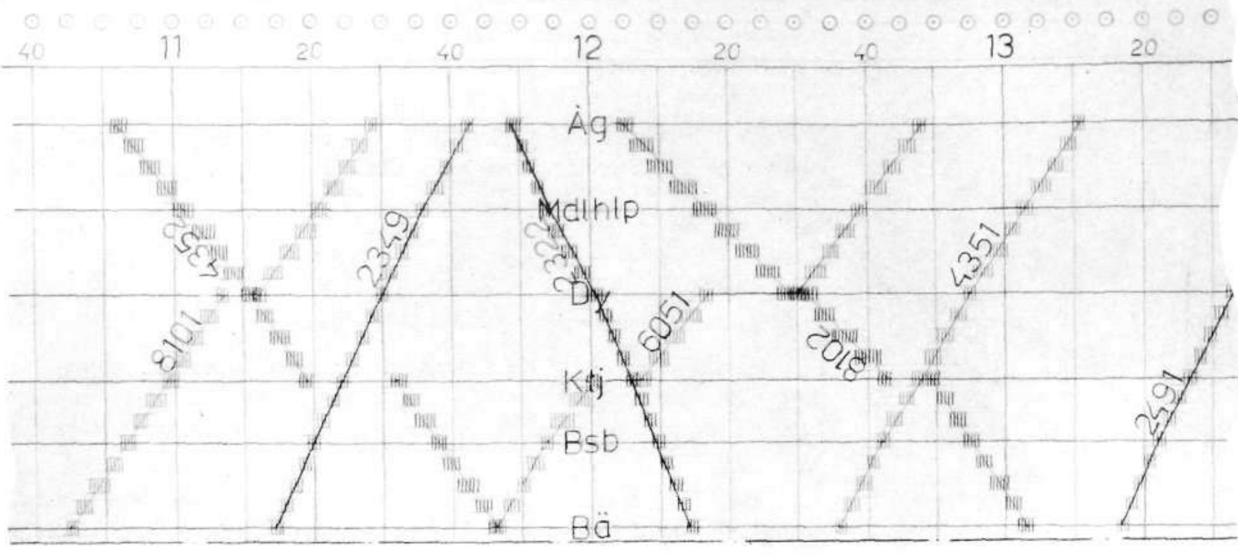


Fig. 5 X 7693

Section of traingraph chart from single track operation.

The graphic time table is pre-printed on the paper

route will be stamped in blue, and on the siding in red, whereas passages over other tracks will not be stamped at all. For single tracks the traingraphs can be coupled to a maximum of 112 passage transmitting devices (fig. 5).

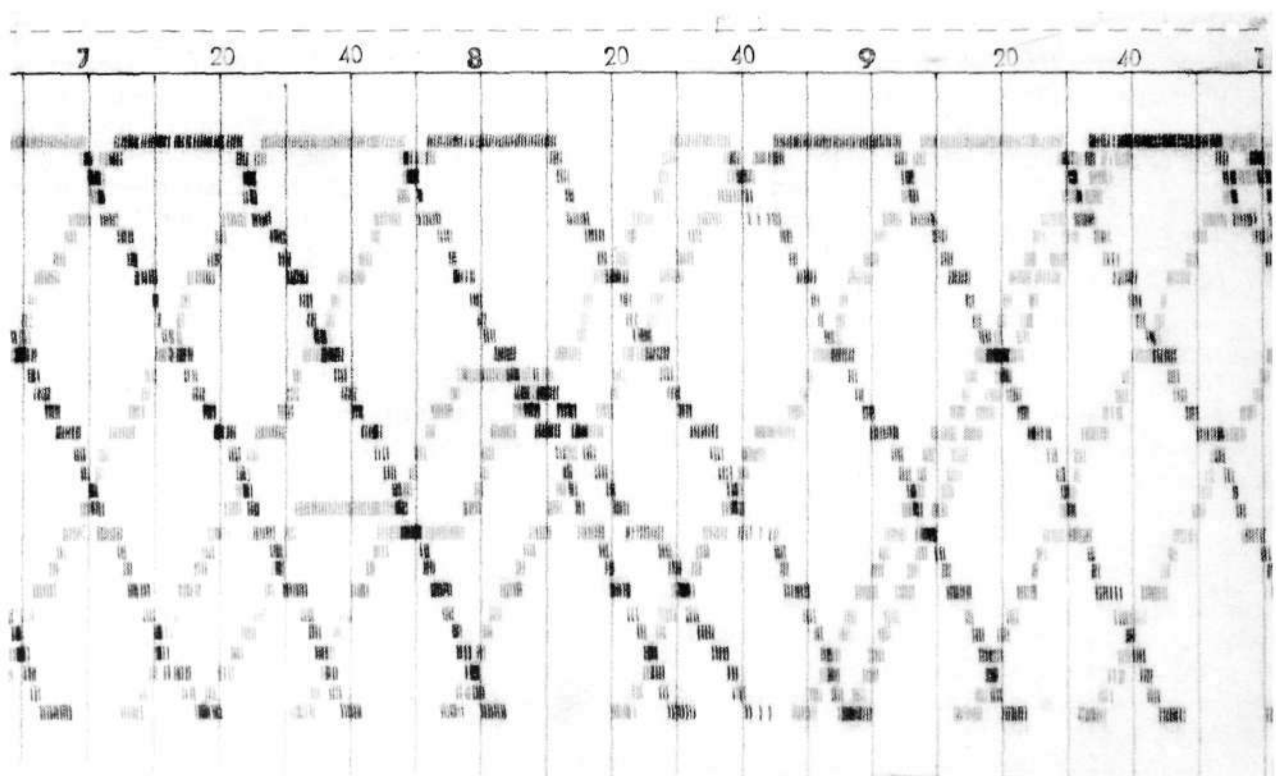
On double-track lines the passage of trains may be marked in blue on one track and in red on the other. Trains passing over stations' sidings are not recorded. On a double-track line the traingraph can be coupled to a maximum of 224 passage transmitting devices (figs. 6 and 7).

Fig. 6 X 7694

Section of traingraph chart from double-track operation.

The chart is not pre-printed. Train passages on one track are stamped in red (the faint marks on the photograph) and on the other track in blue.

If desired, a colour can be used to indicate direction of movement instead of track. Directional relays are employed to ensure that the stamping takes place during the correct colour period.



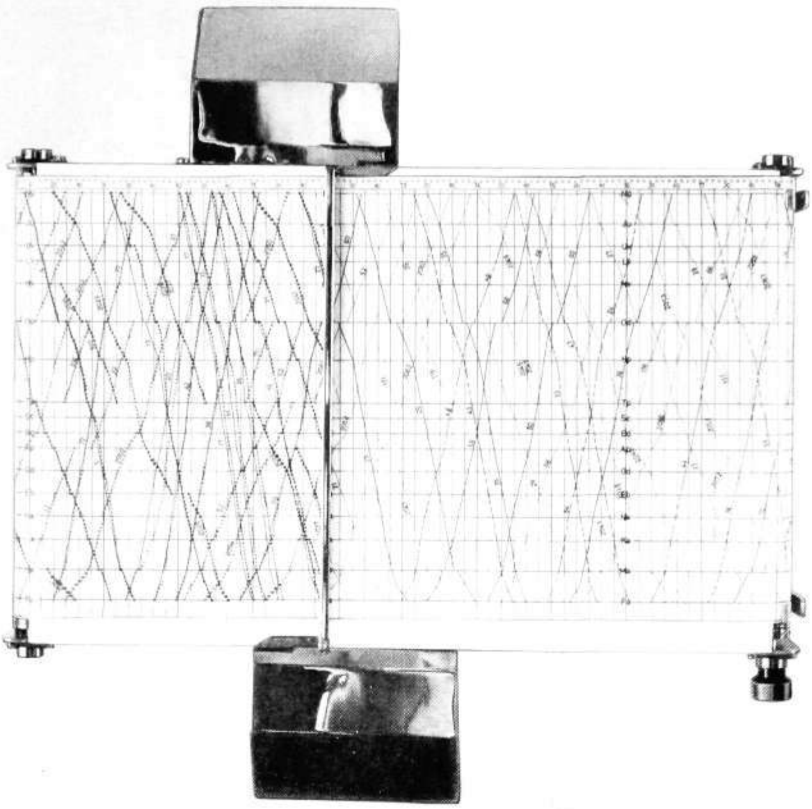
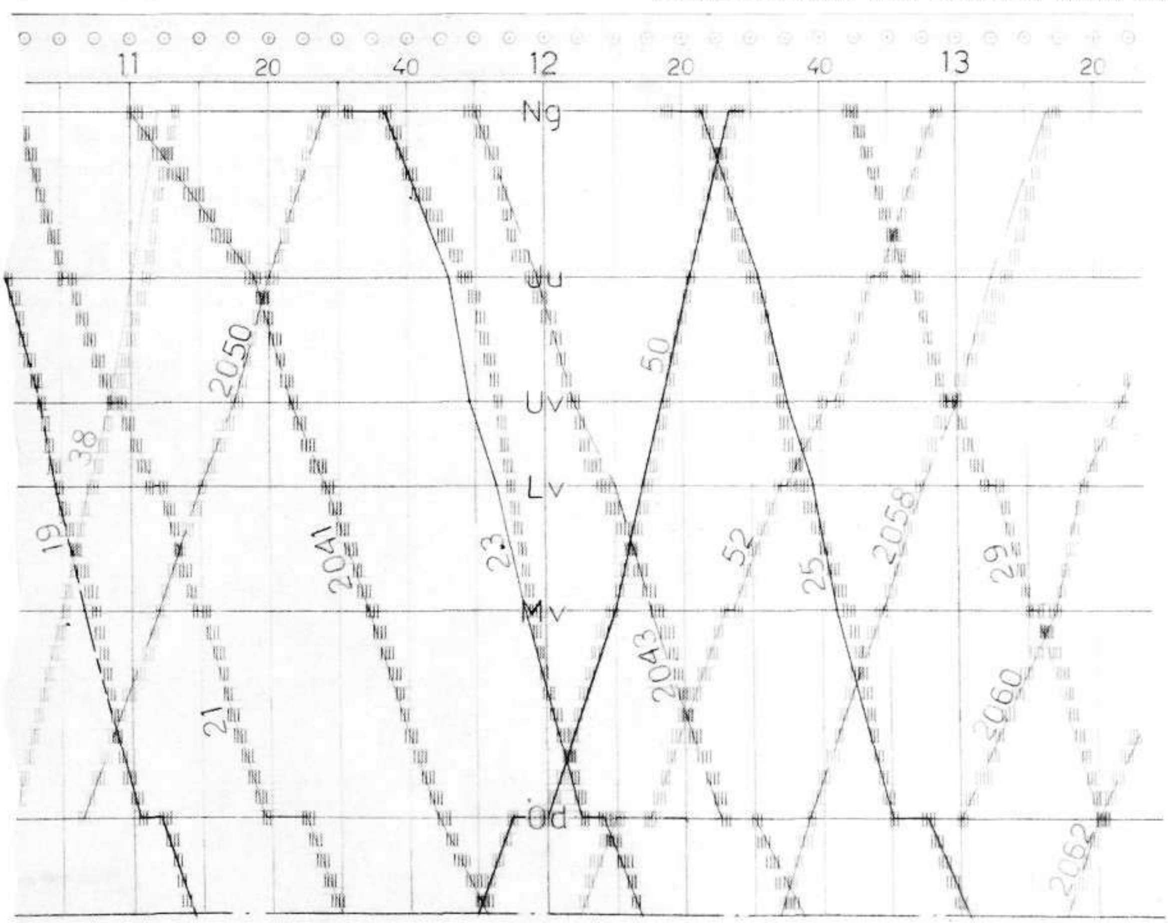


Fig. 7 X 7696, X 7695

(Above). Traingraph in operation on double-track line. (Below). Section of the pre-printed chart.

The blue marks appear rather more clearly than the red.



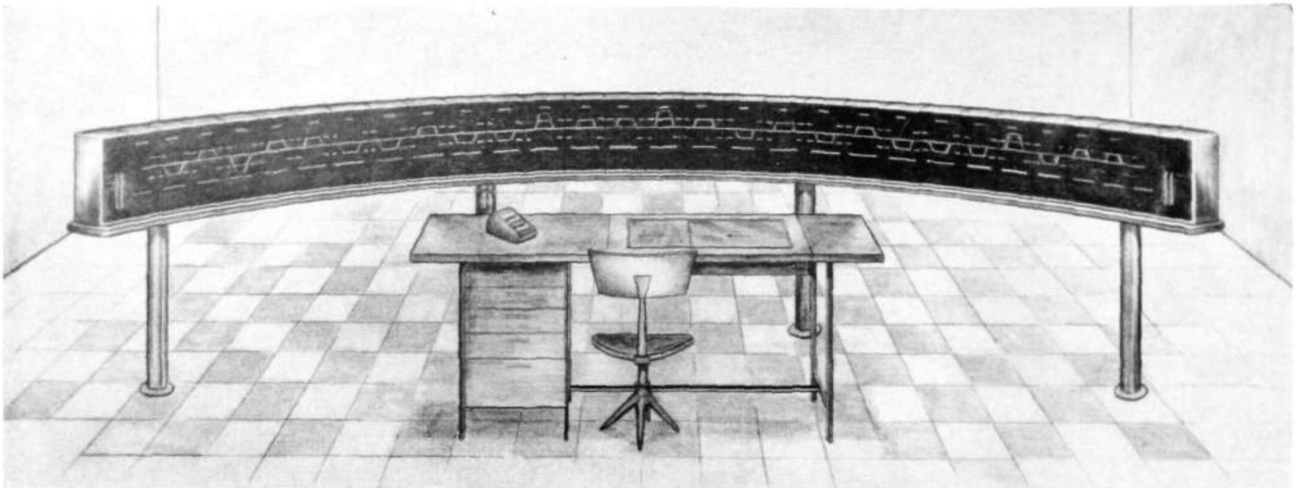


Fig. 8 X 7692

Traingraph in its proper position on the control desk of a C.T.C. office.

The traingraph is on the right-hand side of the control desk, a keyset for control of the C.T.C. system being seen on the left

Printed Charts

As mentioned under the description of the apparatus, the traingraph permits of pencil notes on the chart both immediately before and after stamping. Notes after stamping may consist, for example, of train numbers or reasons for delay. Notes before stamping may refer to the laying on or cancellation of trains, disposition of tracks etc.

If the chart is pre-printed with a graphic diagram of movements in conformity with the time table, the stampings will directly show whether trains are following the time table and the extent of deviations from it. Written notes of train numbers will only be required in the event of abnormal delays. The laying on of extra trains is facilitated, as also notes regarding train cancellations.

The traingraph can be used either with or without printed charts; the advisability of printed charts must be shown by experience in practice.

The main characteristics of L M Ericsson's traingraph, which must be regarded as complete or partial innovations, are listed below.

Large capacity in relation to size of apparatus. Maximum 112 or 224 train passage transmitting devices can be connected.

Stamping is effected in such a manner that a traffic movement diagram is obtained without need of pencil notes or the like.

Notes may be made on the chart both before and after stamping. A picture of the traffic situation is obtained for the hours immediately previous and subsequent to the train movement.

Different colours can be used for different tracks or different directions of movement.

The chart can be pre-printed with movement diagrams in conformity with the time table.

The traingraph can be accommodated on a C.T.C control desk (fig. 8).

Ericsson LM NEWS *from All Quarters of the World*

Maintenance Economy Conference in Stockholm

Representatives of the telephone administrations of Denmark, Finland, Norway and Sweden met in Stockholm May 28 to June 2 on the initiative of L M Ericsson to discuss common technical operating problems.

Since maintenance costs comprise a large part of the telephone administrations' operating budgets, the conference discussed the possibilities of reducing these costs without injury to the public's legitimate demands for service. Particularly dealt with were the operational techniques of automatic exchanges and long-distance equipment. Within this wide field maintenance economy was discussed and light was shed, among other things, on maintenance costs and service requirements, as well as different means of methods improvement to achieve less expensive maintenance. The desirability of uniform terminology in the maintenance field was also expressed at the conference. Other subjects of discussion were qualitative maintenance and statistics, the operating reliability of automatic equipment, training of maintenance personnel and the design of telephone exchange buildings. In connection with the last-mentioned point a trip was arranged to some of the automatic exchanges in the Stockholm area.

The telephone administrations of the partaking countries have at their command a well-developed telecommunications technique. The mutual exchange of operational experiences at the conference was expected to prove of great value in future dealings with the administrations' technical problems.

Above and below are pictures from the maintenance conference in Stockholm with representatives from the nordic countries' telephone administrations.

Representatives of the participating telephone administrations therefore recommended that close collaboration on certain questions of common interest be continued.

L M Ericsson's Telephone Materials Catalogue in Spanish Language

L M Ericsson's catalogue of telephone material, which has been available in Swedish and English editions, has now been issued in Spanish: "Material Telefónico", with catalogue number 684.

The Spanish edition, like the Swedish, is divided into 12 sections, containing altogether 19 separate catalogue parts.

LME Installation Dedicated in Barranquilla

On March 31, exchange equipment for 15,000 lines of L M Ericsson's 500-line system was dedicated in Barranquilla, Colombia. The delivery, which also comprised outside plant and telephone instruments, was divided among three main exchanges: Centro, with 10,000 lines; Estadio, with 3,500, and Sur, with 1,500. Another 15,000 lines with outside plant and telephones have been ordered. The first part of the additional number is expected to be in service by the end of this year.

Above is a picture from the dedication of the Barranquilla installation. Left to right in foreground: Mr. Olaf Gustafson, managing director of Cia Ericsson Ltda; Dr. Rodriguez Carbonell, the city's mayor and Archbishop Gallego Perez of Barranquilla.

L M Ericsson to Deliver Fully Automatic Transit Exchange to Gothenburg

L M Ericsson has received an order for a fully automatic transit exchange in Gothenburg from the Swedish Telecommunications Administration. The exchange is to be built according to the administration's ART 205 system. The exchange will be the largest of its kind with crossbar switches in Sweden. Delivery date is to be April 1, 1959.

With the rapidly proceeding automatization of telephone traffic in Sweden the use of transit exchanges has become of increasing importance. Their task is to connect subscribers on long-distance calls without the assistance of an operator.

The number of transit exchanges planned for the whole country is 50. Of these, 35 are designed for short-haul and 15 for long-haul traffic. To the former, which handle toll traffic, are connected adjacent zone centres which in turn connect with the regional centres. The latter are principally planned for direct interconnection.

The installation ordered for Gothenburg is a regional centre, to which some 800 junctions from Gothenburg's area and local stations and approximately 1,100 incoming trunk lines will be connected in the first stage of construction. When completed, the exchange will have 5,000 to 6,000 trunk lines, incoming as well as outgoing.

New Automatic Exchange in Service in Motala

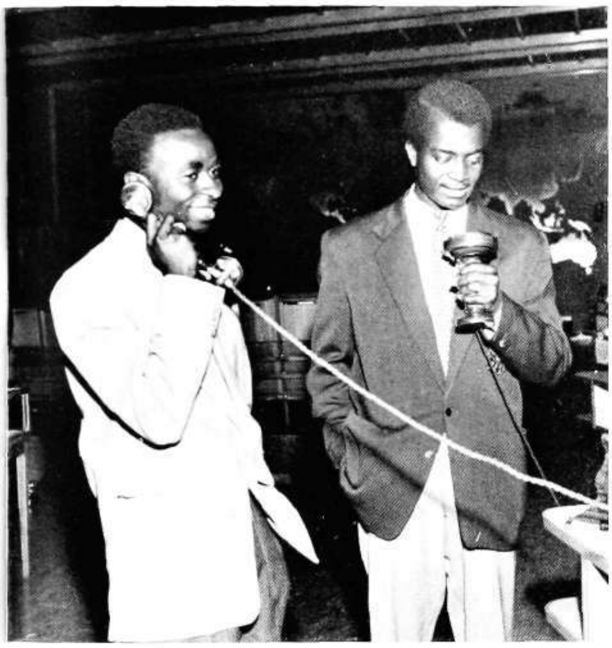
A new automatic central telephone exchange for 6,500 numbers was put into service in Motala on April 15. The exchange, built according to the ART 204 system of the Swedish Telecommunications Administration, was delivered and set up by L M Ericsson. It is provided with equipment for wholly automatic local traffic and is connected with 10 completely automatic terminal exchanges, delivered by the Administration. Subscribers in the Motala area now have completely automatic long-distance connections with Linköping, Norrköping, Söderköping and Vikbolandet.

The exchange is housed in the former post office building and a newly built annex.

At right is a part of the local exchange equipment in Motala. In the foreground an IGV rack is being tested.

At the end of May a trade and good-will delegation from India under the leadership of Mr. H. V. R. Iengar, Permanent Secretary of the Indian Ministry of Trade and Industry, visited L M Ericsson's establishment in Midsommarkransen. In the picture at right, taken in the demonstration room, are (left to right) Mr. D. D. Desai, managing director of the Hindustan Electrical Company, Ltd., Bombay; Mr. S. Moolgaokar, Tata Industries, Bombay, and Mr. Iengar.

L M Ericsson had a royal visitor recently, when the nephew of the king of Ashanti (Gold Coast), Fredu Agyeman Mensah, inspected the main plant. Below he acquaints himself with L M Ericsson's first telephone instrument (at right) in the company of Peter Bawuah, currently working at the company.



Above, Sven T. Åberg, managing director of L M Ericsson, demonstrates a model of the main plant in Midsommarkransen to the Iranian Minister of Posts and Telegraphs, Amir Ghassem Echraghi. At the far right is the new building, now under construction, in miniature.

At the international fair in Utrecht, the Netherlands, in March, Queen Juliana opened a large new exhibition hall in which L M Ericsson's Dutch company, Ericsson Telefoon-Maatschappij N. V., also had a display. The dedication took place to the music of a royal military band, which played in an unusual setting among time recording instruments, centralographs and telephone equipment in the Ericsson booth.

Enlargement of Söderhamn and Karlskrona Plants

L M Ericsson's plant in Söderhamn has increased its floor area by some 50 %, from about 60,000 to 90,000 square feet, with a recently completed addition. It is expected that total production at the plant will be increased by 30 % during 1956 by means of this addition.

Manufacture at the Söderhamn plant includes the 500-line selector, of which production has tripled since the addition was completed.

At the plant in Karlskrona the foundation is being laid for a large addition which will increase floor space by approximately 123,000 square feet.

L M Ericsson Exchange Survives Ecuador Earthquakes

One of L M Ericsson's installation engineers, Lars Hagberg, has spent some time in Guayaquil in connection with delivery of an automatic exchange which was put into service in October last year. In a report of his travels Mr Hagberg gives an account of an earthquake which took place in January. We reprint an extract of the report, which is interesting because it illustrates partly the kind of strains an automatic exchange can be exposed to, and partly how an L M Ericsson exchange survived it.

"Guayaquil was shaken by powerful earth tremors at 6: 35 p.m. Jan. 16, 1956. According to the newspapers the quakes were the worst in duration and intensity to shake the city in the last eight years.

A number of houses were badly damaged, the telephone exchange as well being struck by the quakes. Within the exchange premises there was no real damage to roof and walls except for the cracking of a number of glass blocks on the facade. Electric power was interrupted at the same time and the exchange went over to battery operation, i.e., the reserve motors started up in the bays and the RG generator. The racks, and particularly their top and connecting members, were subjected to considerable strain to judge from the friction sounds that arose in all joints and connection points.

The battery room, on the ground floor, was less damaged by the quakes, but the shock waves were powerful enough to spill so much battery acid out of the jars that we had to add distilled water after the quakes stopped.

A few minutes after the quakes ended the electric power returned and the exchange went back to normal operation. We immediately made a thorough investigation of the exchange and the battery room. We found no damage whatever on the racks, shafts, motors or instruments. In the battery room none of the jars were displaced. We were particularly pleased with this as, at the time the batteries were mounted, we had poured lead frames around all porcelain insulators and then filled the frames with asphalt to make the jars steady. We had done this extra work on the advice of the customer and we now had the opportunity to demonstrate its reliability.

After the quakes definitely had ended the exchange got its baptism of fire. All registers had 30 minutes of intensive traffic and all link circuits were occupied. Even this exceptional traffic load was cleared up without trouble."

Örebro Telephone Exchange Expanded

Since June, 1955, extensive telephone installation work has been going on in Örebro. This has included an increase of the local exchange by 6,000 lines and substitution of the old machine-driven registers by L M Ericsson's modern crossbar switch registers. This replacement has affected 23,000 subscribers. Further, a completely new toll exchange has been built, to which all traffic from the old toll exchange has been transferred. A very large part of the work has affected equipment in use. After new registers have been installed in Örebro, there will be a transition from five to six-digit numbers in the beginning of August. The picture at right shows untwisting and sorting of cables in a repeater bay.

U.D.C. 621.395.722.004.5

ANDERSSON, HANS S: *Qualitative Maintenance of Automatic Telephone Networks.* Ericsson Rev. *33* (1956) No. 2, pp. 34—45.

In this article, further principles in new maintenance practice which were introduced in Ericsson Review No. 4, 1955, are emphasised. The opinion held within telephone administrations that preventive maintenance pays, has in latter years been changed. This article aims at presenting briefly the methods and aids for simplifying test work by elimination of faulty units.

U.D.C. 621.395.44

NEVITT, H J B & ODLAND PH: *New 6- and 8- channel carrier telephone systems for open-wire lines.* Ericsson Rev. *33* (1956) No. 2, pp. 46—51.

For expansion of long distance telephony networks, Telefonaktiebolaget L M Ericsson has constructed long haul systems ZAA 6 and ZAA 8 for 6- and 8- channel carrier telephony. The ZAA 8 system is already used to possible large savings both with regard to installation and maintenance costs. A short description of the equipments is given.

U.D.C. 654.939: 656.2.021

BOBERG, I: *L M Ericsson's Traingraph.* Ericsson Rev. *33* (1956) No. 2, pp. 52—58.

In an article described in Ericsson Review No. 4 (1954) on L M Ericsson's C.T.C. system, one of the items of indicating equipment referred to in a C.T.C. office was the Traingraph. In this new article is described L M Ericssons Traingraph, which was primarily constructed for use with C.T.C., but which can also be employed for the recording of train movements in other connections.

The Ericsson Group

Associated and co-operating enterprises

• EUROPE •

Danmark

L M Ericsson A/S *København F*, Finsens Vej 78, Tel: Fa 6868, tgm: ericsson

Telefon Fabrik Automatic A/S *København K*, Amaliegade 7, tel: C 5188, tgm: automatic

Dansk Signal Industri A/S *København F*, Finsens Vej 78, tel: Fa 6767, tgm: signaler

Deutschland

Ericsson Verkaufsgesellschaft m. b. H. *Düsseldorf 1*, Worringer Strasse 109, tel: 84 461, tgm: erictel

España

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

France

Société des Téléphones Ericsson *Colombes (Seine)*, Boulevard de la Finlande, tel: CHA 35-00, tgm: ericsson

Paris 17e, 147 Rue de Courcelles, tel: Carnot 95-30, tgm: eric

Société Cinéric *Paris 20e*, 111 Rue Villiers de l'Isle Adam, tel: Ménilmontant 87-51, tgm: cinericsson

Great Britain

Swedish Ericsson Company Ltd. *London, W. C. 1*, 329 High Holborn, tel: Holborn 1092, tgm: teleric

Production Control (Ericsson) Ltd. *London, W. C. 1*, 329 High Holborn, tel: Holborn 1092, tgm: productrol holb

Italia

Setemer, Soc. per Az. *Milano*, Via dei Giardini 7, tel: 662241, tgm: setemer

SIELTE, Soc. per Az. — Società Impianti Elettrici e Telefonici Sistema Ericsson *Roma*, C. P. 4024 Appio, tel: 78 02 21, tgm: sielte

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

S.E.T. Soc. per Az. — Società Esercizi Telefonici *Napoli*, Via Roberto Bracco 20, tel: 50 000, tgm: set

Nederland

Ericsson Telefoon-Maatschappij, N.V. *Rijen (N. Br.)*, tel: 01692-555 tgm: erictel

den Haag—Scheveningen, Gevers Deynootplein 30, Kurhaus, tel: 55 55 00, tgm: erictel-haag

Norge

A/S Elektrisk Bureau *Oslo*, P. B. 5055, tel: Centralbord 461820, tgm: elektriken

A/S Industrikontroll *Oslo*, Teatergaten 12, tel: Centralbord 335085, tgm: indtroll

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

A/S Norsk Signalindustri *Oslo*, P.B. Mj 2214, tel: Centralbord 56 53 54

Portugal

Sociedade Ericsson de Portugal, Lda. *Lisboa* 7, Rua Filipe Folque, tel: 57193, tgm: ericsson

Schweiz

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

Suomi

O/Y L M Ericsson A/B *Helsinki*, Fabianinkatu 6, tel: A 8282, tgm: ericssons

Sverige

Telefonaktiebolaget L M Ericsson *Stockholm 32*, tel: 19 00 00, tgm: telefonbolaget

AB Alpha *Sundbyberg*, tel: 28 26 00, tgm: aktiealpha-stockholm

AB Ermex *Solna*, tel: 82 01 00, tgm: elock-stockholm

AB Ermi *Ulvsunda 1*, tel: 26 26 00, tgm: ermibolag-stockholm

AB Rifa *Ulvsunda*, tel: 26 26 10, tgm: elrifa-stockholm

AB Svenska Elektronrör *Stockholm 20*, tel: 44 03 05, tgm: electronics

L M Ericssons Driftkontrollaktiebolag *Solna*, tel: 27 27 25, tgm: powers-stockholm

L M Ericssons Svenska Försäljningsaktiebolag *Stockholm*, Kungsgatan 33, tel: 22 31 00, tgm: ellem

L M Ericssons Signalaktiebolag *Stockholm Sv*, tel: 19 01 20, tgm: signalbolaget

Mexikanska Telefonaktiebolaget Ericsson *Stockholm 32*, tel: 190000, tgm: mexikan

Sieverts Kabelverk *Sundbyberg*, tel: 28 28 60, tgm: sievertsfabrik-stockholm

Svenska Radioaktiebolaget *Stockholm*, Alströmergatan 12, tel: 22 31 40, tgm: svenskradio

• ASIA •

India and Ceylon

Ericsson Telephone Sales Corporation AB *Calcutta*, P. O. B. 2324, reg. mail: *Calcutta 22*, 5 Commissariat Road, P. O. Hastings, tel: Alipore 2951/2952, tgm: inderic

New Delhi, 45, Indra Palace, Connaught Place, tel: 444 90, tgm: inderic

Indonesia

Ericsson Telephone Sales Corporation AB *Bandung*, Djalan Dago 15 javeric

Liban

Telefonaktiebolaget L M Ericsson, Technical Office *Beyrouth*, Rue du Parlement, Immeuble Bisharat, tel: 33555, tgm: ellem

Türkiye

Ericsson Türk Ltd. Şirketi *Ankara*, Âdil Han, Zafer Meydani, Yenişehir, tel: 28379, tgm: ellem

• AMERICA •

Argentina

Cía Sudamericana de Teléfonos L M Ericsson S. A. *Buenos Aires*, Belgrano 894, tel: 332071, tgm: ericsson

Corp. Sudamericana de Teléfonos y Telégrafos S. A. *Buenos Aires*, Belgrano 894, tel: 332071, tgm: cartefe

Cía Argentina de Teléfonos S. A. *Buenos Aires*, Perú 263, tel: 305011, tgm: cecea

Cía Entrerriana de Teléfonos S. A. *Buenos Aires*, Perú 263, tel: 305011, tgm: cecea

Cía Comercial de Administración S. A. *Buenos Aires*, Perú 263, tel: 305011, tgm: cecea

Industrias Eléctricas de Quilmes S. A. *Quilmes FCNGR*, 12 de Octubre 1090, tel: 203-2775, tgm: nidelqui-buenosaires

Brasil

Ericsson do Brasil Comércio e Indústria S. A. *Rio de Janeiro*, C. P. 3601, tel: 43-0990, tgm: ericsson

São Paulo C. P. 5677, tgm: ericsson

Empresa Sul Americana de Telefones S. A. *Rio de Janeiro*, C. P. 4684, tel: 43-0990, tgm: emsulatel

Canada

Ericsson Telephone Sales of Canada Ltd. *Montreal 2, Quebec*, Castle Building, 1410 Stanley Street, tel: AVenue 8-8169, tgm: caneric

Toronto, 18, Ontario, P.O.B. 161, tel: BEImont 1-1306

Cía Ericsson de Chile S. A. *Santiago*, Casilla 10143, tel: 82555, tgm: ericsson-santiago-dechile

Colombia

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

México

Cía Comercial Ericsson S. A. *México D., F.*, Apartado 9958, tel: 35-95-88 tgm: coeric-mexico

Teléfonos de México S. A. *México D. F.*, Paseo de la Reforma 107 tel: 21-91-00, tgm: elmex-mexico

Perú

Cía Ericsson S. A. *Lima*, Apartado 2982, tel: 34941, tgm: ericsson

Soc. Telefónica del Perú, S. A. *Arequipa*, Casilla de Correo 112, tgm: telefonica

Uruguay

Cía Ericsson S. A. *Montevideo*, Casilla de Correo 575, tel: 84433, tgm: ericsson

USA

The Ericsson Corporation *New York 17, N. Y.*, 100 Park Avenue, tel: Murray Hill 5-4030, tgm: erictel

North Electric Co. *Galion, Ohio*, P. O. B. 417, tel: 24201, tgm: northphone-galion-ohio

Venezuela

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

Teléfonos Ericsson C.A. *Caracas*, Apartado 3548, tel: 557467, tgm: tevela

• AUSTRALIA & OCEANIA •

Australia

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

Agencies

• EUROPE •

Belgique

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

Greece

»ETEP», S. A. Commerciale & Technique *Athens*, 1, Stadiou Street, tel: 31 211, tgm: aeter

Ireland

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

Island

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

Yougoslavie

Merkantile Inozemna Zastupelva *Zagreb*, P. O. B. 23, tel: 25—222, tgm: merkantile

Österreich

Inglomark, Industrie-Beliefe-rungs-Gesellschaft Markowitsch & Co. *Wien XV*, Maria Hilferstrasse 133, tel: R 32-0-11, tgm: inglomark

• ASIA •

Burma

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

China

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

Hongkong

The Swedish Trading Co. Ltd. *Hongkong*, Prince's Building, Ice House Street, tel: 20 171, tgm: swedetrade

Iran

Irano Swedish Company AB *Teheran*, Khiaban Sevom Esfand 201-203, tel: 36761, tgm: iranoswede

Iraq

Swedish Oriental Company AB *Baghdad*, Azzoz Building 269 A/195 King Faisal II Street, tel: 848 19, tgm: swede-orient

Israel

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

Japan

Gadelius Co. Ltd. *Tokyo*, Shiba Park No. 7 Minato-ku, tel: (43)-1847, tgm: goticus

Jordan

H. L. Larsson & Sons Ltd. Levant *Amman*, P. O. B. 647, tgm: larsonhus

Liban

Swedish Levant Trading *Beyrouth*, P. O. B. 931, tel: 31624, tgm: skefko

Malaya

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

North Borneo

Thoresen & Co. (Borneo) Ltd. *Sandakan*, P. O. B. 246, tel: 394, tgm: thoresen

Pakistan

Vulcan Trading Co. (Pakistan) Ltd. *Karachi City*, P. O. B. 4776, tel: 32506, tgm: vulcan

Philippines

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

Saudi Arabia

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

Syrie

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

Thailand

The Vichien Radio & Television Co., Ltd. *Bangkok*, 299-301, Prasitsin Bldg, Suriwongse Road, tel: 318 69, tgm: vision

Viet-Nam

Compagnie Internationale de Commerce *Saïgon*, P. O. B. 204, tel: 20253, tgm: intercom

• AFRICA •

British East Africa

Transcandia Ltd. *Nairobi, Kenya*, P. O. B. 5933, tel: 3312, tgm: transcanda

Congo Belge

Société Anonyme Internationale de Télégraphie sans Fil (SAIT) *Bruxelles (Belgique)*, 25, Boulevard de Régent, tel: 12 50 70, tgm: wireless

Egypt

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

Ethiopia

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

Moçambique

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

Nigeria

Scan African Trading Co. *Yaba Lagos* 32, P. O. B. 1, tgm: swedafrica

Rhodesia & Nyasaland

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

Tangier

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

Union of South Africa

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

• AMERICA •

Bolivia

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

Costa Rica

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

Cuba

Mc Avoy y Cía *Habana*, Apartado 2379, tel: U-2527, tgm: macavoy

Curaçao N. W. I.

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

República Dominicana

García & Gautier, C. por A. *Ciudad Trujillo*, Apartado 771, tel: 3645, tgm: gartier

Ecuador

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

Guatemala

Nils Pira *Ciudad de Guatemala*, Apartado 36, tel: 3311, tgm: nilspira-guatemala

Haïti

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

Honduras

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

Jamaica and Brit. Honduras

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

Nicaragua

J. R. E. Tefel & Co. Ltd. *Managua*, Apartado 24, tel: 387-1169, tgm: tefelto

Panama

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

Paraguay

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

El Salvador

Dada-Dada & Co. *San Salvador*, Apartado 274, tel: 4860, tgm: dada

Surinam

C. Kersten & Co. N. V. *Paramaribo*, P. O. B. 216, tel: 2541, tgm: kersten

• AUSTRALIA & OCEANIA •

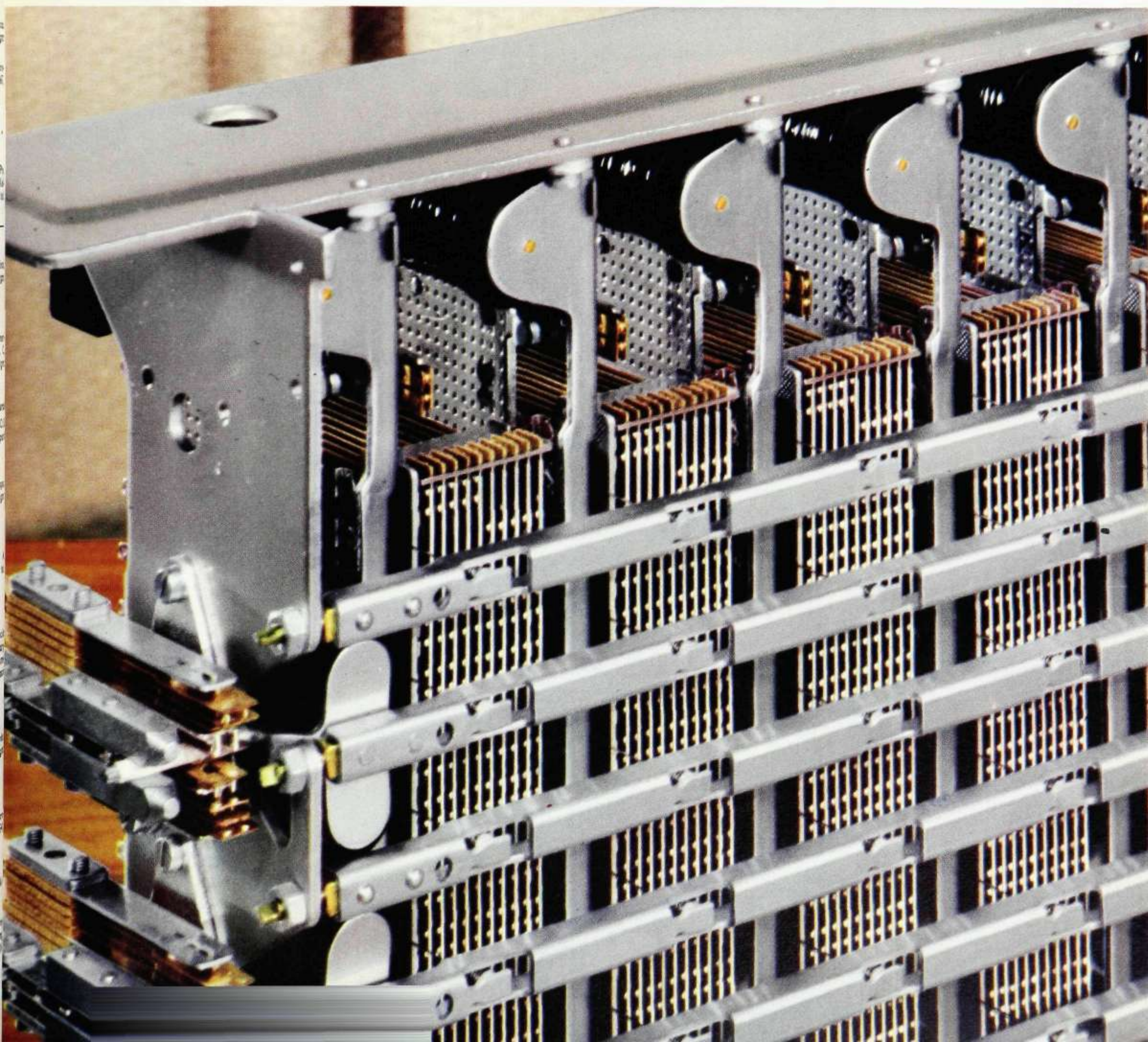
New Zealand

ASEA Electric (N Z) Ltd. *Wellington C 1.*, Huddart Parker Building, Post Office Square, tel: 70-614 tgm: aseaburd

ESSELTE. STHLM 58

ERICSSON Review

3
1956



ERICSSON REVIEW

Vol. XXXIII No. 3 1956

RESPONSIBLE PUBLISHER: HUGO LINDBERG

EDITOR: SIGVARD EKLUND, DHS

EDITOR'S OFFICE: STOCKHOLM 32

SUBSCRIPTIONS: ONE YEAR $ 1.50; ONE COPY $ 0.50

CONTENTS

	page
Application of 8-channel Open-wire Carrier Telephone Systems in Brazil	64
Practical Experience in the Operation of Crossbar Exchanges in the Rotterdam Zone	74
Telesignalling Equipment in a Modern Hospital	81
L M Ericsson News from All Quarters of the World	91

On cover: L M Ericsson's 6-bar crossbar switch.

Application of 8-Channel Open-Wire Carrier Telephone Systems in Brazil

A W EWEN, COMPANHIA TELEFONICA BRASILEIRA, RIO DE JANEIRO, AND H J B NEVITT, TELEFONAKTIEBOLAGET L M ERICSSON, STOCKHOLM

U.D.C. 621.395.44

This article discusses engineering considerations leading to the adoption of L M Ericsson 8-channel carrier telephone system, type ZAA 8, for certain Companhia Telefonica Brasileira open-wire routes in the state of São Paulo, Brazil, and deals with problems arising in such applications. Actual measurements are also given for the ZAA 8 carrier routes demonstrating that all transmission performance objectives have been achieved with minimum investment for new plant.

The authors particularly wish to express their appreciation to the Vice President, Mr. C. R. Freehafer, Assistant General Manager, Mr. T. D. Christian, and Chief Engineer, Dr. J. A. Wiltgen of the Companhia Telefonica Brasileira for permission to publish the information contained in this paper. Successful completion of the project described was due to the combined efforts of many departments of the Companhia Telefonica Brasileira working in close collaboration with the equipment supplier.

In order to implement contracts signed in 1953 by the Companhia Telefonica Brasileira with the São Paulo State Secretary of Communications and Public Works, a large expansion of toll services to all major cities of the state became necessary. This article deals only with the additional carrier facilities provided on open-wire lines between São Paulo and the interior cities.

Major considerations influencing the choice of a carrier telephone system for extension of the above open-wire line carrier plant were as follows:

(1) Short time available before contracted service inauguration dates necessitated minimum installation and construction period.

(2) Capabilities of existing open-wire plant had to be fully exploited without sacrificing CCIF toll transmission standards for noise and crosstalk.

(3) Minor line modifications could be undertaken only where essential and nearly all retransposition would be avoided.

(4) New equipment should be located in existing 3-channel carrier telephone terminal and repeater offices.

(5) Since all toll routes were heavily overloaded traffic interruptions could not be tolerated.

(6) In order to minimize training programs it was desirable for maintenance and test procedures to be similar to the 3-channel system.

(7) Equipment must be arranged to permit unattended operation with centralized maintenance.

(8) No serious limitation should be placed on future expansion of the long distance network.

A detailed study of open-wire line test data and available carrier telephone equipment indicated that the above conditions could best be satisfied by the L M Ericsson 8-channel carrier telephone system, type ZAA 8, using frequencies up to 77 kc/s. Eight of these systems were accordingly chosen for the principal open-wire leads radiating from the city of São Paulo to Sorocaba, Bauru, Marilia, Ourinhos, Araraquara, Ribeirão Preto, Campinas and São João de Bôa Vista, shown on Fig. 1, with line facilities available, and route distances between terminal and repeater stations.

Carrier System Features

The electrical performance and equipment features of the ZAA 8 carrier telephone system have been described in the article "New 6- and 8-channel carrier telephone systems for open wire lines" (Ericsson Review No. 2, 1956). Those characteristics, however, which are of particular interest for the state of São Paulo application are briefly reviewed below.

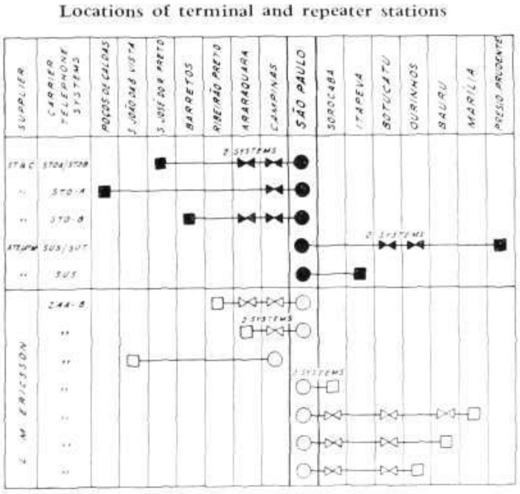
The ZAA 8 system provides eight duplex speech channels each of 200—2,700 c/s bandwidth, which may be terminated either 2 or 4-wire, and utilizes an open-wire pair, from which a single channel carrier telephone system and the usual physical voice frequency circuits may also be derived. Carrier frequencies of 20—44 kc/s are employed for the B—A direction and 52—76 kc/s or 53—77 kc/s for the A—B direction. The ZAA 8 therefore coordinates with existing types of 3-channel systems which may be operated over the same route. Where the CCIF type I 12-channel carrier facilities must share the same pole line over a considerable distance, however, it may sometimes be necessary to sacrifice three of their lower channels to keep intersystem crosstalk within tolerable limits. There are four frequency allocations available in the 20—77 kc/s range with "erect" and "inverted" bands. By this means crosstalk may be reduced between ZAA 8 systems, when more than one operates on the same route, and this will be mainly unintelligible.

The ZAA 8 is so designed that, in 4-wire operation, levels from — 14 dbm to + 1 dbm can be accepted from, and — 8 dbm to + 7 dbm delivered to, the toll board. The 2/4-wire terminating units introduce an overall loss of 7 db from terminal to terminal. Output level per channel to the line is + 17 dbm and input level per channel from the line should not be less than — 48 dbm, thus permitting a maximum line attenuation of 65 db at the highest transmitted frequency.

Intermediate repeaters compensate for these losses. Variation in line attenuation with weather, at the higher line frequencies used for the ZAA 8, are greater than those encountered with the 3-channel system. Automatic gain regulating equipment provides "flat" and "slope" compensation for the loss frequency characteristic of each repeater section. This is accomplished by means of pilots at 20 and 44 kc/s in the B—A direction and 52 and 76 kc/s, or 53 and 77 kc/s, in the A—B direction.

Compandors may be plugged-in where necessary to meet toll transmission standards for signal/noise plus crosstalk ratio. This equipment is described in the Ericsson Leaflet 1260 "Compandors". A large variety of terminating arrangements and signalling schemes are also available as options to coordinate with other facilities as required.

Locations of terminal and repeater stations



Terminal
A B

■——● 3-channel carrier system

□——○ 8-channel carrier system

—▶◀— Repeater

Representation of systems on pole profiles:

Z : ZAA 8
A : STO-A
B : STO-B
S : SUS
T : SUT

X 7706
X 2174
X 9138

Fig. 1

Layout of 3- and 8-channel carrier systems, State of São Paulo, Brazil

The terminal and repeater with associated a.c. power supply, test and supervisory equipment, each occupy one bay. Individual apparatus and sub-assemblies are of plug-in type to permit easy replacement of defective parts and facilitate establishment of centralized maintenance.

Open-Wire Line Characteristics

Construction

The open-wire lines available for this project, shown in Fig. 1, are all "D" transposed and originally intended for application of four 3-channel carrier systems on the first crossarm side circuits, with single channel carrier systems on the remaining side circuits of crossarms 2 to 6, for maximum development of the lead. The crossarms are either of 10 pins with 30 cm spacing between

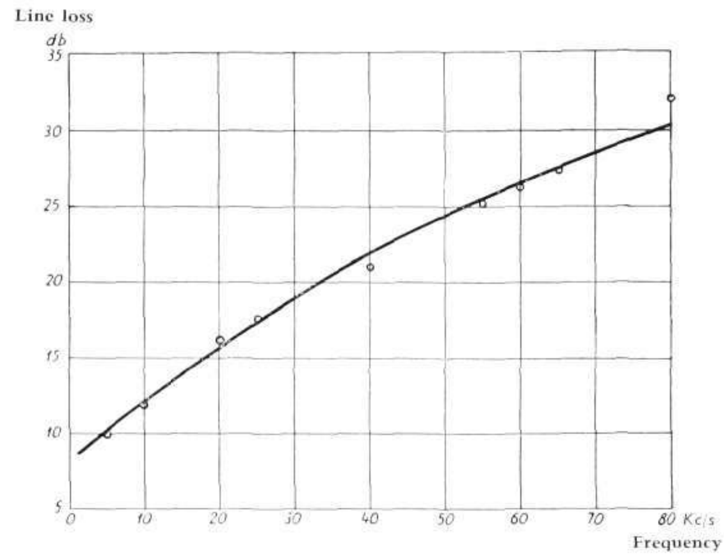


Fig. 2 X 6988

Attenuation/frequency measurements Campinas—Araraquara line section

Date: 9.5.1954, hrs. 23.00 to 23.20
Length of line: 204 km.
Pin numbers, Campinas: 3—4
» » Araraquara 3—4
Insulation resistance between pairs: 150,000 Ω

wires of side circuits in the phantom groups, or 18 pins with 15 cm wire separation. Average pole spacing is 66—67 metres with occasionally 80 metres. However, the root sum square of pole spacing deviations does not exceed the length of one transposition interval. No. 12 B & S copper wire is used throughout with No. 2 porcelain insulators and hardware made in Brazil so that, with the exception of imported copper, the line material is entirely Brazilian.

Attenuation

Extensive attenuation-frequency tests were made on all lines up to 150 kc/s with particular care being taken to check for absorption peaks. Fig. 2 shows a typical attenuation-frequency characteristic for frequencies up to 80 kc/s measured on pair 3/4 of the Campinas to Araraquara line section. The absence of major absorption peaks in this frequency range is characteristic of practically all side circuit pairs on crossarms 1 and 3 for "D" transposed lines. Fig. 3 shows far-end crosstalk ratio for pairs 1/2, 3/4 of the phantom group on the first crossarm of the Campinas—Araraquara section. Measurements were made up to 80 kc/s with pair 1/2 disturbing and pair 3/4 disturbed, and vice-versa, all pairs being terminated in their characteristic impedance. It will be observed from Fig. 3 that no far-end crosstalk ratio of less than 34 db occurred in the ZAA 8 carrier range, and this was the worst case encountered on pairs actually used for ZAA 8 application. Crosstalk measurements on combinations of the above with pairs 7/8 and 9/10 proved pairs 1/2 and 3/4 to be controlling in comparison with all other first and third

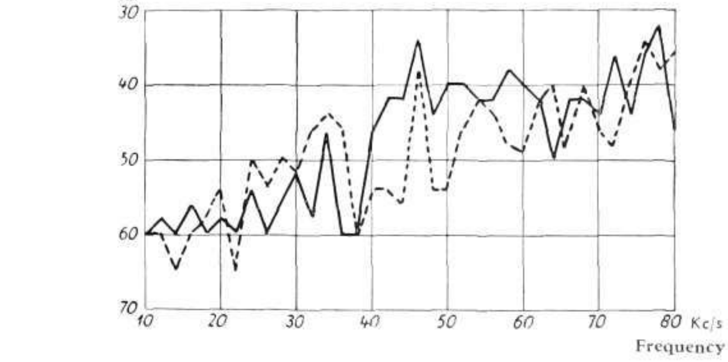


Fig. 3 X 6989

Far-end crosstalk ratio measurements Campinas Araraquara line section

——— Pin numbers, disturbed: 3—4
» » , disturbing: 1—2
Date 7.5.54
— — — Pin numbers, disturbed: 1—2
» » , disturbing: 3—4
Date: 8.5.54
Length of line: 204 km.
Insulation resistance between pairs: 150,000 Ω

crossarm phantom group pairs of a three crossarm line. Results of the same general type were obtained on other repeater sections.

Noise

Interference from radio stations does not occur in Brazil at these frequencies and power line carrier is so far of limited application. Atmospheric noise is, therefore, generally considered as controlling, but this is influenced by the standard of line maintenance and whether point or drop transposition brackets are used. For the lines under consideration drop brackets are employed for phantom, and point brackets for side circuit transpositions, while the general standard of maintenance is good.

Transmission Planning

System transmission performance estimates were based on the above physical plant and measurements, with the additional assumptions indicated below, to ensure that CCIF noise and crosstalk standards would be met. Choice of suitable line pairs, staggering of carrier frequencies, and the use of compandors were determined on the basis of these data. In accordance with CTB noise objectives the total noise measured on a 2 B Noise Measuring Set, using 144 line weighting, at the toll test board during the busy hour, at a point of zero db relative level, should not exceed 10,000 picowatts or 34 dba for 1 % of the time. This objective would be applicable to End Links, Toll Center Links and Terminal Grade Circuits, such as the additional facilities to be provided by ZAA 8 systems. All facilities were to be operated at a terminal net loss of 6 db, giving a total noise objective of 28 dba, 144 line weighting, including equipment noise, crosstalk and atmospheric line noise. Noise and interchannel crosstalk arising within the ZAA 8 system itself were known to be less than a total of 18 dba, about average for systems meeting CCIF recommendations. The atmospheric line noise objective was 22 dba, leaving 25 dba for unintelligible crosstalk. The above three noise allocations, summed on a power basis, gave the total noise objective of 28 dba, 144 line weighting, for a 6 db equivalent circuit. By proper application of staggered systems the noise due to crosstalk could be rendered unintelligible.

Atmospheric Line Noise

The procedure adopted for estimating noise due to atmospherics was as follows:

(1) From a consideration of the type of open wire line construction, quality of maintenance, variety of transposition system and transposition brackets employed, together with an appraisal of thunderstorm incidence for the area involved, a value of 25dbRN for unweighted atmospheric noise in a 3 kc/s band was stipulated. This value was applied to all the open wire lines under study, since they were similar in both construction and maintenance practices. It was assumed that noise of 25dbRN would not be exceeded for more than 1 % of the time even during the season of maximum atmospherics from November to March.

(2) A level diagram was prepared for each new carrier system based on transmitting 800 c/s on the top channel, for wet weather conditions. The level diagram included the loss of all line filters, entrance cables, or intermediate cables but did not include the loss of any entrance cable at the receiving terminal, this having negligible effect on noise.

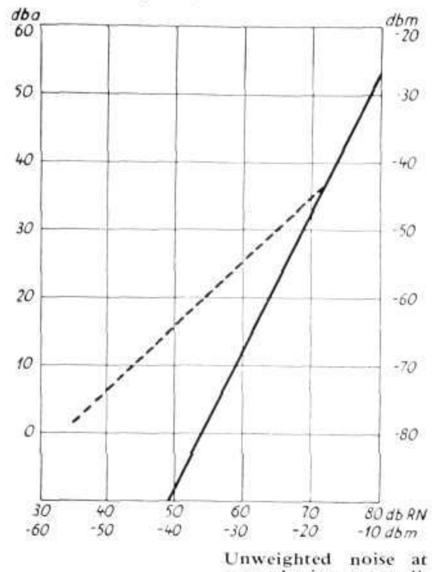


Fig. 4 X 2175

ZAA 8 expandor action on noise

Unweighted noise expandor output dbm + 82 + 5 − 7 = effective noise in dba 144 weighting at 0 db relative level

- - - - - probable expandor response for expanded input signal levels less than — 18 dbm

(3) For all repeater sections, except the last receiving section, the atmospheric line noise was added to the line loss of each section taken from the level diagram. Subtracting from these values the line loss of the last receiving section yielded the noise for each repeater section at the receiving terminal line jacks, the noise contribution of the last receiving section being 25dbRN. Summing all these noise contributions on a power basis gave the total noise at the receiving terminal line jacks. This noise was corrected for the receiving terminal gain to the + 7 db level at the input to the expandor, thus yielding the total unweighted noise in a 3 kc/s band at the expandor input, and from Fig. 4 (using the dotted line for values below — 18 dbm) was obtained the unweighted noise at the expandor output in dbm, or 144 line weighting, effective value in dba (dbRN), at zero relative level. If the circuit were operated at an equivalent of less than zero a further correction would be necessary. Results of the noise estimates based on the above procedures indicated that the noise objective of 22 dba would not be exceeded on any ZAA 8 carrier telephone channel.

Effect of Compandors on Noise

The compandor consists essentially of a compressor at the transmitting end, which raises the level of low speech volumes before transmission to the line, and an expandor at the receiving end, which restores these speech volumes to their original levels. The total input for levels greater than — 40 dbm is compressed in the ratio of 2 : 1 by the compressor, while the output is expanded in the ratio of 1 : 2 by the expandor. Fig. 5 is a diagram which shows the change in signal levels for various signal inputs as they pass through both compressor and expandor. With no speech being transmitted the expandor is assumed to introduce a loss of 25 db for low level signals. This reduces line noise by the same amount, provided that the noise itself is not sufficient to lower expandor loss. During speech transmission the loss is decreased and thus the noise increases. The effective increase in noise depends on the speech volume and varies from talker to talker. Based on previous experience the

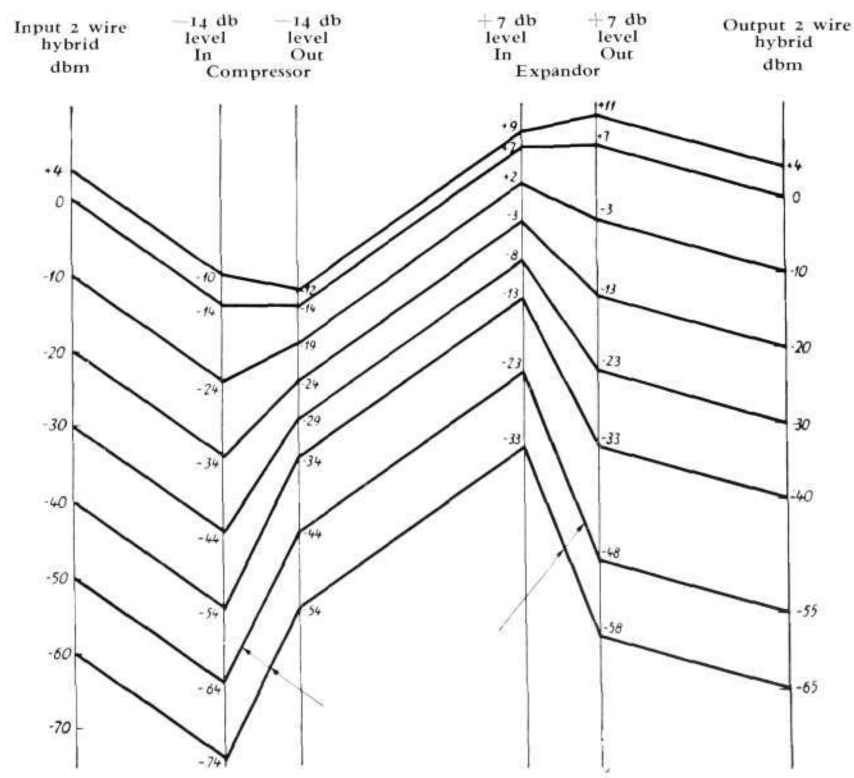


Fig. 5 X 6990

ZAA 8 compandor level diagram

Input signal of 0 dbm at zero db relative level passes compandor unchanged. The total input compressor ratio is 2 : 1 and expandor output ratio is 1 : 2 except for input levels below —40 dbm when maximum compressor gain and expandor loss is very nearly as indicated.

average increase in noise in the presence of speech was taken as 5 db, resulting in an effective compandor advantage of 20 db, which was used for engineering purposes. When estimating the effective noise in a compandored system the noise was, therefore, computed at the net circuit equivalent for the line frequency, in the A—B direction with 800 c/s in the top channel, under wet weather conditions, and the compandor advantage of 20 db subtracted from this result.

As pointed out above, it is assumed that the expandor introduces a loss of 25 db, when no signal is being transmitted, and reference to Fig. 5 will show that this expandor loss is obtained when the input signal level to the expandor is — 23 dbm or less. For expandor input levels greater than — 23 dbm the expandor loss will be less than 25 db, and its output will increase 2 db for every 1 db its input increases above — 23 dbm. For large noise magnitudes, however, the expandor loss may be less than 25 db, even in the absence of speech, and the compandor advantage will then be reduced. Fig. 4 shows the assumed relation betveen noise at the input and output of the expandor. The full line indicates the relationship between unweighted noise at the expandor input in dbm or dbRN at + 7 db relative level, with unweighted noise at the expandor output in dbm, OR 144 weighted noise, effective value at zero relative level in dba. This chart is used for atmospheric noise estimates with even distribution in 3 kc/s bandwidths. The dba scale in Fig. 4 has been adjusted to include an 8 db correction, for converting noise having a uniform distribution in a 3 kc/s band into 144 weighted noise, and also includes a 5 db correction for average increase in noise with the presence of speech and a — 7 db correction for difference in relative levels. The dotted line in Fig. 4 represents the probable expandor response for input signal levels of less than — 18 dbm. It should be noted that expandor performance for very low signal levels has not actually been measured but is understood to be not inferior to that shown by the dotted line in Fig. 4.

Far-End Crosstalk

A careful examination of the open wire line crosstalk test results indicates that it is safe to assume that the total far-end crosstalk in a single repeater section due to five other disturbers, will not cause a far end crosstalk ratio less than 30 db, if four ZAA 8 systems are applied to the first crossarm and two on the third crossarm, one on each side circuit of a phantom group of the "D" transposed lines. For a compandor advantage of 20 db this results in a total far end signal to noise ratio of 50 db, which is fairly good from an open wire line carrier crosstalk performance point of view. It is therefore considered advisable to limit the total far-end crosstalk ratio in any repeater section to about 30 db. The above assumes identical ZAA 8 systems, but since four frequency allocations are available, advantage may be taken of frequency staggering.

Experience shows that further improvements can be gained in crosstalk ratio by this means. With six systems applied as indicated, and taking full advantage of frequency staggering, intersystem crosstalk will generally be unintelligible.

The total far-end crosstalk ratio at the receiving terminal, for the top channel in the high frequency direction of transmission, was estimated for each route, taking into consideration the number of systems in each repeater section, as well as the number of repeater sections involved. These studies indicated that crosstalk objectives could be met on all routes.

Effect of Compandors on Crosstalk

When compandors are used, the compressor at the transmitting end reduces the range of speech volume by half and amplifies all but highest level speech before transmission, while the expandor at the receiving end restores levels to their original distribution.

Experience shows the compressor may be considered as providing an effective gain of 7 db for speech levels affecting crosstalk performance. With low level signals, such as crosstalk, it will be assumed that the compandor introduces a loss of 25 db, which applies for all signals less than — 23 dbm at the input to the expandor. This loss is effective in reducing crosstalk. Between two compandored circuits the net compandor advantage is, therefore, 25 — 7 = 18 db. As already noted, however, crosstalk from a compandored to a non-compandored system is subject to an impairment of 7 db so that in certain cases it may be necessary to provide compandors for the non-compandored system. The greater the number of ZAA 8 systems operated on any particular route, the less will be the crosstalk ratio in any particular disturbed circuit.

Interaction Crosstalk

In order to control interaction crosstalk at repeater points it was believed advisable to follow the same practices normally applicable to 12-channel open wire carrier telephone systems. Although the ZAA 8 system uses a top frequency of 77 kc/s, compared with 143 kc/s for the 12-channel system, the open wire lines actually employed for 8-channel systems offer considerably higher couplings at 77 kc/s than correctly transposed lines normally used for 12-channel systems at 143 kc/s. Due also to longer repeater sections resulting from the utilization of existing 3-channel repeater stations, 8-channel repeater gains may be rather large.

The measures adopted to control interaction crosstalk were therefore as follows:

(1) All 3-channel repeaters were equipped with roof filters at 8-channel repeater stations.

(2) Common entrance cables were eliminated and steps taken to provide a gap in the line of at least 15 metres at each 8-channel repeater.

(3) Line facilities were arranged to enter and leave repeater stations via the entrance cables, no carrier circuit being permitted to cross the station.

(4) Non-repeatered carrier circuits were equipped with crosstalk suppression filters at three repeater stations.

Longitudinal retard coils have not been provided on open wire pairs at terminal poles. This may cause a small increase in circuit noise, since longitudinal voltages induced on other pairs of the line may be coupled back into the 8-channel pair through unbalances in the entrance cable. However, the noise component arising from the vertical atmospheric field at the drop bracket transpositions is controlling, so that longitudinal retard coils are not believed to be justified.

Choice of Line Facilities

Pairs transposed for voice frequency operation are generally unsuitable for the application of ZAA 8 systems due to the presence of absorption peaks. However in some cases it may be possible to operate one such system, since no intersystem crosstalk is involved, but it should be remembered that voice frequency transposed lines with drop bracket transpositions are much more susceptible to atmospheric noise than carrier transposed pairs. Whenever the application of a ZAA 8 system is contemplated on voice frequency transposed lines, attenuation-frequency measurements should first be made in order to check the absence of absorption peaks in the frequency range of interest. Carrier line noise tsets should then be undertaken if suitable test equipment is available, otherwise estimates should be made as discussed above.

The applicability of "D" type transposed lines for ZAA 8 operation has been discussed above. With lines transposed for the alternate arm, or "C1" transposition scheme, ZAA 8 compandored system can be operated on all carrier transposed pairs and, due to the improved performance of such transpositions, greater range may be expected. Naturally ZAA 8 systems can be operated on all carrier transposed pairs of lines transposed according to the "K8-2", "J1", "J2" or "J5" schemes and in such instances compandors will generally not be required.

Actual System Performance

After all installation and overall line-up tests had been completed satisfactorily, noise and crosstalk tests were made on VF channel terminals of eight systems at the São Paulo terminal using a Western Electric 2B Noise Measuring Set, with 144 line weighting. The São Paulo terminal was chosen for these tests as this terminal receives the high frequency direction of transmission. Tests were made during the busy hour in order to measure the effect of crosstalk from active corresponding channels of other 8-channel systems on the same route.

The results of these tests are tabulated below and these may be considered as typical of the noise and crosstalk performance which could be expected for the major part of the time. From an examination of the test results it will be observed that they are well within the estimated values for noise and crosstalk with ample margins to guard against changes in climatic conditions.

The above tests were verified by monitoring over considerable periods. These indicated a complete absence of intelligible crosstalk, with noise in the absence of speech inaudible. Repetitions on all calls observed were negligible. All the above tests were carried out during dry weather conditions on each route.

Noise and Crosstalk Test Results

Connection	Channel							
	1	2	3	4	5	6	7	8
System 1	dba (dbRN)							
São Paulo to Ourinhos	12	15	18	20	20	15	25	25
» » » Araraquara	8	8	8	8	15	8	8	20
» » » Ribeirão Preto	13	16	12	13	14	12	18	10
» » » Sorocaba	14	8	8	8	8	8	14	8
System 2								
São Paulo to Araraquara	15	8	9	8	25	13	8	22
» » » Sorocaba	9	20	8	8	8	8	20	15

Conclusions

Experience with the Estado São Paulo project has justified all assumptions on which the choice of ZAA 8 carrier equipment was based. Few changes were needed in the open wire plant and major service interruptions were entirely avoided during installation. It was also possible to use existing 3-channel terminal and repeater offices with no additional building construction or maintenance personnel. The 8-channel system permitted an increase of 64 toll telephone circuits using carrier telephone plant which had already been fully exploited by 3-channel, 1-channel and voice frequency telephone facilities. The proper application of 8-channel systems also made possible a useful rearrangement of existing 1-channel and 3-channel equipment to provide toll facilities for other centers. In some cases 3-channel systems were operated on 1-channel assignments with compandors to reduce noise and crosstalk. Large economies in cost per additional channel were thereby achieved. Overall transmission performance of the derived voice circuits was highly satisfactory in all cases, demonstrating by good margins in practice the conservative nature of engineering estimates for noise and crosstalk made during the planning of this project.

Practical Experience in the Operation of Crossbar Exchanges in the Rotterdam Zone

F W VAN DER HAER, THE NETHERLANDS ADMINISTRATION OF POSTS, TELEGRAPHS AND TELEPHONES, ROTTERDAM

U.D.C. 621.395.344:654.153.28.(492)

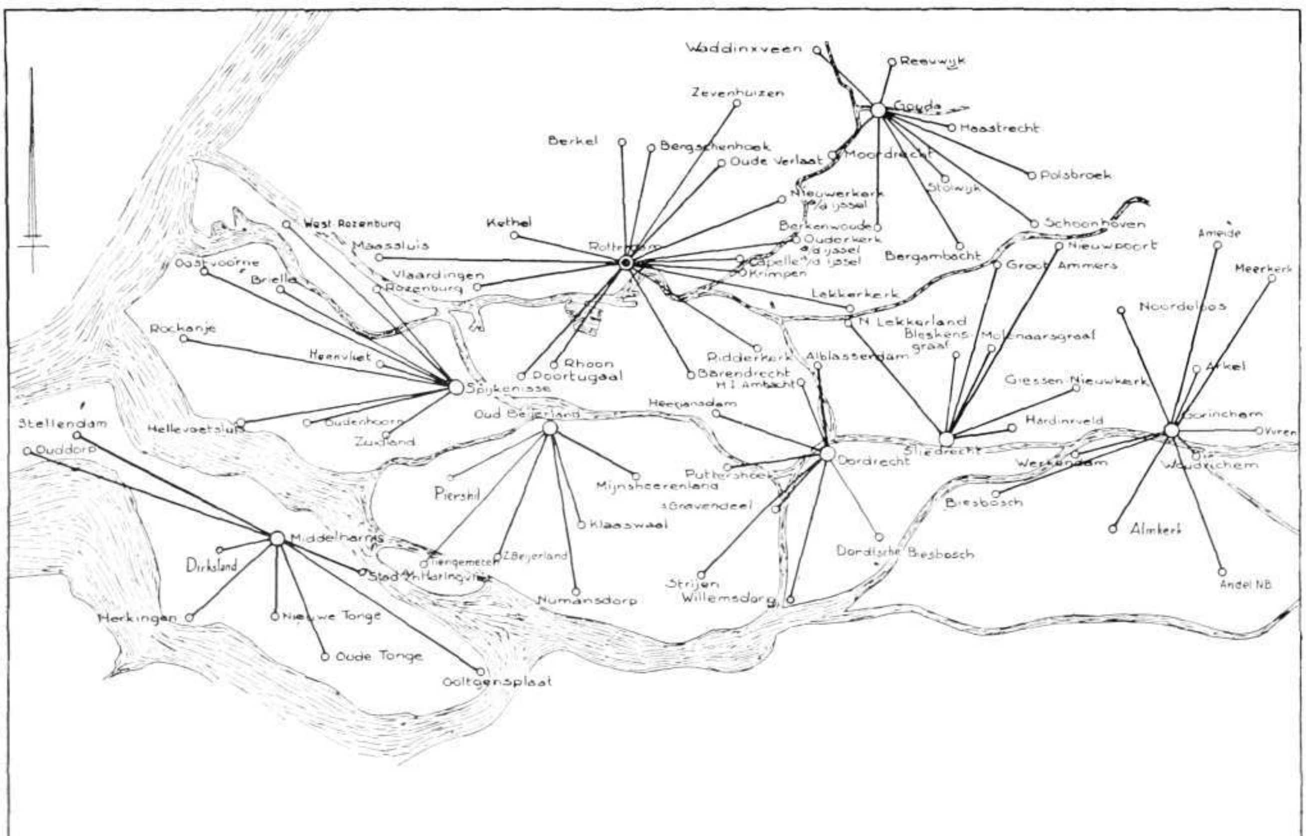
After a short review of the telephone network in the Netherlands, the place of the Rotterdam zone centre in this system is described. An account is given of how this crossbar exchange and the crossbar rural exchanges in the Middelharnis area have come into being and how they are at present operating. Attention is paid to fault statistics in these exchanges and conclusions are drawn from them with respect to maintenance routines. Finally the results of traffic observations in the Rotterdam zone centre are discussed.

The Netherlands Telephone Network

For nation-wide subscriber-to-subscriber dialling the Netherlands are divided into 20 zones. Each zone is sub-divided into a maximum of 10 groups and each group into a number of local areas not exceeding 10. Each zone has a zone centre, situated as far as possible in a large town in the geographical centre of the zone, and each group has a group centre, generally situated close to the centre of the area it serves. The exchanges serving the local areas are called terminal exchanges. The majority of terminal exchanges are unattended. A zone centre also contains one or two group centre equipments serving the terminal exchanges in the immediate surroundings.

Fig. 1 X 7698

Map of Rotterdam zone with associated group centres and terminal exchanges



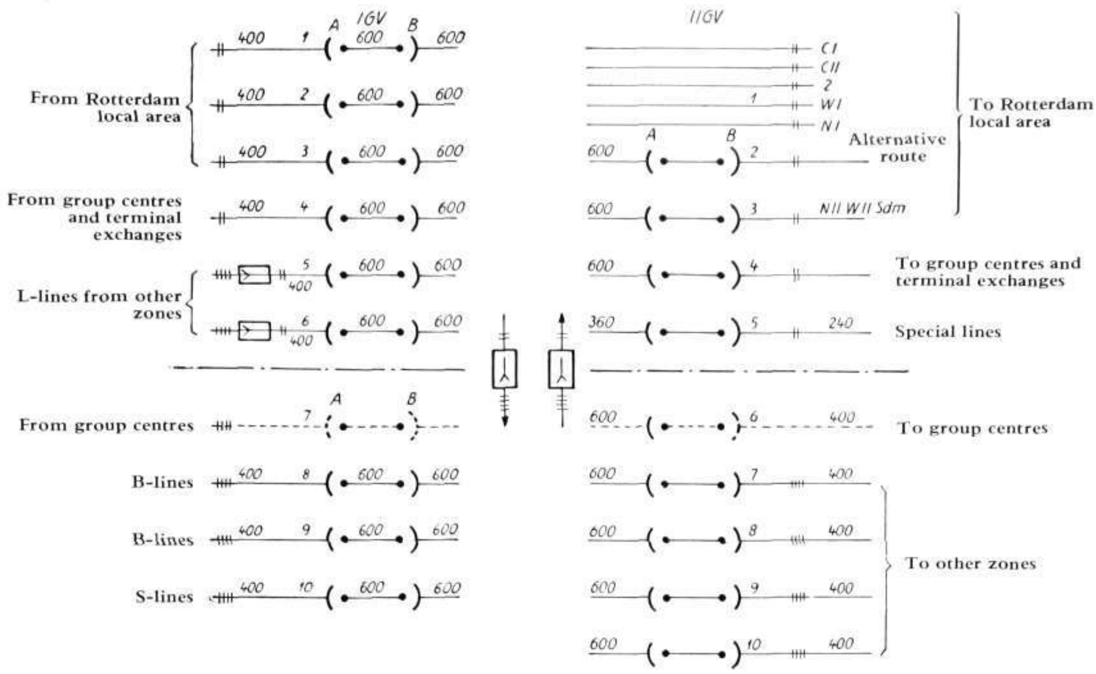


Fig. 2 X 6994
Ultimate trunking scheme of Rotterdam zone centre

The traffic routes in a zone area are generally of the radial type, whereas the network interconnecting the 20 zones is a practically complete mesh configuration, with overflow over one of the two national transit centres in Amsterdam or Rotterdam.

Figure 1 shows the Rotterdam zone with its group centres and their terminal exchanges. The Rotterdam zone centre and the exchanges in the Middelharnis group are of the crossbar type. This type of exchange will also be used in the Spijkenisse group, of which the automatization is expected to be completed in the course of 1957.

The Rotterdam Zone Centre

In pre-war days Rotterdam had a step-by-step zone centre. This exchange was destroyed in May 1940. It was provisorily rebuilt after the war, but plans were drawn up for a new zone centre which would completely interwork with the L M Ericsson 500-selector local exchanges in the city of Rotterdam. The choice for the new Rotterdam zone centre fell on L M Ericsson's crossbar system ARM 10.

A connection in the crossbar exchange is established over 2 switching stages, an incoming and an outgoing stage. Fig. 2 shows the grouping as it ultimately will be. Extension of the exchange is being carried out in phases, of which the first 3 phases are now completed. At present there are 3 incoming groups and 5 outgoing groups in operation. Two more incoming groups and one outgoing group will follow in 1956.

The grouping plan shows clearly that the exchange is divided into a two-wire and a four-wire switching section. Junctions within the Rotterdam zone are mostly two-wire lines, whereas the interzone traffic is completely handled on a four-wire basis. As mentioned above, the Rotterdam exchange will also act as a transit overflow centre for traffic between other districts. This kind of traffic comes in on so-called S-lines and is switched through the Rotterdam transit exchange completely on a four-wire basis. Traffic from other zones to the Rotterdam zone comes in over B-lines. The portion of this traffic that is destined for Rotterdam city, however, will be handled over a special group of lines, the L-lines, which at the outgoing end are reached by dialling a 2-digit instead of the usual 4-digit group routing number.

The Middelharnis Group

The Middelharnis group covers the island of Goeree-Overflakkee. Automatization of the telephone exchanges in this island was started already before 1940, but was interrupted by the war. After the war the installations were taken down and moved to other parts of the country for repair of heavily damaged equipment there. In 1951 automatization of Middelharnis started again, but now with crossbar exchanges of L M Ericsson's system ARK 315. In July 1952 the Middelharnis group centre with 800 lines, and the terminal exchanges Dirksland and Herkingen with 400 and 100 lines respectively, were opened. The terminal exchanges Ouddorp, Stellendam and Stad a/h Haringvliet, each for 200 lines, were practically ready for cut-over when, on the 1st of February 1953, the dykes broke in a storm and the major part of the island was flooded.

The exchanges Herkingen and Ouddorp were heavily damaged, and Stellendam was a total loss (fig. 4). In the Middelharnis exchange the ground floor was flooded, but the automatic equipment being situated on the first floor continued to operate. The exchange at last broke down owing to failure of the power supply. Two hours later a rescue party arrived with an emergency power set and the exchange soon was in working condition again. The exchanges Dirksland and Stad a/h Haringvliet escaped damage.

Fig. 3 X 6969 X 6970

Rotterdam zone centre

(Left) IIGV racks, (right) marker and register racks

Fig. 4 X 6971
Stellendam terminal exchange
during floods in February 1953

With the help of stocks of material on hand for the construction of exchanges in the eastern part of the island, the two damaged exchanges in Herkingen and Ouddorp could be repaired fairly quickly and were opened again in July of the same year. Unfortunately the major part of the material in stock had also suffered severely from the water and therefore had to be redelivered by the factory. Consequently the installation of the three exchanges in the eastern part of the island had to be delayed until the end of 1954, and the last exchange in the group was cut over in March 1955.

Maintenance Requirements

In exchanges of the step-by-step system, which until recently were exclusively used in the Rotterdam area—with the exception of Rotterdam city—a periodical overhaul of the principal devices like two-motion selectors, uniselectors and repeaters is prescribed in addition to electrical testing. There is no need for such a program with crossbar exchanges. It suffices to perform periodical routine tests on important devices like time and zone-metering equipment and registers. The maintenance staff interferes only if the number of faults recorded by the alarm system, by complaints from subscribers or from other exchanges, would indicate that the quality of service offered to subscribers threatens to become unsatisfactory. Besides the above mentioned sources of fault indication the Rotterdam zone centre possesses a Centralograph which, in case of an unsuccessful marker operation, records which switching devices were engaged in the attempted connection. This instrument has been found useful for fault location.

Fig. 5 X 2146
Dirksland terminal exchange

As long as the maintenance situation in the Rotterdam zone centre and in the Middelharnis group centre is not fully stabilized—and in the zone centre this may take several years owing to extension of the equipment—it is difficult to fix a fault rate that can be accepted without prescribing an overhaul. Experience has, however, shown that the number of recorded faults in these exchanges is low in comparison with equivalent exchanges of other systems in the same area, and therefore overhauling of crossbar exchanges has so far been a rare occurrence.

Fault Statistics from Rotterdam Zone Centre

Table I shows the fault record of the Rotterdam zone centre in 1954, specifying the various types of faults and their location.

Table I. Fault statistics

Rotterdam Zone Centre 1954 — Total number of calls 6,141,512		Time and zone-metering equipment	Register finders	Registers	Markers GV I	Markers GV II	Link relay sets	Fork repeaters	Incoming two-wire repeaters	Outgoing two-wire repeaters	Outgoing three-wire repeaters	Incoming four-wire repeaters	Outgoing four-wire repeaters	Selector stages	Alarms	Distribution frames	Miscellaneous	Total
Relays	Adjustment	17	—	2	5	1	—	—	—	—	—	—	1	—	—	—	2	28
	Insulation of contacts	2	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	4
	Coils	—	1	—	—	—	—	—	—	—	—	—	3	—	—	—	—	4
	Sticking	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	2
	Contact spring sets	10	—	2	—	—	—	1	—	—	—	—	1	—	—	—	—	14
Crossbar switches	Adjustment of selecting bars	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1
	Adjustment of selecting fingers	—	—	4	—	—	—	—	—	—	—	—	—	22	—	—	—	26
	Adjustment of contacts	—	1	—	1	—	—	—	—	—	—	—	—	4	—	—	—	6
	Coils	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Miscellaneous	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1
General	Cabling	13	3	10	5	1	1	6	—	2	—	—	6	6	—	7	—	60
	Rectifiers	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Resistors	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
	Capacitors	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
	Meters	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	3
	Keys and jacks	1	—	—	—	—	—	—	—	—	—	—	—	1	2	—	1	5
	Multi-contact plugs	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	2
	Fuse alarm contacts	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
	Miscellaneous	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total		45	5	20	11	2	1	8	—	4	—	—	11	36	2	7	7	159

All fault statistics must be seen against the background of the traffic handled in the period and of the installed number of switching devices. It is therefore necessary to mention that, in the beginning of 1954, one incoming and two outgoing groups were in operation, this capacity being increased in June 1954 to two incoming and three outgoing groups. In January 1954 the average number of calls per week handled by the exchange was 90,000, which figure in December 1954 had increased to about 190,000. The total number of calls handled by the exchange in 1954 was 6,141,512.

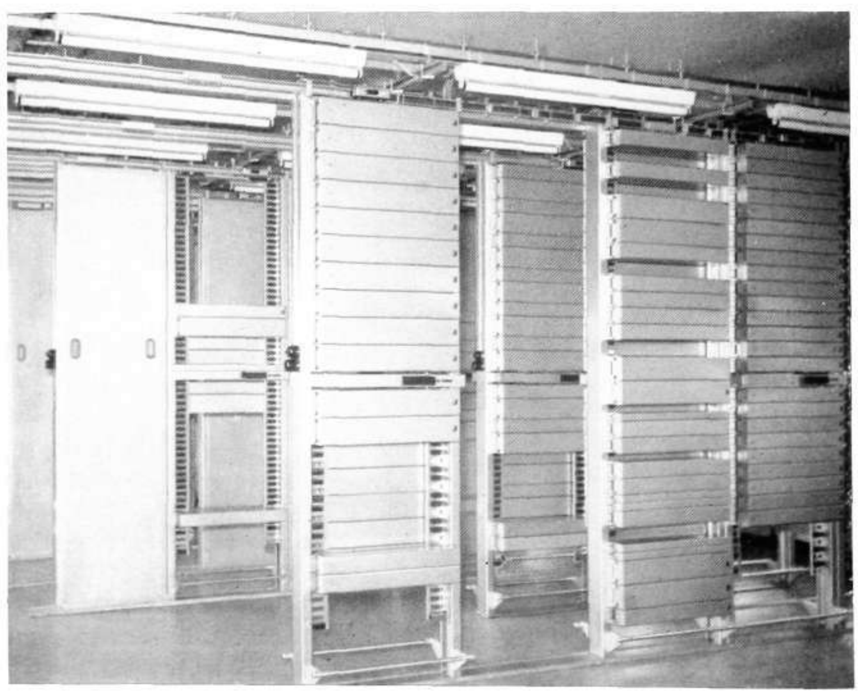


Fig. 6 X 6972

Middelharnis group centre

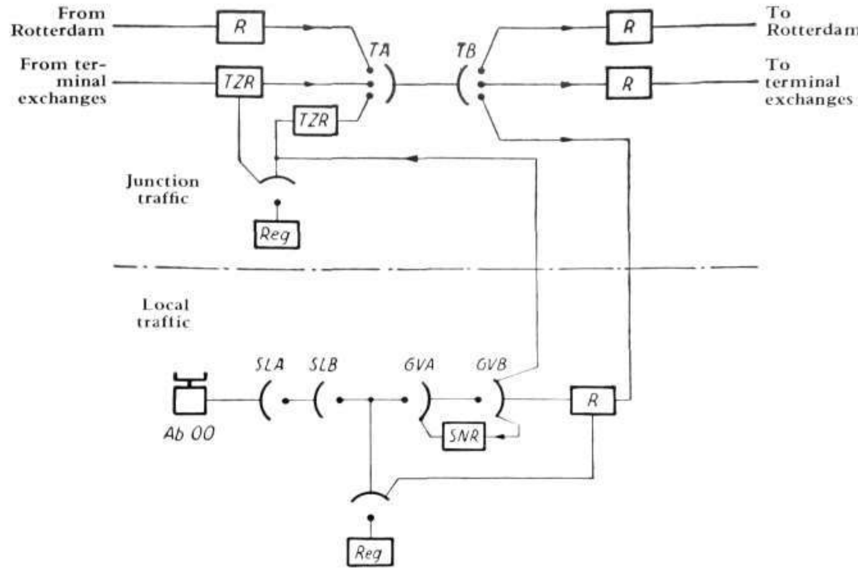


Fig. 7 X 6993
Trunking scheme of Middelharnis group centre

An analysis of the fault statistics shows that, although the absolute percentage is very low, certain faults occur more frequently than others. Wiring faults, for example, are regularly more frequent during the period immediately following the cut-over of new equipment. The usual teething troubles in the form of faulty adjustments and the like have, however, now been remedied.

Fault Statistics from Middelharnis Group Centre

The fault statistics of the Middelharnis group centre are given in table II, also for the year 1954. These statistics cover the whole group area comprising per 1st January 1954 five exchanges with a total number of 1,700 lines, and per 31st December 1954 six exchanges with a total number of 1,900 lines. The total number of calls originated by the subscribers in this group area during the year 1954 was 3,123,477.

Table II. Fault statistics

Middelharnis group centre 1954 Total number of calls 3,123,477		Time and zone-metering equipment	Register finders	Registers	Markers local	Markers transit	Connecting circuits	Subscriber line-circuits	Incoming two wire repeaters	Outgoing two wire repeaters	Selector stages	Alarms	Distribution frames	Miscellaneous	Total
Relays	Adjustment	—	—	1	1	—	—	—	—	—	—	—	—	1	3
	Insulation of contacts	1	—	—	—	—	—	—	—	—	—	—	—	—	1
	Coils	—	—	—	—	—	2	6	—	—	—	—	—	—	8
	Sticking	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Contact spring sets	1	—	1	2	—	—	—	—	—	—	—	—	—	4
	Miscellaneous	—	—	—	—	—	—	1	—	1	—	—	—	1	3
Crossbar switches	Adjustment of selecting bars	—	—	—	—	—	—	—	—	—	2	—	—	—	2
	Adjustment of selecting fingers	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Adjustment of contacts	—	—	—	—	—	—	—	—	—	2	—	—	—	2
	Coils	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Miscellaneous	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General	Cabling	2	—	—	—	1	—	—	—	—	3	1	2	—	9
	Rectifier cells	1	—	—	—	1	—	1	—	—	—	—	—	—	3
	Resistors	2	—	—	—	—	—	—	—	—	—	—	—	—	2
	Capacitors	1	—	—	—	—	—	—	—	—	—	—	—	—	1
	Meters	5	—	—	2	—	—	6	—	—	—	—	—	—	13
	Keys and jacks	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Multi-contact plugs	2	—	—	—	—	—	—	—	—	—	—	—	—	2
	Fuse alarm contacts	—	—	—	—	—	—	1	—	—	—	—	—	—	1
	Electron tubes	—	—	—	—	—	—	—	—	—	—	—	—	4	4
	Miscellaneous	—	—	—	—	—	—	—	—	—	—	—	—	1	1
	Total	15	—	2	5	2	2	15	—	1	7	1	2	7	59

The above figures do not include the exchanges in the eastern part of the island which were opened as late as December '54; neither are these exchanges included in table II.

Analyzing the fault statistics of the Middelharnis group centre it would seem that, apart from the fault rate being very low, there are no faults which are considerably more frequent than others, with the possible exception of subscriber meters, for which however the supplier of the exchange is not responsible, the meters being provided by the Telephone Administration.

Traffic Observations

Apart from fault statistics, another important aid in arriving at a complete picture of the grade of service offered to subscribers is traffic observations. In the Rotterdam zone centre traffic observations can be effected by sampling of the traffic in the register control desk.

Table III shows the results of such samplings. Unsuccessful calls owing to faulty subscriber action such as uncompleted dialling, dialling of non-existent group routing numbers, etc., are not included.

Table III. Chart of traffic observations in the Rotterdam zone centre

Month	% Technically successful			% Technically unsuccessful					Total % columns 1—3	Total % columns 4—8	Total number of observations
	1	2	3	4	5	6	7	8			
	Conversation established	B-subscriber engaged	No answer	No outlets in Rotterdam	No outlets elsewhere	Fault in Rotterdam zone centre	Fault elsewhere	Transmission fault			
January 1954	69.2	16.8	3.6	4.2	4.7	—	1.5	—	89.6	10.4	590
February .. »	70.2	17.1	4.8	3.2	3.6	—	1.0	0.1	92.1	7.9	956
March .... »	73.9	15.0	4.8	3.7	1.4	—	1.2	—	93.7	6.3	644
April ...... »	69.1	18.3	4.2	5.3	1.0	0.2	1.9	—	91.6	8.4	524
May ...... »	65.8	17.9	5.7	7.9	2.3	—	0.4	—	89.4	10.6	809
June ...... »	64.0	17.5	5.4	9.3	3.2	—	0.6	—	86.9	13.1	663
October .... »	67.0	14.2	4.8	9.1	1.9	0.1	2.9	—	86.0	14.0	996
November .. »	59.7	13.5	4.7	17.9	4.0	—	0.2	—	77.9	22.1	1,555
February .. 1955	75.9	15.3	5.0	2.9	0.6	—	0.3	—	96.2	3.8	1,210
March .... »	74.4	14.4	6.2	1.5	2.3	0.1	1.1	—	95.0	5.0	1,517
April ...... »	69.9	18.1	5.5	4.1	1.7	—	0.7	—	93.5	6.5	980
May ...... »	67.2	16.9	5.9	7.3	2.4	—	0.3	—	90.0	10.0	1,502
June ...... »	70.2	18.0	8.3	2.0	1.2	—	0.3	—	96.5	3.5	706
August .... »	69.4	11.7	6.3	9.1	3.2	0.2	0.2	—	87.4	12.5	667

The table shows clearly that the quality of service offered by the exchange is in the present circumstances governed by the number of outgoing lines available. There is a constant need of more lines in most of the routes. A congestion percentage as high as 17.9 in November 1954 indicates a considerable shortage of lines and, although early in 1955 some improvement was gained by extensions of lines in the heaviest loaded routes, the demands are still far from satisfied.

Summary

To summarize, it may be said that, as regards maintenance, crossbar exchanges of the type described above should be left alone as much as possible. Periodical maintenance should be restricted to electrical routine tests of the principal devices like time and zone-meters and registers. Mechanical overhaul should only take place if there is an evident need for it. Such a need may be established by studying fault statistics and charts of traffic observations.

Telesignalling Equipment in a Modern Hospital

A TRÄGÅRDH, TELEFONAKTIEBOLAGET L M ERICSSON, DIVISION ERGA, AND J KAMP JØRGENSEN, AALBORG

U.D.C. 654.9:725.511:681.116.2

Telesignalling equipment has found increasing use in modern hospitals. Experience shows that telesignalling equipment contributes greatly to efficiency and to rapidity in treatment and care of patients, while at the same time reducing the work of nurses. The equipment is also appreciated by patients, for the possibility of immediate contact with the staff increases their sense of security; to some extent, too, it adds to the general sense of well-being, which is an important stimulus to rapid recovery.

The Hjørring County Hospital at Dronninglund, Denmark, was opened at the end of last year. The planners[1] *of the hospital as well as the financing authorities had been fully alive to the considerations outlined above and had decided on the acquisition of various telesignalling systems. The entire installation was entrusted to L M Ericsson A/S of Copenhagen.*

The units and components of the various systems are manufactured by L M Ericsson in Stockholm and incorporate certain new designs and principles which imply greater flexibility and rapidity than in previous installations.

The complete installation at the Hjørring County Hospital, Dronninglund, comprises the following systems:

Patients' calling system combined with intercom system for communication between patients and nurses,

supervision system for infants' wards,

signalling systems for roentgen, physiological and tuberculosis departments, and for admissions department,

door signalling system for senior physician's office,

staff locator system for paging physicians etc., master clock system with slave clocks in all departments,

sound distribution system for wards.

[1] Messrs. Brix-Pedersen and Kamp Jørgensen.

Fig. 1 X 6979
The Hjørring County Hospital at Dronninglund, Denmark

A private branch telephone system has, of course, also been installed by arrangement with the Danish P.T.T.

Patients' Calling System with Emergency Signals combined with Intercom Telephones

Some form of signalling system, enabling patients to call the attention of nurses, is now a regular feature in modern hospitals. But the combination of a system of this kind with intercom telephones for communication between patients and nurses is an innovation which greatly simplifies the general routine, saves nurses much running backwards and forwards between duty offices and wards, and enables them to concentrate more effectively on their work. At the same time the patients obtain quicker contact with the staff, which is of great value both on practical and psychological grounds.

Every ward in the hospital is equipped with a combined system of this kind, consisting of the following main units:

In the wards

at every bed: *Switch panel*

at the door: *Restoring panel* for calls from patients in the ward, and *loudspeaker* with secrecy lamp for communication with nurses' room.

In the corridor

outside the door of every ward: *Overdoor room indicator* with red and green lamps let into the wall above the door.

In the nurses' duty office

Control panel containing lamps, switches, relays, buzzers etc. Some panels also contain a loudspeaker connected to the central radio system for checking the quality of reception.

Master set of intercom system for answering calls from wards and communicating with patients.

Amplifier for intercom system.

In basement

Central installation with relays for patients' calling system and a program clock which switches off the audible signals from all departments at night and switches them on in the morning.

Fig. 2 X 2152

Switch panel

mounted on bedside table; pillowspeaker plugged-in

Description of Apparatus

The patients' *bedside switch panels* may be of different designs according to the type and method of operation of the telesignalling system. The most common form is a panel as shown in fig. 2, containing all controls the patient has to operate personally—nurse call button, bedlamp switch, socket for pillowspeaker with volume control, and a socket for a pendant push which the patient can hold in his hand and operate very easily if severely ill and unable to reach the panel.

The panel may be laid on the bedside table, or attached to it for greater convenience and accessibility.

Fig. 3 X 2153

Pull switch

at bedside. Switch for bedlamp at bottom right

At the Dronninglund Hospital, however, the night lights cannot be switched on and off individually, but are controlled by the staff. The switch for the bedlamp, therefore, need not be accessible to the patient; this is one reason why the switch panel, the pillowspeaker socket and the bedlamp switch have been let into the wall beside the bed. The call device here consists of a pull switch (fig. 3) which transmits a signal as soon as the patient pulls the cord. The pull switches are placed alternately on the left and right of the beds. Thus a patient who, for example, has broken his right arm can be placed in a bed where the pull switch is on his left. A separate wall socket is provided for the pillowspeaker, so that the patient can listen to the radio or local music transmission program.

The restoring panel (fig. 4 b), placed beside the door, contains the relay for mechanical resetting of the patient's signals, and two lamps, a red and a green. The green lamp lights as soon as anyone in the room has signalled. The red lamp indicates that the signalling circuit is switched to the nurse's present location. When she enters the ward, she turns the knob on the restoring panel and the red lamp lights. As long as the knob is turned, all calls from other rooms, emergency signals, paging calls, telephone calls and summons from doctors cause a buzzer in the panel to sound and the red lamp to flash. At nighttime these conditions merely cause the red lamp to flash without operation of the audible signal.

The loudspeaker (fig. 4 a) above the door of the ward serves both as microphone and loudspeaker, and thus requires no manual operation by patients when conversing with a nurse in the duty office. When the lamp is on, patients know that they are in communication with the duty office.

Fig. 4 X 6980 X 2154

a **Ward with loudspeaker above the door**

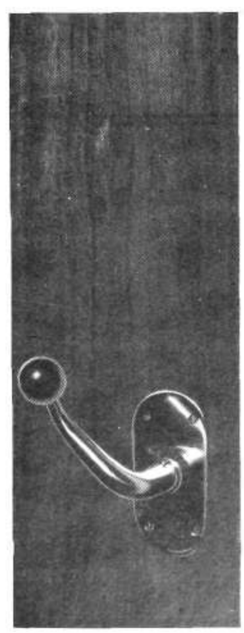
for communication with nurses. A red lamp below the loudspeaker lights when switched for speaking.

b **Close-up of restoring panel**

with pilot lamps. Installed in ward.

The overdoor room indicator (fig. 5) outside the door of each room has a green and a red lamp mounted vertically on a recessed panel. The red lamp indicates that a patient in the room has called the nurse, and the green lamp that the nurse is in that room.

The control panels in the duty offices are of the form shown in fig. 6. The panel has a red lamp which lights to indicate a call from a patient or an emergency signal.



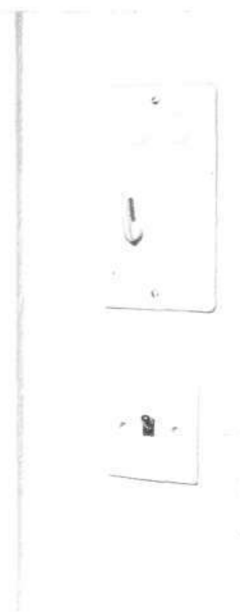


Fig. 5 X 6981

One of the hospital corridors with a slave clock on the left and, under it, a paging indicator

The overdoor room indicators are seen outside the doors on the right

It also has switches for connection and disconnection of buzzers, and a relay which operates the buzzers on an incoming telephone call. The same relay causes a yellow lamp to light outside the nurses' office to indicate a telephone call. Two lamps and switches have been provided for eventual extensions of the patients' calling system. In two cases, finally, a loudspeaker has been added for supervising the reception quality of the radio system.

A certain supervision of the main hospital entrance and of the boiler room is exercised from the control panel on the ground floor. In addition to the normal equipment, therefore, this panel has lamps and resetting relays for signals from the admissions room, main entrance and boiler room.

The *master set* (fig. 7), which is the intercom "switchboard", is placed on a table in the nurses' office. The amplifier is fitted to the wall beside the table. Calls to patients are switched from the master set, which contains a speak-and-listen key and a call lamp for each ward in the department. The call lamps are placed on a key base below the master set and indicate from which room a call has originated.

Fig. 6 X 6982 X 2151

a **The nurses' duty office with control panel on the wall to the right**

On the table are seen the master sets of the intercom and infants' supervision systems, and the telephone set. The amplifier is on the wall beside the nurse's chair.

b **Close-up of control panel in one of the departments**

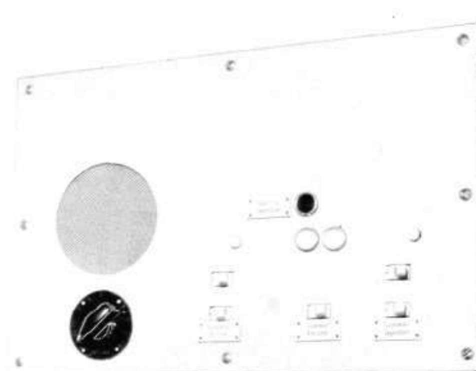


Fig. 7 X 6983

Master set of intercom system

for conversations with the various wards. (Right) Master set of infants' supervision system.

Operation

A patient wishing to speak to a nurse sends a signal by pulling the bedside cord. The green lamp by the door lights, indicating that the signal has been transmitted. Outside the door the room indicator lights, as do also the call lamps on the control panel and master set in the nurses' office. Audible signals sound in the nurses' office, as well as in the corridor, kitchen, washing room and linen room. If the nurse is in the corridor or in any of the other locations, she proceeds direct to the patient, guided by the overdoor room indicator. She clears the signal by turning the knob on the restoring panel. If she is in the nurses' office, on the other hand, she answers the call by pressing the relevant button on the master set and then asks on the loudspeaker what the patient wants. The signal is at the same time cleared electrically.

Many calls can be answered on the loudspeaker without the nurse needing to go to the ward. But if her presence in the ward is necessary, she indicates her whereabouts by turning the knob on the restoring panel on her arrival in the ward. This lights the red lamp on the restoring panel as well as the lamp outside the door. Thus the whereabouts of the nurse can be seen in the corridor. If any kind of call arrives while the nurse is in the ward, it is transferred to the ward by the location signalling circuit; at the same time the red lamp on the restoring panel flashes and an audible signal is given. If the nurse requires the help of additional staff, she sends an emergency signal from the ward. Since the location circuit is now engaged, the emergency signal is effected by pulling the cord. The red lamp outside the ward starts flashing at a high frequency, and the buzzers in the nurses' office and at the other locations sound at the same frequency.

When help arrives at the ward, the emergency signal is cleared by turning the knob on the restoring panel, first to the left and then to the right.

The various forms of signal, which are designed to guide and assist the nurses in their work, must of course not be confused. To prevent any such confusion, easily recognizable code signals are employed, i.e. lamps and audible signals operate at different frequencies.

The following variations occur:

ordinary call signal from a patient — — — — — —
(1 sec. signal, 5 secs. interval)

emergency signal — — — — — —
(1 sec. signal, 1 sec. interval)

telephone call — – — – — – — –
(2½ secs. signal, 1 sec. interval, 1 sec. signal, 5 secs. interval.)

Fig. 8 a X 2171
Pushbutton switch KEH 1001

At nighttime audible signals in the wards would be disturbing and are, therefore, automatically switched on and off at predetermined times by means of a program clock. They can also be switched off by hand from the control panel in the nurses' office. The control panel likewise has facilities for disconnection of the buzzer outside the door of the nurses' office, which is used for calling the attention of nurses in the corridor.

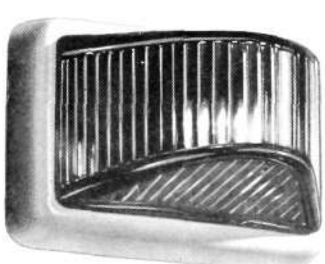
When a doctor visits a department, he usually wants immediate contact with a nurse. A push button has been installed for this purpose at the entrance of the department, which causes a white lamp above the door of the nurses' office to light and audible signals to be given in the nurses' and other rooms. If the nurse is in a ward, the signal is sent to the ward provided that she has indicated her presence there. The signal is cleared by means of a push button at the door of the nurses' office.

Fig. 8 b X 2172
Pushbutton switch KEM 2011

Supervision System for Infants' Wards

Every department has an infants' ward. Irrespective of the nature of the illness and age of the children, they need supervision of a kind different from that in adult wards; the children may either be unable to operate the normal signalling systems, or during convalescence they may disturb other patients. A listening system greatly facilitates supervision by the nurses and makes supervision much more effective than it would otherwise be.

This system consists of a master set located in the nurses' office, and a amplifier and a sub-set in the ward.



The master set (fig. 7) contains a microphone-loudspeaker, switch and speak button; the sub-set is a microphone-loudspeaker.

The system is switched on with the switch on the master set. With the system switched on, the nurse in the duty office is able to overhear all that happens in the ward since the master set functions as loudspeaker and the sub-set as microphone. If the nurse wishes to speak to the ward, she presses the speak button on the master set, so reversing the direction of speech.

Fig. 8 c X 2173
Lamp indicator KNH 832

The supervision system of each department is entirely separate from the intercom system, so that the two systems can be used simultaneously.

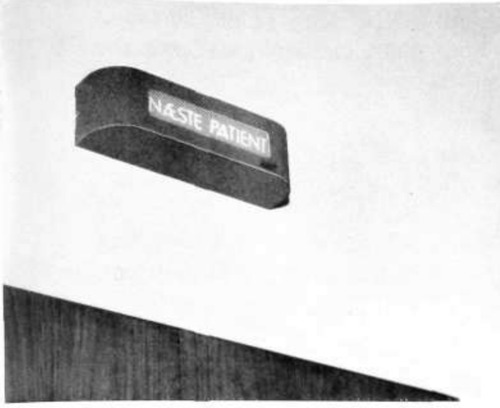


Fig. 9 X 2156

Illuminated panel in waiting room with text "Next patient"

The signal is operated by the nurse on duty and is cleared automatically when the patient opens the door

Signalling Systems for Roentgen Department

Two signalling systems have been installed in the Roentgen Department, each of which assists the work of the department and increases the speed of handling patients.

Emergency Signal System

In the roentgen diagnosis room there is a push button for calling personnel as required. The pressing of the button causes audible signals to sound in the passage outside the room and in the duty nurse's office. When the nurse enters the anteroom, she switches off the signal with a knob on a restoring panel.

"Ready for Examination" Signal

The roentgen department has three changing rooms, in each of which is a switch. The patient in the changing room announces when he is ready for examination by operating the switch, which lights a green lamp outside the door. During exposure of roentgen plates in the diagnosis room the green lamps would have a disturbing effect and can, therefore, all be extinguished simultaneously by a switch in the anteroom.

Signalling System for Tuberculosis Department

"Next Patient" Signal

The duty nurse has a push button (fig. 8 b) which produces an audible signal in the waiting room and lights an illuminated panel with the text "Next patient" (fig. 9). The signal continues only as long as the button is depressed, but the text on the panel remains illuminated until the next patient opens the door from the waiting room to the nurse's office. This is effected by a door contact which causes the resetting relay to extinguish the illuminated text.

Signalling System for Admissions Department

"Engaged" Signals

In each of the bathrooms and examination rooms is a waterproof switch which is operated when any of these rooms is engaged, lighting a red lamp outside the door. The lamp is extinguished by means of the same switch.

Signalling Systems for Physiological Department

Like the Roentgen Department, the Physiological Department is equipped with certain signalling systems.

Door Signals

Treatment is given in three separate rooms, in each of which there is a push button. When one of them is pressed, a lamp lights outside the door and another in the supervisor's room. Of the three sets of lamps, one is white, one yellow and one red, to indicate which room is signalling. In addition to the visual signals an audible signal is given, but only as long as the button is pressed. When the nurse enters the room from which the signal was sent, she clears it by pressing the restoring button.

"Ready for Treatment" Signal

The department has four changing rooms, all equipped with signalling systems similar to those in the changing rooms of the Roentgen Department.

Door Signals for Senior Physician's Office

The Senior Physician has many visitors during his office hours and must have means of remaining undisturbed with them. A door signalling system has therefore been installed.

On his desk is a control set (fig. 10), and outside the door a wall panel. The visitor presses the button on the wall panel, which produces an audible signal in the senior physician's office. The latter presses a button on his control set, causing the text "Engaged", "Wait" or "Come In" to light up on the door panel. If he presses the "engaged" button, a red lamp at the same time lights at the hospital switchboard.

The control set has two additional buttons for calling the secretary or an attendant—at present only the former button is used. An audible signal sounds in the secretary's room when the button is pressed.

Fig. 10 X 2157

Senior physician's desk with control set connected to wall panel outside the door. "Engaged", "Wait" or "Come In" may be signalled, as desired.

Paging System

It is essential that doctors and other members of the staff shall be immediately accessible wherever they are. A paging system is therefore indispensable in a hospital. Its manner of operation on the other hand must be adapted to the particular requirements. For a hospital of the size of Dronninglund, and with its particular form of organization, the most suitable type appeared to be a combined visual and audible paging system operated from the switchboard.

The system caters for 30 persons and incorporates indicators set up in the corridors, offices etc. The indicators (fig. 5) are made up of five differently coloured lamps, and every individual is allocated a different display code. The lamps are operated by a relay set connected to the switchboard and supplied with 24 volts a.c. from the commercial lighting system via a transformer.

When one of the thirty persons fails to answer a telephone call on his ordinary number, the operator or any other member of the hospital staff can page him by initiating a new call, but this time by dialling the prefix of the paging system. When the acknowledgement tone is received from the paging system, the caller dials the paging number of the wanted person as listed in the internal directory. The display code of that person then flashes on all indicators in the hospital, accompanied by sounding of the associated buzzers. When he observes the signal, the person dials the prefix of the paging system on the nearest telephone, whereupon the signals immediately cease and he is connected to the line from which he is being sought.

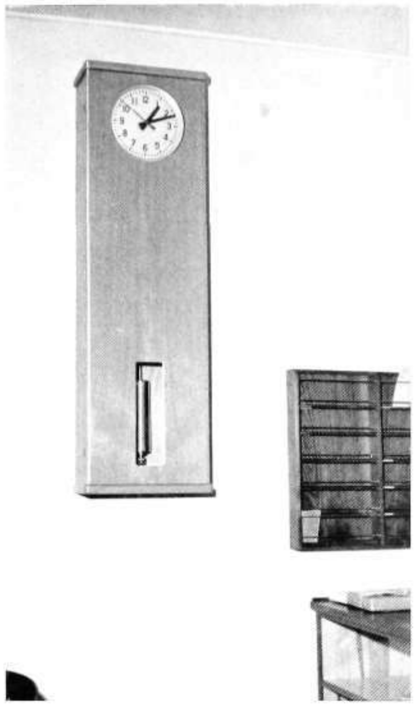


Fig. 11 X 2158 X 2159

a Master clock
located in general office

b Slave clock with second hand
in one of the operating theatres

Electric Clock System

A clock system which always shows the correct time forms an essential part of a modern hospital. Many routine jobs have to be done at a definite time, and exact timing in operating theatres is of absolute necessity.

Electric slave clocks controlled by a precision master clock (fig. 11 a) have therefore been installed. The master clock is operated from a 24-volt storage battery, and the slave clocks, divided into three individually controlled groups, are connected through relay sets and fuses. The three groups are allocated as follows:

Group 1. Slave clocks with hour and minute hands: in corridors outside wards and treatment departments, and in offices.

Group 2. Slave clocks, similar to group 1, but with seconds hand as well: in obstetric, operating and treatment rooms.

Group 3. Slave clocks with hour and minute hands for the household department.

The master clock and the slave clocks associated with it can be simply adjusted by means of a regulating relay set.

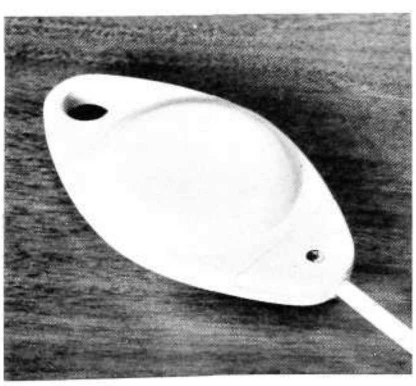


Fig. 12 X 2160
Pillowspeaker

Sound Distribution System for Wards

The possibility of listening to radio programs and local musical programs from a gramophone or tape recorder is of inestimable value for the general comfort of patients. While providing for these facilities, a sound distribution system can at the same time be used for internal communications to all patients or to any group of patients.

The sound distribution system at the Hjørring County Hospital is an L M Ericsson combine-unit system, as described in Ericsson Review No. 2, 1955. The central equipment, here consisting of amplifier, distribution unit,

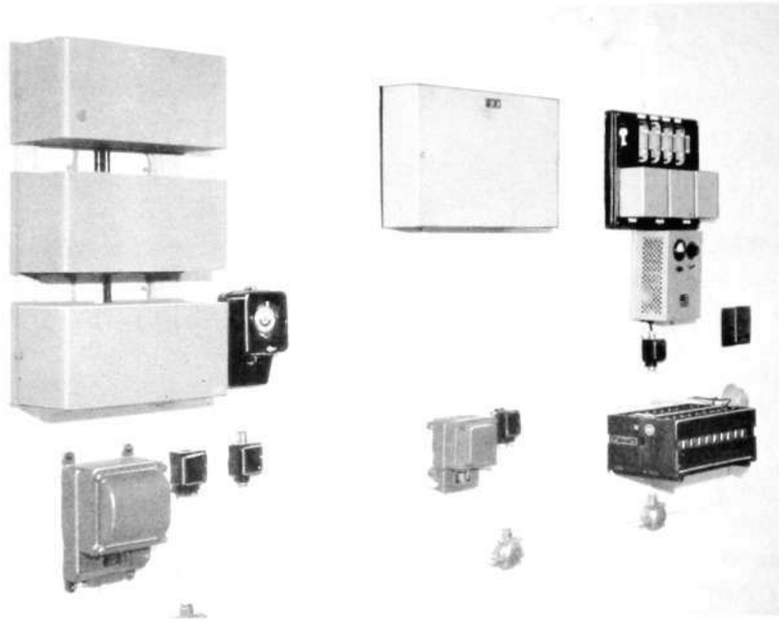


Fig. 13 X 6994

Central equipment

On the left are three relay sets for signalling systems, with transformer at bottom. To the right of them a synchronous program clock for switching off buzzer signals. In the centre the relay and fuse equipment of the paging system, and rectifiers and storage battery for electric clock system.

radio receiver, gramophone and tape recorder, is placed in a control room, where there is also a microphone for making local announcements. Microphone points are provided also in the day rooms.

The program is heard by patients in the pillowspeakers (fig. 12). The pillowspeakers, which connect to a bedside socket by cord and plug, are of a new design with extremely good quality of reception. The plastic cap of the speaker is easy to keep clean and is unaffected by knocks. The pillowspeaker will be described in greater detail in a coming number of Ericsson Review.

Fittings

Wiring and apparatus in the wards, corridors and nurses' rooms are flush mounted as far as possible, as this simplifies cleaning of the apparatus and reduces the space requirements to a minimum.

The relay equipment and other auxiliary apparatus of the systems is installed in a room in the basement (fig. 13). Here there are relay sets for the signalling systems, transformers for the current supply, the program clock for connection and disconnection of buzzers, and the relay set and transformer of the paging system. The electric clock system has a separate storage battery, which with its rectifiers and fuses is placed in the same room.

Power Supply

All systems described above are connected to the a.c. mains, either directly or through transformers. This does not mean, however, that the important internal communications will break down on a power failure, for the hospital possesses a diesel-driven generator as standby power supplying all internal system as well as lighting and other electrical installations.

NEWS *from* All Quarters of the World

Extension of L M Ericsson's Cable Works, Älvsjö

L M Ericsson's Cable Works have long nurtured plans for extension of their plant to be able to cope with growing production demands and to complete the installation of the new machinery on which cable manufacture increasingly relies.

The recent opening of a new cable shop completed the first stage of the program. The next stage, comprising a rather larger building, is expected to start at the end of this year. But a third building will be added before the plant assumes its ultimate shape.

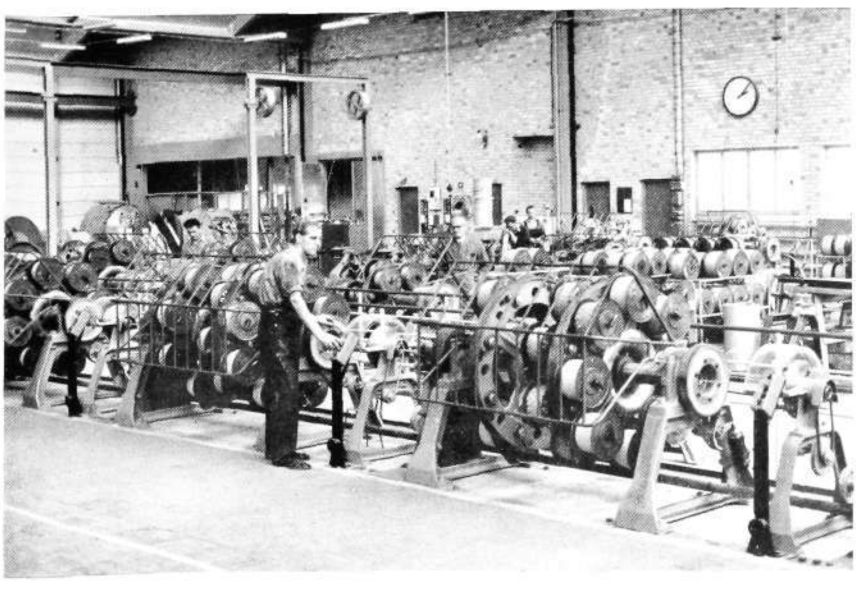
Cable and wire are an important part of every telephone network and telesignalling system. The merging of the Älvsjö Cable Works with the L M Ericsson group in 1921, after its launching by AB Stockholmstelefon a few years earlier, was thus a natural development. In 1928 L M Ericsson also took over Sieverts Kabelverk, which necessitated a reorganization of the activities of the two cable manufacturers, with Älvsjö concentrating mainly on local cable.

The present production schedule comprises local cable, exchange cable, connecting wire, lead-in cable, telephone and switchboard cordage, enamelled copper wire; and, in addition, a few products which lie outside the field of actual telephony, such as cable for railway signalling, fire alarm and paging systems, high frequency circuits etc.

Great changes in cable technique have come about in the last ten years, primarily due to the new plastic materials that have opened the way for new types of cable, which are better, and usually cheaper, than the previous types. As a result of this development, practically all textile insulated cable and wire has disappeared from production and been replaced by plastic insulated types. Plastics are now also making their way into the field of paper insulated cable. Side by side with these technical developments a heavy quantitative expansion has become necessary, and the production of the Cable Works has been more than tripled in ten years, counted on length of wire in manufactured cable. There is at present a very heavy demand for telephone cable in Sweden, as in all other parts of the world.

The first extension of the Älvsjö cable shop is 230 ft. in length and 200 ft. in depth. Work is shortly to start on the second stage, which will give the building a frontage of 500 ft.

(Below.) One of the new cabling machine assemblies.



New Automatic Exchanges in Denmark

Inauguration of the new automatic exchange at Horsens. Mr. P Draminsky, Head of the Jutland Telephone Co., makes the first call through the exchange. He is seen (right) speaking to Mr. Robert Holm, Mayor of Horsens.

In conjunction with the opening of the exchange, the Jutland Telephone Co. had arranged an exhibition of the new features provided by conversion to dial working. Subscribers were given the opportunity of expert instruction in the use of the new dial telephones.

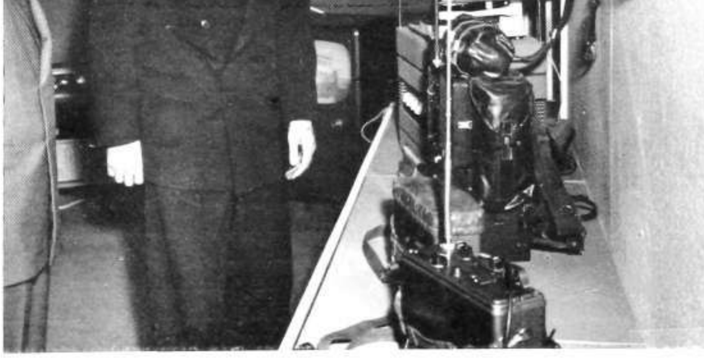
A great step forward in the conversion of Copenhagen to dial working was taken on the night of October 21, 1956, when the Lyngby exchange was cut over. The exchange equipment, consisting of crossbar system ARF 10 for 10,000 lines, was delivered and installed by L M Ericsson. This system now covers 49,000 lines in operation in the Copenhagen area, as well as a transit exchange handling the Copenhagen area traffic. L M Ericsson has work in progress, or on contract, for a further 70,000 lines of the same system in Copenhagen, and an automatic trunk exchange of crossbar system ARM 20.

Horsens' new automatic exchange, built by L M Ericsson, was also put into service in October. The cut-over, which was effected with great smoothness, means that the previous manual subscribers in Horsens have been transferred to the new crossbar exchange, which has now been extended to 5,000 lines and also incorporates equipment for automatic trunk traffic. Subscribers in Horsens can now dial calls to Aarhus and Copenhagen among other places.

The Horsens automatic exchange is the first plant to have the local section equipped with L M Ericsson's modified crossbar system type ARF 101.

New Autoexchange in Stockholm

New telephone exchanges in Stockholm are nowadays a comparatively rare occurrence—Farsta with 10,000 lines, completed in 1952, was the last large automatic exchange to be put in service—but this autumn, on September 21, a new automatic exchange was opened in Ulriksdal. It is a 500-point selector exchange with an initial capacity of 3,000, and ultimate 4,000, lines. It serves the new Bergshamra and neighbouring residential districts and will also take over a number of subscribers from the Råsunda and Djursholm exchanges, which can thus release these lines for new subscribers.



Presidential Visit to Radio Exhibition

A radio and television exhibition was held in Helsinki in October, at which the Finnish Ericsson Company was among the exhibitors. The exhibition was visited by the Finnish President, Mr. Kekkonen, who is here seen inspecting Svenska Radioaktiebolaget's portable radio stations. The Chairman of the Exhibition Committee, Col. Saarmaa, is seen on the left.

From the Visitors' Book

The Swedish Ambassador to India, Mrs. Alva Myrdal, visited Midsommarkransen in early September. Mr. Göte Fernstedt is demonstrating the new Ericofon. In the background are (from left) Messrs. Åke Myrlöv of the Swedish Export Association, Nils Sköldberg and E Klingström of LM Ericsson.

The Uruguyan Minister to Sweden, Juan Felipe Yriart, Senator Luiz A Troccoli, and the Secretary of the Senate Committee for International Affairs, Alberto Mañé, photographed during a visit to L M Ericsson. Minister Yriart is speaking to Senator Troccoli via a demonstration switchboard in the Exhibition Room.

The Colombian Ambassador to Spain, Gilberto Alzate Avendo, made the acquaintance of the Ericofon during a recent visit to Midsommarkransen. The other members of the party are the Colombian Minister to Portugal, Cesar Augusto Noriega, and Colombia's Chargé d'Affaires in Sweden, Fernando Arbelaez, with Mr. Göte Fernstedt between them.

Among visitors to L M Ericsson this autumn were Mr. Soekardan, Director General of the Indonesian P.T.T., and Mr. Ichsan, the Indonesian Minister in Sweden, accompanied by their wives. The President of L M Ericsson, Ture Åberg, is seen standing in the centre behind them.

Automatic Telephone Equipment for Finnish State Railways

The Finnish State Railways recently placed an order with L M Ericsson for automatic telephone equipment for the Finnish Railway Telephone System.

The order comprises chiefly crossbar type exchanges for Helsinki and five other stations, as well as additions to the existing exchanges at three stations. The latter exchanges are of the L M Ericsson 500-line selector type.

These exchanges form the first stage in an automatic railway telephone system planned to cover the whole of Finland.

Ericsson Technics

Ericsson Technics No. 1, 1956, was published recently. The issue contains the following articles: "Statistical Methods for Supervision of Telephone Exchanges and Networks" by A. Elldin and G. Lind, Telefonaktiebolaget L M Ericsson; "On Equations of State for a Two-Stage Link System" by A. Elldin; and "Distortionless Coaxial Cables" by G. Mattsson of Sieverts Kabelverk.

New LM Exchanges at Alingsås and Sunne

Two new automatic exchanges constructed by L M Ericsson were recently opened at Alingsås and Sunne. This brings nationwide subscriber-to-subscriber dialling one step nearer, since Alingsås subscribers can now dial direct to the Gothenburg, Borås, Trollhättan and Vänersborg areas among others.

The Alingsås exchange for 4,500 lines, the switching equipment for which was manufactured and installed by L M Ericsson, is constructed on the Swedish Telecommunications Administration's crossbar system ART 204. LME also supplied the toll traffic equipment for this exchange, which serves 36 automatic satellite exchanges.

Also at Sunne, which is a 1,300-line ART exchange, the switching equipment was manufactured and installed and the toll traffic equipment supplied by L M Ericsson.

Extension of L M Ericsson's Plant at Midsommarkransen

An extension is being made to the L M Ericsson plant at Midsommarkransen. The new wing, which was started in the autumn and will form a direct extension to the existing office building, will be 122 ft. long, 43 ft. wide and 178 ft. high. It is planned that the 13-storey building shall include accommodation for the management of the entire Ericsson group.

The new wing will add a further 62,000 sq.ft. to the present accommodation, and the entire south facade of the Midsommarkransen building will be 856 ft. in length.

Testing repeaters at the new Alingsås exchange.

U.D.C. 621.395.44

EWEN, A W & NEVITT, H J B: *Application of 8-channel Open-wire Carrier Telephone Systems in Brazil.* Ericsson Rev. *33* (1956) No. 3, pp. 64—73.

The article discusses engineering considerations leading to the adoption of L M Ericsson 8-channel carrier telephone system, type ZAA 8, for certain Companhia Telefonica Brasileira open-wire routes in the state of São Paulo, Brazil. Actual measurements are also given for the ZAA 8 carrier routes demonstrating that all transmission performance objectives have been achieved with a minimum investment for new plant.

U.D.C. 621.395.344:654.
153.28(492)

VAN DER HAER, *F W: Practical Experience in the Operation of Crossbar Exchanges in the Rotterdam Zone.* Ericsson Rev. *33* (1956) No. 3, pp. 74—80.

A short review of the Netherlands telephone network with particular reference to the Rotterdam zone. A history is given of the crossbar exchanges in the Middelharnis group served from Rotterdam. Fault statistics and maintenance routines are discussed, and figures are given of traffic observations in the Rotterdam zone centre.

U.D.C. 654.9:725.511:681.116.2

TRÄGÅRDH, A & KAMP JØRGENSEN, J: *Telesignalling Equipment in a Modern Hospital.* Ericsson Rev. *33* (1956) No. 3, pp. 81—90.

Telesignalling equipment has found increasing use in modern hospitals. Experience proves that telesignalling systems contribute greatly to efficiency and to rapidity in treatment and care of patients, while at the same time reducing the work of nurses. The planners of the Hjørring County Hospital at Dronninglund, Denmark, opened at the end of 1955, had decided on the acquisition of various telesignalling systems, the entire installation of which was entrusted to L M Ericsson A/S of Copenhagen.

The equipment for these systems, most of which was manufactured by L M Ericsson in Stockholm, incorporates certain new designs and principles which imply greater flexibility and rapidity than in previous systems.

The Ericsson Group

Associated and co-operating enterprises

• EUROPE •

Danmark

L M Ericsson A/S *København F*, Finsens Vej 78, Tel: Fa 6868, tgm: ericsson

Telefon Fabrik Automatic A/S *København K*, Amaliegade 7, tel: C 5188, tgm: automatic

Dansk Signal Industri A/S *København F*, Finsens Vej 78, tel: Fa 6767, tgm: signaler

Deutschland

Ericsson Verkaufsgesellschaft m. b. H. *Düsseldorf 1*, Worringer Strasse 109, tel: 84 461, tgm: erictel

España

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

France

Société des Téléphones Ericsson *Colombes (Seine)*, Boulevard de la Finlande, tel: CHA 35-00, tgm: ericsson

Paris 17e, 147 Rue de Courcelles, tel: Carnot 95-30, tgm: eric

Société Cinéric *Paris 20e*, 111 Rue Villiers de l'Isle Adam, tel: Ménilmontant 87-51, tgm: cinericsson

Great Britain

Swedish Ericsson Company Ltd. *London, W. C. 1*, 329 High Holborn, tel: Holborn 1092, tgm: teleric

Production Control (Ericsson) Ltd. *London, W. C. 1*, 329 High Holborn, tel: Holborn 1092, gm: productrol holb

Italia

Setemer, Soc. per Az. *Milano*, Via dei Giardini 7, tel: 662241, tgm: setemer

SIELTE, Soc. per Az. — Società Impianti Elettrici e Telefonici Sistema Ericsson *Roma*, C. P. 4024 Appio, tel: 78 02 21, tgm: sielte

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

S.E.T. Soc. per Az. — Società Esercizi Telefonici *Napoli*, Via Roberto Bracco 20, tel: 50 000, tgm: set

Nederland

Ericsson Telefoon-Maatschappij, N.V. *Rijen (N. Br.)*, tel: 01692-555 tgm: erictel

den Haag—Scheveningen, Gevers Deynootplein 30, Kurhaus, tel: 55 55 00, tgm: erictel-haag

Norge

A/S Elektrisk Bureau *Oslo*, P. B. 5055, tel: Centralbord 461820, tgm: elektriken

A/S Industrikontroll *Oslo*, Teatergaten 12, tel: Centralbord 335085, tgm: indtroll

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

A/S Norsk Signalindustri *Oslo*, P.B. Mj 2214, tel: Centralbord 56 53 54

Portugal

Sociedade Ericsson de Portugal, Lda. *Lisboa 7*, Rua Filipe Folque, tel: 57193, tgm: ericsson

Schweiz

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

Suomi

O/Y L M Ericsson A/B *Helsinki*, Fabianinkatu 6, tel: A 8282, tgm: ericssons

Sverige

Telefonaktiebolaget L M Ericsson *Stockholm 32*, tel: 19 00 00, tgm: telefonbolaget

AB Alpha *Sundbyberg*, tel: 28 26 00, tgm: aktiealpha-stockholm

AB Ermex *Solna*, tel: 82 01 00, tgm: elock-stockholm

AB Ermi *Ulvsunda 1*, tel: 26 26 00, tgm: ermibolag-stockholm

AB Rifa *Ulvsunda*, tel: 26 26 10, tgm: elrifa-stockholm

AB Svenska Elektronrör *Stockholm 20*, tel: 44 03 05, tgm: electronics

L M Ericssons Driftkontrollaktiebolag *Solna*, tel: 27 27 25, tgm: powers-stockholm

L M Ericssons Svenska Försäljningsaktiebolag *Stockholm*, Kungsgatan 33, tel: 22 31 00, tgm: ellem

L M Ericssons Signalaktiebolag *Stockholm Sv*, tel: 19 01 20, tgm: signalbolaget

Mexikanska Telefonaktiebolaget Ericsson *Stockholm 32*, tel: 190000, tgm: mexikan

Sieverts Kabelverk *Sundbyberg*, tel: 28 28 60, tgm: sievertsfabrik-stockholm

Svenska Radioaktiebolaget *Stockholm*, Alströmergatan 12, tel: 22 31 40, tgm: svenskradio

• ASIA •

India and Ceylon

Ericsson Telephone Sales Corporation AB *Calcutta*, P. O. B. 2324, reg. mail: *Calcutta 22*, 5 Commissariat Road, P. O. Hastings, tel: Alipore 2951/2952, tgm: inderic

New Delhi, 45, Indra Palace, Connaught Place, tel: 444 90, tgm: inderic

Indonesia

Ericsson Telephone Sales Corporation AB *Bandung*, Djalan Dago 151, tel: 2135, tgm: javeric

Liban

Telefonaktiebolaget L M Ericsson, Technical Office *Beyrouth*, Rue du Parlement, Immeuble Bisharat, tel: 33555, tgm: ellem

Türkiye

Ericsson Türk Ltd. Şirketi *Ankara* Âdil Han, Zafer Meydani, Yenişehir, tel: 28379, tgm: ellem

• AMERICA •

Argentina

Cía Sudamericana de Teléfonos L M Ericsson S. A. *Buenos Aires*, Belgrano 894, tel: 332071, tgm: ericsson

Corp. Sudamericana de Teléfonos y Telégrafos S. A. *Buenos Aires*, Belgrano 894, tel: 332071, tgm: cartefe

Cía Argentina de Teléfonos S. A. *Buenos Aires*, Perú 263, tel: 305011, tgm: cecea

Cía Entrerriana de Teléfonos S. A. *Buenos Aires*, Perú 263, tel: 305011, tgm: cecea

Cía Comercial de Administración S. A. *Buenos Aires*, Perú 263, tel: 305011, tgm: cecea

Industrias Eléctricas de Quilmes S. A. *Quilmes FCNGR*, 12 de Octubre 1090, tel: 203-2775, tgm: nidelqui-buenosaires

Brasil

Ericsson do Brasil Comércio e Indústria S. A. *Rio de Janeiro*, C. P. 3601, tel: 43-0990, tgm: ericsson

São Paulo C. P. 5677, tgm: ericsson

Empresa Sul Americana de Telefones S. A. *Rio de Janeiro*, C. P. 4684, tel: 43-0990, tgm: emsulatel

Canada

Ericsson Telephone Sales of Canada Ltd. *Montreal 8, Quebec*, Bates Road, Town of Mount Royal, tel: REgent 1—6428, tgm: caneric

Toronto, 18, Ontario, P.O.B. 161, tel: BElmont 1-1306

Chile

Cía Ericsson de Chile S. A. *Santiago*, Casilla 10143, tel: 82555, tgm: ericsson-santiagodechile

Colombia

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

México

Cía Comercial Ericsson S. A. *México D. F.*, Apartado 9958, tel: 35-95-88 tgm: coeric-mexico

Teléfonos de México S. A. *México D. F.*, Paseo de la Reforma 107 tel: 21-91-00, tgm: elmex-mexico

Perú

Cía Ericsson S. A. *Lima*, Apartado 2982, tel: 34941, tgm: ericsson

Soc. Telefónica del Perú, S. A. *Arequipa*, Casilla de Correo 112, tgm: telefonica

Uruguay

Cía Ericsson S. A. *Montevideo*, Casilla de Correo 575, tel: 844 33, tgm: ericsson

USA

The Ericsson Corporation *New York 17, N. Y.*, 100 Park Avenue, tel: Murray Hill 5-4030, tgm: erictel

North Electric Co. *Galion, Ohio*, P. O. B. 417, tel: 24201, tgm: northphone-galion-ohio

Venezuela

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

Teléfonos Ericsson C.A. *Caracas*, Apartado 3548, tel: 557467, tgm: tevela

• AUSTRALIA & OCEANIA •

Australia

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

Agencies

• EUROPE •

Belgique

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

Greece

»ETEP», S. A. Commerciale & Technique *Athens*, 1, Stadiou Street, tel: 31 211, tgm: aeter

Ireland

E. C. Handcock, Ltd. *Dublin, C 5*, 17 Fleet Street, tel: 76 501, tgm: forward

Island

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

Yougoslavie

Merkantile Inozemma Zastupetva *Zagreb*, P. O. B. 23, tel: 25—222, tgm: merkantile

Österreich

Inglomark, Industrie-Beliefe-rungs-Gesellschaft Markowitsch & Co. *Wien XV*, Maria Hilferstrasse 133, tel: R 32-0-11, tgm: inglomark

• ASIA •

Burma

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

China

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

Hongkong

The Swedish Trading Co. Ltd. *Hongkong*, Prince's Building, Ice House Street, tel: 20 171, tgm: swedetrade

Iran

Irano Swedish Company AB *Teheran*, Khiaban Sevom Esfand 201-203, tel: 36761, tgm: iranoswede

Iraq

Swedish Oriental Company AB *Baghdad*, Azzoz Building 269 A/195 King Faisal II Street, tel: 848 19, tgm: swedeorient

Israel

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

Japan

Gadelius Co. Ltd. *Tokyo*, Shiba Park No. 7 Minato-ku, tel: (43)-1847, tgm: goticus

Jordan

H. L. Larsson & Sons Ltd. Levant *Amman*, P. O. B. 647, tgm: larsonhus

Kuwait

Latiff, Supplies Ltd. *Kuwait*, P.O.B. 67, tgm: latisup

Liban

Swedish Levant Trading *Beyrouth*, P. O. B. 931, tel: 31624, tgm: skefko

Malaya

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

Pakistan

Vulcan Trading Co. (Pakistan) Ltd. *Karachi City*, P. O. B. 4776, tel: 32506, tgm: vulcan

Philippines

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

Saudi Arabia

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

Syrie

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

Thailand

The Vichien Radio & Television Co., Ltd. *Bangkok*, 299-301, Prasitsin Bldg, Suriwongse Road, tel: 318 69, tgm: vision

Vietnam, Cambodja & Laos

Compagnie Internationale de Commerce *Saïgon*, (Vietnam), P. O. B. 204 tel: 20253, tgm: intercom

• AFRICA •

British East Africa

Transcandia Ltd. *Nairobi, Kenya*, P. O. B. 5933, tel: 3312, tgm: transcanda

Congo Belge

Société Anonyme Internationale de Télégraphie sans Fil (SAIT) *Bruxelles (Belgique)*, 25, Boulevard de Régent, tel: 12 50 70, tgm: wireless

Egypt

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

Ethiopia

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

Gold Coast (Ghana)

The Standard Electric Company *Accra*, P. O. B. 17, tel. 2785, tgm: standard

Moçambique

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

Nigeria

Scan African Trading Co. *Yaba Lagos* 32, P. O. B. 1, tgm: swedafrica

Rhodesia & Nyasaland

Reunert & Lenz, (Rhodesia) Ltd. *Salisbury* (Southern Rhodesia), P. O. B. 2071, tel: 27001, tgm: rockdrill

Tangier

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

Union of South Africa

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

• AMERICA •

Bolivia

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

Costa Rica

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

Cuba

Mc Avoy y Cía *Habana*, Apartado 2379, tel: U-2527, tgm: macavoy

Curaçao N. W. I.

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

República Dominicana

García & Gautier, C. por A. *Ciudad Trujillo*, Apartado 771, tel: 3645, tgm: gartier

Ecuador

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

Guatemala

Nils Pira *Ciudad de Guatemala*, Apartado 36, tel: 3311, tgm: nilspira-guatemala

Haïti

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

Honduras

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

Jamaica and Brit. Honduras

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

Nicaragua

J. R. E. Tefel & Co. Ltd. *Managua*, Apartado 24, tel: 387-1169, tgm: tefello

Panama

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

Paraguay

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

El Salvador

Dada-Dada & Co. *San Salvador*, Apartado 274, tel: 4860, tgm: dada

Surinam

C. Kersten & Co. N. V. *Paramaribo*, P. O. B. 216, tel: 2541, tgm: kersten

USA

State Labs. Inc., *New York 12, N.Y.*, 649 Broadway, tel: Oregon 7-8400, tgm: statelabs. Only for electron tubes

• AUSTRALIA & OCEANIA •

New Zealand

ASEA Electric (N Z) Ltd. *Wellington C 1.*, Huddart Parker Building, Post Office Square, tel: 70-614, tgm: aseaburd

ESSELTE, STHLM 57

ERICSSON Review

4
1956

ERICSSON REVIEW

Vol. XXXIII No. 4 1956

RESPONSIBLE PUBLISHER: HUGO LINDBERG

EDITOR: SIGVARD EKLUND, DHS

EDITOR'S OFFICE: STOCKHOLM 32

SUBSCRIPTIONS: ONE YEAR $ 1.50; ONE COPY $ 0.50

CONTENTS

	page
Ericsson Telephones	96
Ericofon—The New Telephone Set	99
The Ericofon Chassis	110
Circuit Design of Ericofon	115
Ericofon Receiver and Transmitter Insets	119
Ericofon Induction Coil	122
L M Ericsson News from All Quarters of the World	123

Ericsson's Telephones

SVEN TURE ÅBERG, PRESIDENT, TELEFONAKTIEBOLAGET LM ERICSSON, STOCKHOLM

U.D.C. 621.395.721

In this issue of the Ericsson Review we present an entirely new instrument, the *Ericofon,* which we believe will have a great influence on the evolution of the telephone. In doing so, we feel we should say a few words about the past achievements of L M Ericsson in the development of telephone instruments.

When the founder of the Company, the young Swedish technician Lars Magnus Ericsson, started making telephones in 1878—only two years after Bell's invention—he naturally took the American instruments as his prototype. Soon, however, he was producing his own designs. They evolved both out of Lars Magnus Ericsson's own creative ability and in answer to the desires of his rapidly-growing circle of customers abroad. He was, in fact, one of the pioneers among telephone designers.

In the early eighties L M Ericsson brought out the wall instrument, illustrated in fig. 1, with writing tablet, fixed transmitter and separate receiver, polarized bell, hand generator and battery. This became the prototype of Ericsson's wall instruments and remained the predominant model for a long time. The wall telephone was soon followed by a desk instrument, but it was not until 1892 that Ericsson was ready with the handset illustrated in fig. 2, which was to carry his name across the world and which for many years remained his trademark. It was Ericsson, in fact, who designed the first handsets. Some years earlier, in response to an idea conceived in Sweden, he

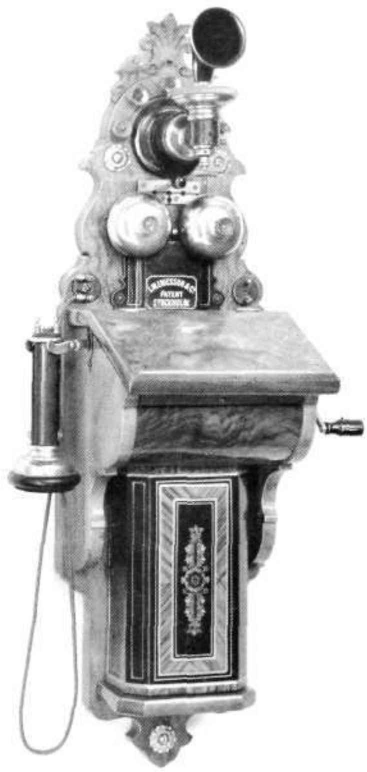


Fig. 1 X 2177
L M Ericsson's wall set of 1882

Fig. 2 X 6995
L M Ericsson's first desk handset instrument, the 1892 model

Fig. 3 X 6996
The 1909 telephone

had combined the receiver and transmitter into a single unit on the two ends of a handle. However, it was in a desk telephone of 1892 that he first succeeded in creating a convenient and efficient handset by introducing the carbon granule transmitter and a receiver with a ring magnet in an inner case. It was the first telephone handset in the world, and it met with outstanding success. This type of telephone was still being asked for by loyal customers as late as the nineteen-thirties.

It is not only the handset, however, which makes this telephone interesting. Despite the form and decoration characteristic of the taste of those times, one must admire the technical design of the instrument. The use of the permanent magnets of the generator as base for the remaining, exposed parts of the instrument bears witness to Ericsson's unusual ability to create functional products well adapted to industrial production.

Fig. 4 X 2179
The 1922 dial desk set

The leading position in telephone design which Lars Magnus Ericsson won for us has been maintained since he relinquished the management of the Company at the beginning of this century.

The introduction at that period of common-battery telephone exchanges was followed by the well-known desk and wall telephones in metal cases, as illustrated in fig. 3. They had cleaner lines, but their style was still influenced by earlier ideals. A dial was added, as shown in fig. 4, when automatic systems began to make progress in the early twenties.

By 1931 the Ericsson Group was ready to introduce the plastic-encased dial set, a bold new step forwards in the development of the telephone. This set (fig. 5) differed from earlier types in that both handset and instrument case were made of a thermosetting plastic, and that the handset no longer rested in a moving cradle but in a fixed seating on top of the case. The fundamental

Fig. 5 X 6997

The 1931 desk set

design and the radical modern form, adapted for plastic moulding, were the work of Ericsson's Norwegian associate, Elektrisk Bureau. The component designs and the organization of modern mass production methods were developed by L M Ericsson in Stockholm.

The plastic set marked an epoch in the evolution of the telephone comparable with the introduction of the handset 40 years before. It is no exaggeration to say that this Ericsson telephone created a school of design and became the prototype of the plastic-case dial telephones which have since appeared in various parts of the world.

The future will show whether the same may one day be said of the Ericofon.

Fig. 6 X 6993

The same set in its modernized form (1947)

The Ericofon—the New Telephone Set

HUGO BLOMBERG, ERICSSON GROUP, STOCKHOLM

UDC 621.395.721.4

Some years ago the problem of developing an improved version of the well-known Ericsson plastic-encased telephone set came up for consideration. It soon became clear that the technical prerequisites for the creation of a radically new design were at hand. Great advances had been made in the development of ferromagnetic materials, so that smaller, lighter receivers and induction coils were possible; the use of aluminium alloys as constructional materials was making rapid progress; and new types of plastics suited to telephone design had become available. The possibility of reducing the weight and size of the components and parts of a dial telephone set meant that the design of the new instrument could be approached from entirely new directions.

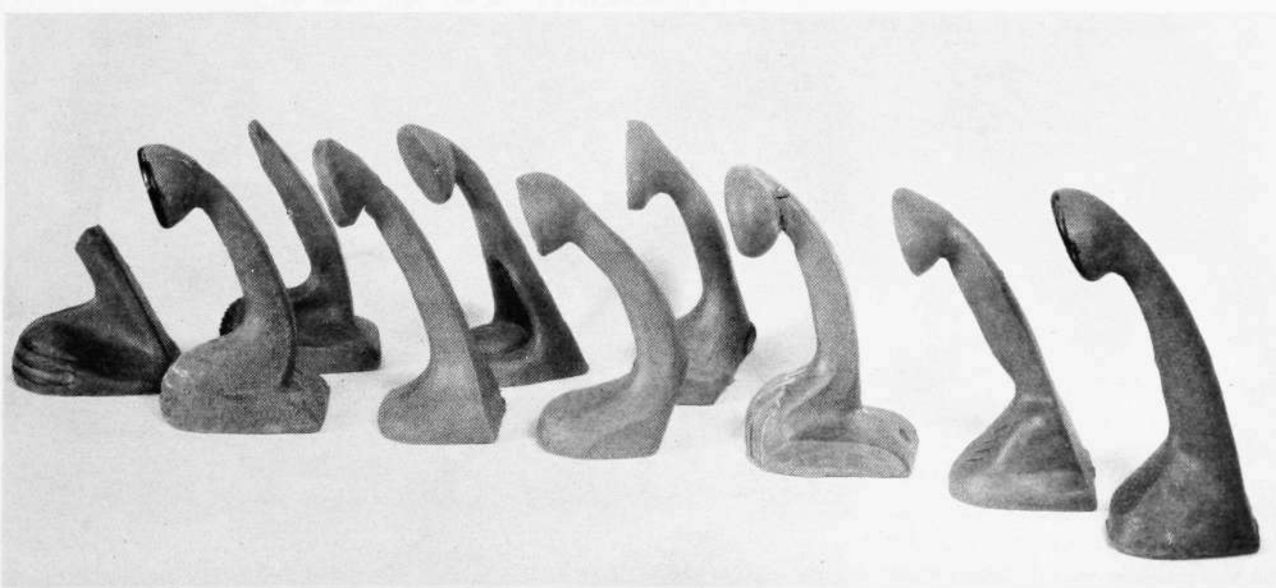
The Fundamental Idea

The main principle enjoined on the designers was that all parts handled by the subscriber when making a telephone call should be combined into a *single unit*. This was a complete departure from the conventional two-piece desk type dial telephone with transmitter and receiver mounted in the handset and dial and cradle switch in the main case of the instrument. We believed that a one-piece telephone would be much more convenient and more efficient to use.

The idea was that the instrument should consist of a desk-handset incorporating at least the dial and switch with the transmitter and receiver, while the remaining components could be mounted in a wall terminal box. The subscriber would hold in his hand the entire desk unit, and the set must therefore not weigh more than an ordinary handset alone.

Since the chief requirement was convenience in handling, the best design proved to be a kind of *standing microtelephone*, which we call the "standset". It was from this point of departure that the problem was attacked; it resolved mainly into a question of designing a unit of modern and attractive appearance.

Fig. 1 X 7707
Some early clay models of the Ericofon



The relative positions of the transmitter and receiver were virtually predetermined, whereas the placing of the dial allowed various alternatives. Since it was desirable to retain roughly the existing form of finger wheel—the diameter of which is considerably larger than that of the receiver and transmitter—the most appropriate position for the dial was found to be on the bottom of the set, with the finger wheel facing downwards. In other words, the base of the set would be constructed on an inverted dial. The "standswitch" was to be located in the base and to be actuated by the weight of the set when placed on the table.

Considerable advantages were gained by this arrangement of the dial. Its low placing meant that its comparatively large size and weight would impart stability to the telephone. During conversation it would be out of the line of saliva spray from the speaker's mouth. When the set was not in use, the dial would be protected from accidental operation and dust.

Under these conditions the immediate task was to design an attractive instrument case. It should be easy to grasp the set, lift it from the table, bring the finger wheel to convenient dialling position and—still without shifting the grip—hold the set in a good speaking position. In addition, the case must contain the receiver, transmitter, dial and switch with their wiring and terminals.

The design was based on the commonly made observation that many people, when using an ordinary telephone, do not hold the microtelephone by the actual handle but at the end, by the mouthpiece. The case was therefore shaped so that it could be grasped at the base, where the greatest weight is concentrated.

Some clay models, early versions of this design, are shown in fig. 1. The first model used in actual telephoning is shown in fig. 2. After many years of experimentation and practical tests the new telephone set—the *Ericofon*—can now be presented.

Fig. 2 X 6999
The first working model

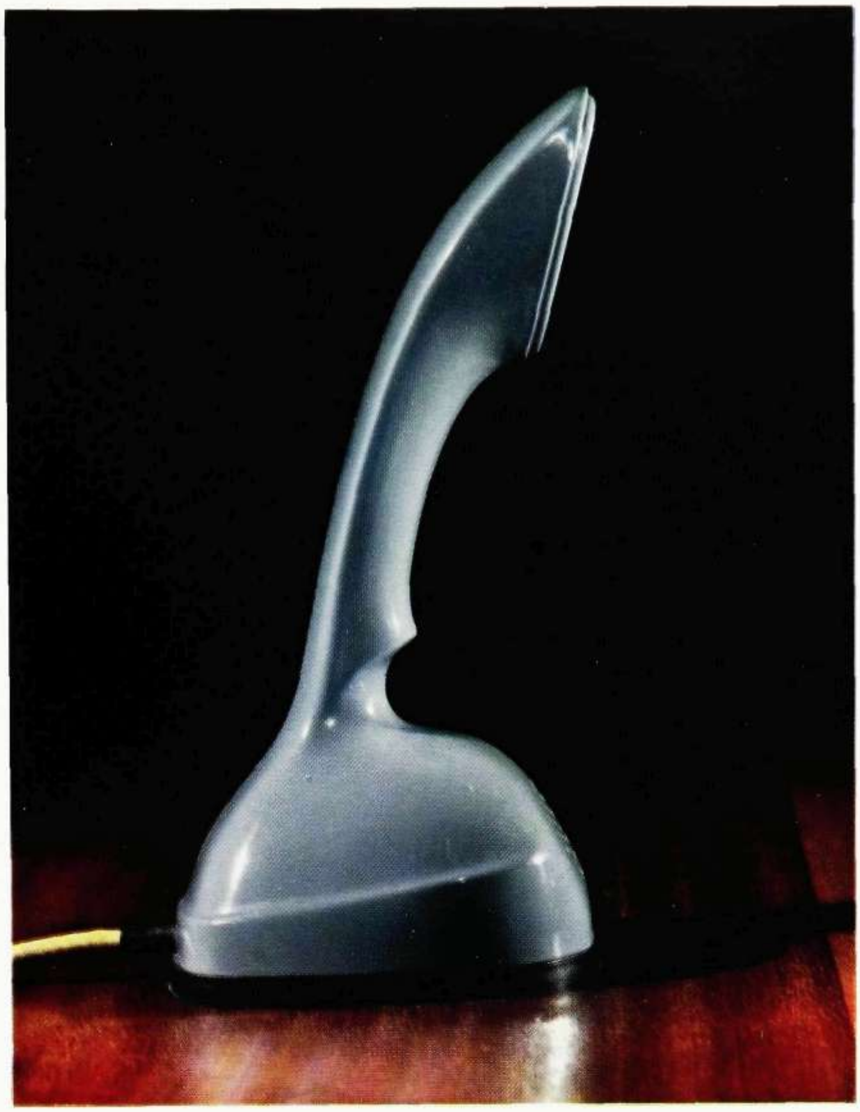


Fig. 3
The characteristic lines of the Ericofon

The Construction of the Ericofon

The Ericofon consists of three parts:

1. the set, which stands on the table and is picked up and used by the subscriber,

2. the wall terminal box,

3. a cord connecting the two.

1. *The Standset*

Appearance and operation. The exterior of the set is shown from various angles in figs. 3, 4 and 5.

When the set is standing on a table, only the plastic case is visible. Out of the substantial base a horn-shaped neck with a slight forward slope arises, growing broader towards the top. The transmitter is located in the front of the base, and the receiver at the upper end of the neck. The case is fully symmetrical and can be grasped easily with either hand.

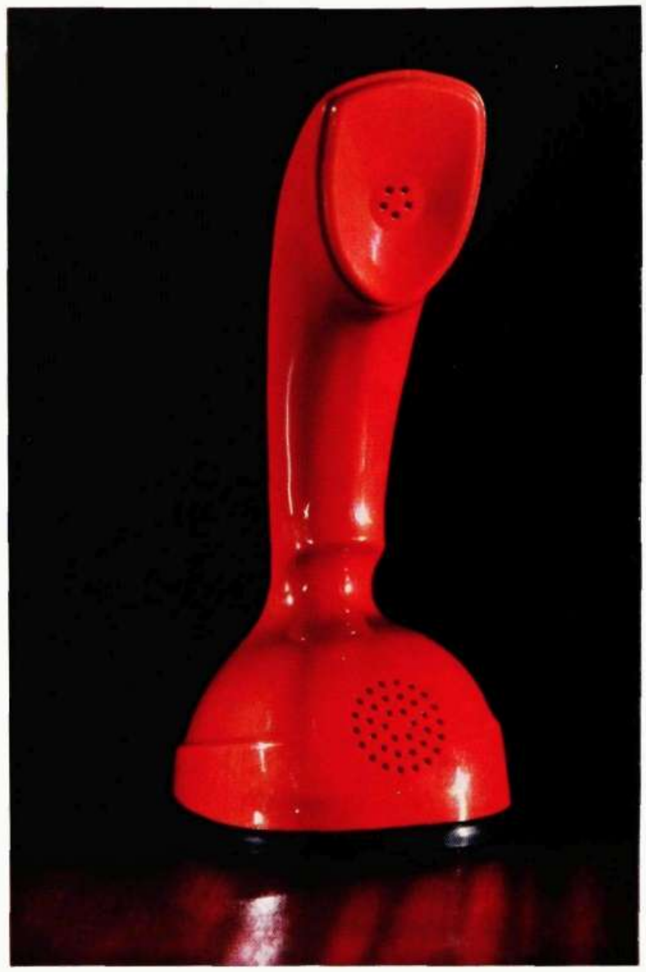


Fig. 4
The Ericofon is made in several colours

The base is designed to enclose the various components and at the same time fit the hand naturally. At the juncture of base and neck there is a rounded depression in the front face (fig. 5) which serves as a thumb grip. When the thumb of the left hand is placed here, the palm lies against the slightly curved rear of the base and the fingertips against the side, as seen in fig. 6. The conspicuous thumb grip tends to indicate to the new user of the Ericofon that the set should be grasped around the base and not at the neck, like an ordinary handset. The Ericofon may, of course, be held in this way if desired, but the lower grip is much more convenient. After thorough experimentation and study of various types of hands, a form was arrived at which fits a large male hand and a small female hand equally well.

The earpiece of the Ericofon has been given an entirely new shape. In place of the ear cap of the ordinary telephone instrument, the earpiece of the Ericofon is formed by the upper end of the horn-shaped neck. It is not circular, but has the form of a shell to fit the auricle, with the sound holes immediately opposite the auditory duct. Thus it provides good acoustic transmission and at the same time fits the ear very comfortably.

The colour problem has found a simple solution in the Ericofon, since the case consists of a one-piece moulding. A common difficulty in the use of light colours for conventional telephone sets is that most of the plastic parts are visible, and it is difficult to obtain an exact colour match when a part has to be replaced. This problem does not exist with the Ericofon. A colour may be easily replaced without needing to maintain a large stock of spare parts.

Fig. 5
The case of the Ericofon is a copolymer of styrene and acrylonitrile—a plastic material which combines a handsome, easily cleaned surface with good impact-resistance and scratch-resistance

The Ericofon is produced in pastel tones—ivory, light grey, light green and light blue—and in a dark blue-grey and a bright red.

After thorough study of the properties of numerous plastics, a copolymer of styrene and acrylonitrile was selected as the material for the case. This plastic has a fine surface with good impact-resistance and scratch-resistance. It is not affected by sweat from the hand, skin creams, lipstick, common detergents, or other chemical agents to which it may be exposed.

When the Ericofon is grasped as described above, a slight twist of the wrist and forearm pivots the set backwards so that the base comes up to meet the user's hand, as seen in fig. 7. The set then rests well balanced in the palm with the dial in a convenient position. The dialler need not worry about the exact position of the instrument, as he unconsciously holds it at the angle and distance most convenient to him from the point of view of vision, illumination and comfort.

The plastic finger wheel is well protected, being recessed in the base of the set. The characters are usually printed round the circumference of the wheel. If the subscriber numbers include both letters and numerals, the letters are located on the surface beneath the finger holes.

Projecting from the centre of the finger wheel is the pushbutton stand switch, which is pressed upwards by the weight of the Ericofon when it is

Fig. 6

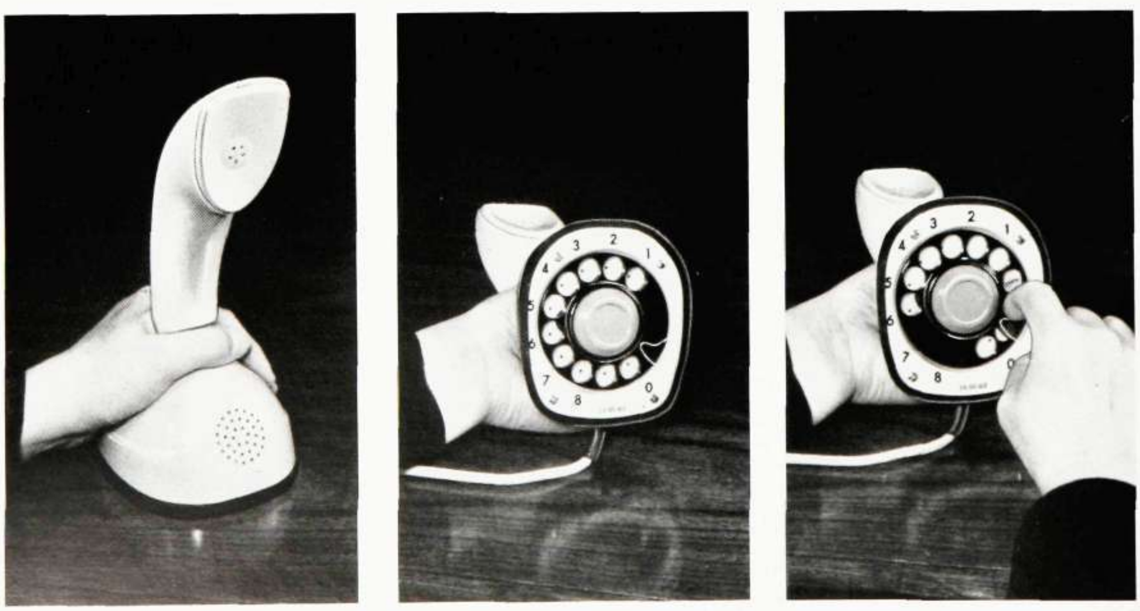
The dial comes straight to you, makes dialling simple and sure

placed on the table, and switches the instrument from speaking to signalling condition. The button is made of nylon, it is of large diameter, it slides easily over irregular surfaces, and it does not mark the top of a table or desk. Being coloured red, it stands out clearly from the finger wheel, and accidental contact is therefore unlikely.

When the subscriber has listened for dial tone and has dialled the number in the manner related above, he puts the receiver shell to his ear and the transmitter swings naturally into proper speaking position. The same grip can be retained throughout. At the end of the conversation he puts the set down anywhere on the table, as there is no separate handset cradle to look for or reach for.

Fig. 7 X 7709

Holding the Ericofon by the base, one can easily tilt the instrument backwards into a convenient position for dialling



Since the base of the set is only slightly larger than the dial, the Ericofon occupies very little space—roughly one third as much as an ordinary desk set. It stands very steady, however, and must be tilted to an angle of 45 degrees before it will fall over.

General construction. Enclosed in the base of the housing is the chassis (fig. 9) carrying the dial, standswitch, induction coil—in some cases a capacitor as well—and the terminals and contact springs for connection to the transmitter and receiver.

The frame of the chassis is made of a die-cast aluminium alloy. Attached to its bottom is a thin cup-shaped sheet of transparent acrylic. The sheet completely covers the underside of the instrument, and on its rear are printed the characters of the dial, which are thus visible through the plastic and entirely protected by it. The finger stop is part of this sheet, which, on the back, also contains a pocket into which the telephone number card can be inserted. Thus the parts handled by the subscriber are entirely of plastic.

The edge of the chassis frame is covered by a U-shaped neoprene rubber bumper pedestal. The upper flange of the bumper pedestal serves as a packing between the frame and the plastic case, which are secured to one another from underneath by four screws. By this means a complete seal is obtained; dust, insects, and the like are effectively excluded. The rubber bumper pedestal is at the same time the structure on which the entire set stands. It prevents the telephone from sliding, and softens the impact if the set is dropped. The neoprene rubber does not mark or stain the underlying surface.

Fig. 8

The entire Ericofon is lighter than an ordinary handset, and it lies well balanced in the hand during conversation

The die-cast aluminium frame is formed with the holes, recesses, pillars, and other features required for mounting the various components. Owing to the limited space in the base, the assembly is, of course, extremely compact. However, the parts are accessibly and clearly arranged, while at the same time important simplifications in wiring have been achieved which have reduced the number of soldering points to a minimum. A substantial amount of the available space is, of course, taken up by the dial mechanism, the design of which is described in a separate article.

The standswitch of the Ericofon consists of the aforementioned red push-button projecting from the centre of the finger wheel. It continues in the form of a plunger through the main spindle of the dial and actuates at its other end a springset on the top of the chassis. The button must move a considerable distance from its inner position before switching over takes place. The calling conditions are therefore not affected if the set is placed by mistake on the cord, a newspaper or the like, instead of flat on the underlying surface. The circuit arrangements preclude accidental switching if the button should be involuntarily actuated during dialling.

The springsets of the dial and standswitch are fitted to a single bracket and form an independent unit which is insulated from the frame of the chassis and secured to it by two screws. The springsets require only a few soldered connections, which are made before mounting the unit in the instrument. The unit also contains two silver-plated springs which, when the plastic case is put on, press against the transmitter inset. The transmitter inset is held in position in the front of the case by a simple locking ring and can thus be easily removed. In addition, the springset bracket carries two springs facing upwards, which press against two terminal plates fixed in the case at the lower end of the neck (see fig. 9). From these terminals, two wires lead up to the receiver inset. The receiver inset has been developed especially for the Ericofon. The receiver and transmitter insets are described in a separate article.

The receiver inset is permanently fixed in the case. It cannot be removed for replacement. Trouble in Ericsson's modern receiver insets is most unusual and, in the rare event of a receiver fault, it is extremely simple to replace the entire case. The permanent mounting of the receiver is attended by important advantages. The inset always lies in the correct position and is protected against tampering; a simpler and more functional design of the case has been possible; and the electrical connections of the receiver could be simply and reliably arranged in the manner described above.

It might have appeared more logical to place the Ericofon receiver on the chassis with a simple acoustic channel up to the ear shell, which would have simplified the case still further and eliminated wiring inside it. This variant was given thorough study, but the idea was rejected. One reason was that placing the receiver in the base would make the telephone too bottom-heavy, and the fine balance which is a feature of the Ericofon, both in speaking and in dialling, would have been lost.

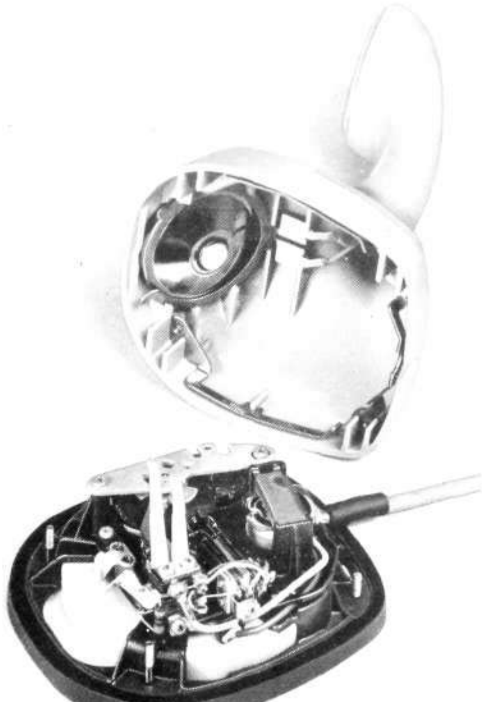


Fig. 9 X 2184

The chassis of the Ericofon is enclosed within the base of the plastic case. The transmitter inset and the terminal plates for connection to the receiver can be seen in the case.

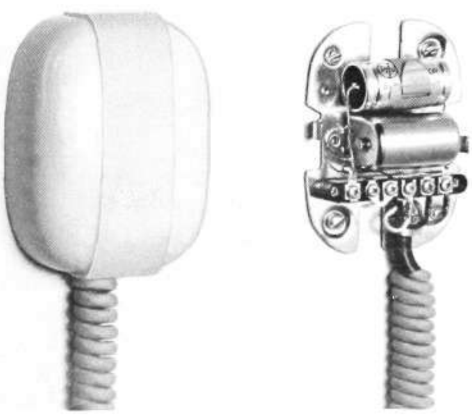
As already stated, one of the initial specifications for the designers was that the new instrument should not weigh more than an ordinary microtelephone. By utilizing every means of reducing the weight of parts, it has been possible to embody all essential components and, in addition, the induction coil—even in some types a capacitor—without exceeding the weight limit. The weight of the Ericofon, including the induction coil, is only 400 grams (14 oz.), which is about 20 per cent less than the weight of the ordinary Ericsson handset. The induction coil is of the entirely new miniature type which is described elsewhere in this issue.

2. *The Wall Terminal Box*

Apart from the subscriber's line and cord terminals, the wall terminal box also contains the bell set and capacitor. In the model illustrated in fig. 10 the bell set consists of a buzzer. The capacitor is of the metallized paper type.

Fig. 10 X 2185

The wall terminal box and coiled cord (Right) with cover removed



Extension telephone sets have the capacitor placed in the standset instead of in the wall terminal box. They are made with or without buzzer. The buzzer, when present, can be disconnected by means of a switch on the terminal box.

3. *The Cord*

A great advantage of the Ericofon is that it has only one cord instead of the two cords of the ordinary desk set.

The cord between the standing Ericofon and the wall terminal box is coiled at the wall end, which permits adequate extension during conversation (see fig. 11). The cord will take a much stronger pull than an ordinary handset cord, which has no fixed point at its other end. It thus allows the telephone

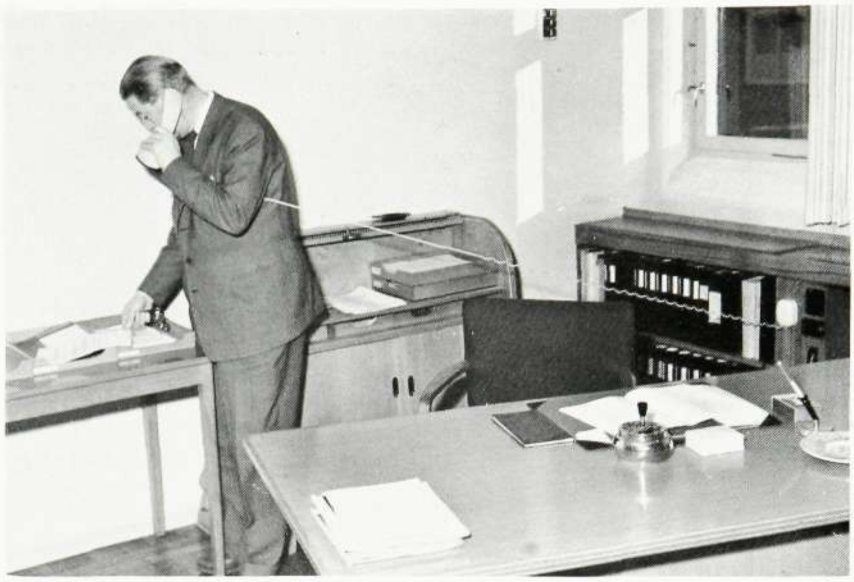


Fig. 11 X 8004
The coiled cord allows wide freedom of movement

user great freedom of movement. The remainder of the cord is straight, so as not to catch on the edge of the desk. It enters between the plastic case and the bottom frame and connects directly to terminals on the springset. The cord has only three conductors, a result of the newly developed circuit design of the Ericofon described in a separate article.

Operating Characteristics of the Ericofon

The advantages offered by the Ericofon both to subscribers and telephone companies are manifest.

For subscribers, the main value is the extreme convenience in handling the Ericofon. The placing of the dial in the handset simplifies its use in practically every situation, as proved by several years of trials with a large number of Ericofons. The dial, so to speak, comes straight into the subscriber's hand,

Fig. 12
The caller instinctively holds the dial at the distance best suited to the eye

and without conscious effort he holds it at the distance and angle most convenient to him. Mistakes in dialling have proved to be rare. The very small space occupied by the set also adds to its ease of operation.

In office work, the telephone user normally employs only a limited area of his desk. He can now operate the telephone within this working space and replace it after a call without needing to think particularly of where to put it. Thus telephoning causes a minimum of disturbance in his work, which is of course extremely important for anyone who is constantly on the phone. If he wishes to make another call immediately, he need not replace the set but can simply press the button switch for a moment.

An Ericofon that is to be used by two or more persons can be conveniently picked up and operated from all sides—a useful feature in offices, at shop counters, and in similar locations.

In the home equally great advantages are offered by the convenience in dialling, the small space requirements, and the ease of placing the Ericofon on a table, sideboard or the like. The Ericofon is probably the only telephone having a dial that can be easily operated from the depths of an armchair or in bed, as illustrated in fig. 13. This makes the Ericofon a very desirable extension set. It should also prove ideal for hotel rooms, hospitals, and other public locations, owing to its simple and hygienic design and the ease of cleaning the plastic case. The wide choice of light colours is an additional attraction.

For telephone companies the most valuable feature of the Ericofon, in addition to its good transmission characteristics, is the likelihood of its proving extremely reliable and involving minimum maintenance costs. This is assured by the general simplicity of construction, with the one-piece, easily removed, plastic case containing receiver and transmitter; by the chassis for the remaining components which has a minimum of soldered connections and which, when the case is removed, lies open for inspection and service; by the single cord; and, finally, by Ericsson's high-quality components and parts. The small weight and dimensions of the Ericofon make for simpler and cheaper transport and storage. The wide choice of colours and the ease of changing the case makes it possible to offer this service feature without great expense and without maintaining a large stock of spare parts.

Fig. 13

Even in bed, you can easily use the Ericofon—the telephone with the most accessible dial

Fig. 14

The Ericofon is made in six colours: ivory, light blue, bright red and blue-grey as shown above, and also light grey and light green

A Word about Form

The appearance of the Ericofon may be a surprise to some subscribers. That, however, often happens when an old, well-known utility changes its form in the course of technical evolution. The aim of the Ericofon designers has been to create a highly simplified and efficient form for the commonplace telephone set.

A fully conscious attempt has been made to produce a dynamic design. Out of the sturdy base, the slender neck of the Ericofon rises as though listening and ready for action. In all its simplicity, the Ericofon is an expression of the dynamic power that lies hidden in the spoken word.

The Ericofon Chassis

H G THAMES AND C O SOHLBERG, TELEFONAKTIEBOLAGET L M ERICSSON, STOCKHOLM

U.D.C. 621.395.721.4

A characteristic feature of a conventional telephone set is that its dial is a separate unit. In the Ericofon, however, the dial mechanism is built up with other components on the base plate of the instrument.

The requirements of reliability and convenience meant that the dial could not be miniaturized as many other components of the Ericofon have been. The only remaining course was to reduce the weight as far as possible. This has been effected partly by the employment of light alloys and plastics in all parts for which such materials are equal to or superior to heavier metals, and partly by making the dial frame serve a number of purposes. It has in fact been united with the chassis, accommodating a large proportion of the telephone components in the form of an insert (figs. 1 and 2) enclosed within the base of the housing.

The different parts of an Ericofon insert correspond to the following elements of a conventional telephone instrument:

dial
cradle switch
induction coil and holder
capacitor and holder (in certain instances)
spark quench resistor
transmitter and receiver springsets
terminal strip
subscriber's number card holder
telephone cord clamp
instrument feet
base plate

At first glance it might appear as though so great a concentration of components must result in a complicated and inaccessible layout. This is not the

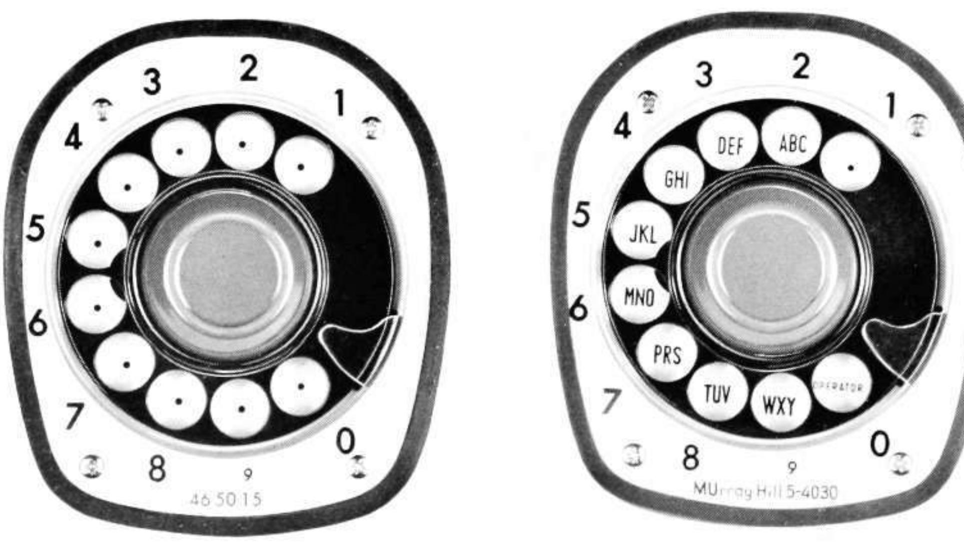


Fig. 1 X 2192 X 2193
Underside of insert
with various dial numbering schemata

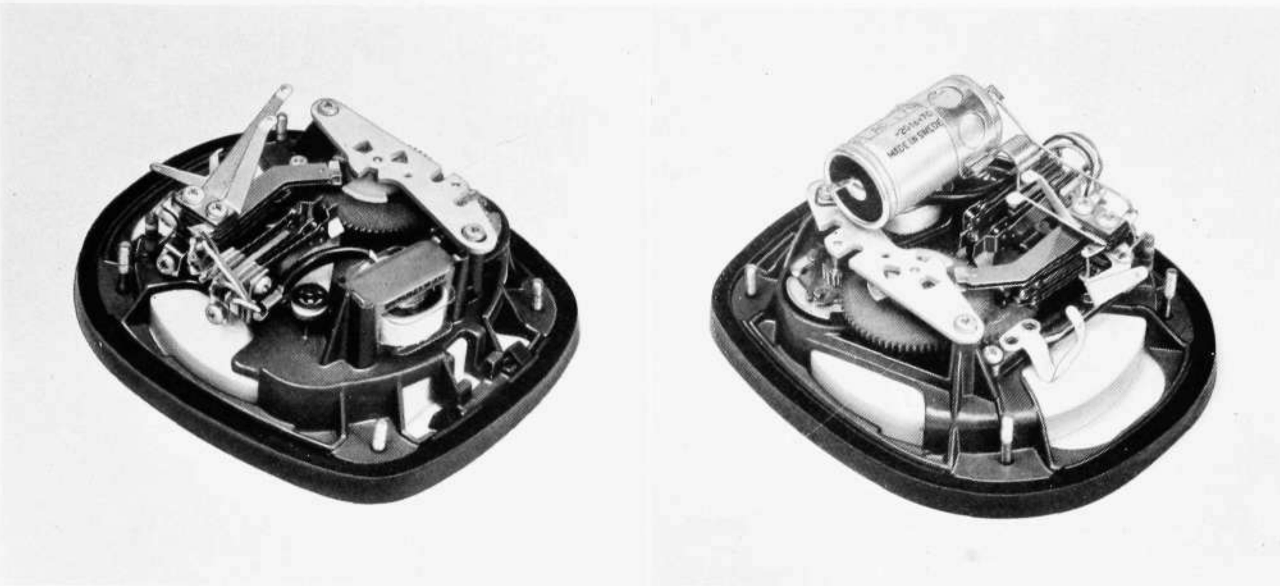


Fig. 2 X 7708

Upper side of insert

(Left) rear view, (right) front view including capacitor

case, however, one reason being the almost complete absence of separate brackets and similar mounting units. Instead, the mountings are formed out of the actual body of the chassis, and thus far fewer screws and rivets are required. Another factor is the extreme simplicity and clear arrangement of the wiring, which is described in a separate article on the Ericofon circuit design. This has been achieved by the special design of the springsets and by the placement of the remaining components in relation to them.

It is interesting to note that the weight of the entire insert—7.3 oz. (208 grams)—is exactly the same as that of an ordinary Ericsson dial.

The dial mechanism is based on roughly the same principles as L M Ericsson's well-known Type RGA 30 dial, which is described in *Ericsson Review* No. 3, 1947. Many of the components of the new dial, however, differ from those of the previous model. The governor, impulse wheel and springset, for instance, are of new design.

Apart from the dial mechanism, the insert carries the standswitch for connecting the telephone to the line, the induction coil, and the terminals for the transmitter, receiver and cord, among other components. Certain types of insert also carry a capacitor.

Mechanical Construction

As stated above, the various parts of the insert are mounted on the *dial frame*. All the pillars, lugs, hubs, and the like are integral with the frame, which is an aluminium alloy die casting.

As for the dial mechanism, the underside of the frame is shaped to accommodate the main spring, while its upper face is formed into pillars and lugs for the bearing plates and the bridge which carries all contact springs. The governor cup is also cast into the frame.

Two guideways serve for the attachment of the induction coil, and two slots in the rim of the frame for the stay clip on the cord. The rim has the same outer profile as the telephone housing in order that the frame may take up whatever impact the instrument may be subjected to.

The combined number ring and base plate, in the form of a transparent acrylic moulding, extends across the bottom of the frame and accommodates,

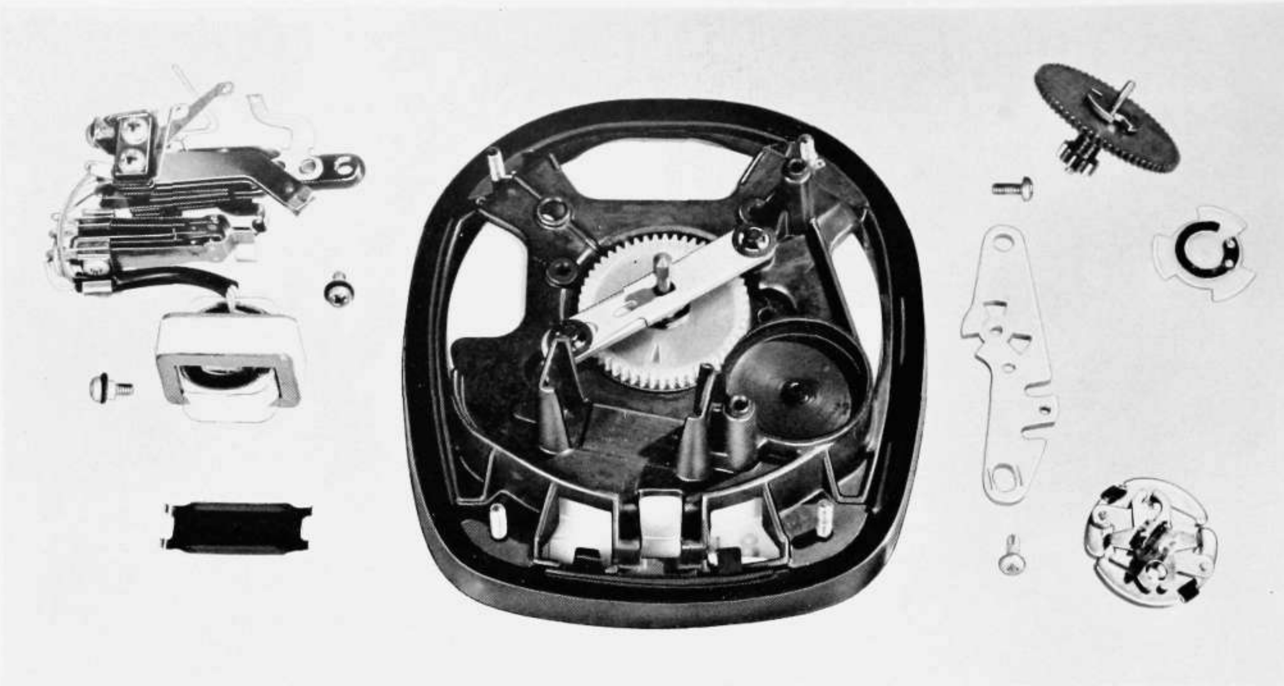


Fig. 3 X 7710

The insert partly dismantled

In the centre of the frame are the main gear wheel and the switch plunger with its locking device. To the left of the frame are the springsets with the induction coil connected to them and (below the coil) the coil-holding spring. To the right of the frame are the bearing plate, the intermediate spindle and gear wheel, the clutch spring and plate, and the impulse wheel and governor.

Fig. 4 X 2196

Inserting subscriber's number card

Access to the number card pocket is obtained by bending back the rubber bumper.

in addition, the finger stop and a pocket for the subscriber's number card. The dial characters are printed on the rear of the transparent moulding, which, in combination with the good scratch-resistance of the acrylic material, ensures that the characters will remain clearly legible. After the characters have been printed, the rear of the moulding is painted in a contrasting colour, with the exception of the space for the subscriber's number card.

The dial characters are usually placed around the periphery of the finger wheel. For dials with several characters per hole, including both numerals and letters, one series of characters is placed outside the finger wheel and the other under the holes. By this means the characters can be printed in large type and are easy to read.

The base plate molding and the die-cast frame are engirdled by a rubber bumper pedestal which acts both as seal and shock absorber. Two tongues on the pedestal hold the subscriber's number card in its pocket. For change of subscriber's number the pocket is accessible from outside by bending back the rubber bumper pedestal as shown in fig. 4. The bumper pedestal is made of a non-staining grade of neoprene which withstands both contact and migration stain tests.

The finger wheel is molded from a copolymer of styrene and acrylonitrile, the same material used in the telephone housing. The finger wheel is recessed in a well in the base plate. The finger holes occupy ten-thirteenths of the circumference of the dial.

The rotary movement of the finger wheel is transmitted to the main spindle by the spring box. The spring box and finger wheel are attached to the spindle by a nut which is covered by the push button of the switch. The switch plunger passes through the hollow spindle and its upper end actuates the switch springset. The push button can be easily removed by moving aside a locking device which runs along the bearing plate of the main spindle. The push button is injection moulded in red polyamide (nylon).

The central gear wheel which is held to the main spindle by a bowed retaining ring, carries two lugs, one of which limits the rotation of the finger wheel, while the other actuates the springset. The gear wheel is a polyamide moulding, and its profile has been modified to allow for the slight variations in diameter at different humidities. Owing to the low friction of polyamide,

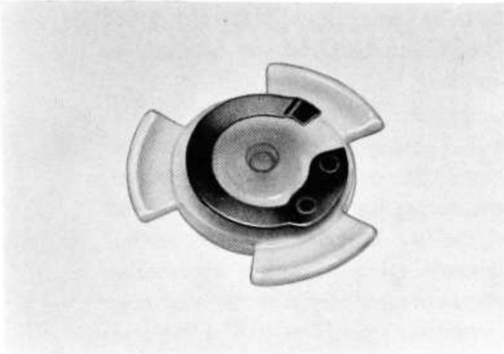


Fig. 5 X 2198

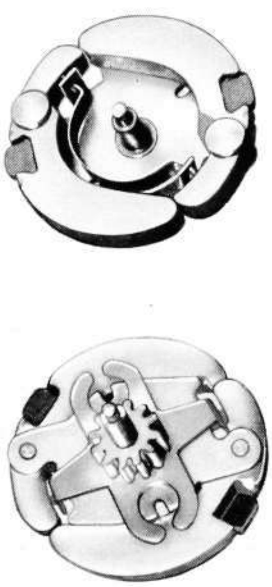
Impulse wheel

Underneath the impulse wheel there is a flat detent spring similar to the one visible in the photograph.

Fig. 6 X 2141

Governor

The two weights are fixed to the bridge on pivot pins. The rotatable yoke is seen between the bridge and the gear wheel. As the upper picture shows, the bent-down ends of the yoke between the bridge and the weights serve as a holder for the leaf spring.



there is very little wear in the gears and on the springset lifting stud, while the elasticity of the material enables the gears to run more quietly than if they were entirely of metal.

The intermediate spindle carries the usual two gear wheels, coupled by a clutch spring, and the impulse wheel with its three-lobed clutch plate.

The impulse wheel (fig. 5) is made of polyamide. For some years it has been used on the Type RGA 30 dial as well. The rims of the impulse cams are domed to reduce the friction between the cams and impulsing springs. The friction surfaces between cams and impulsing springs should not be lubricated because of the risk of oil splashing onto the contacts; for this reason the low friction of polyamide is a special advantage here.

The governor works in the same way as the governor in the dial type RGA 30. Being of identical size, moreover, the two governors are interchangeable. Their difference lies in the mounting of the weights and in the shape of the back pressure spring. In addition, materials with greater resistance to corrosion have been employed.

The governor is seen in fig. 6. The weights are pivoted on a bridge which, with the gear wheel, is rigidly fixed to the spindle. The friction studs are, as before, made of self-lubricating material. Since neither the studs nor the friction surface of the governor cup need be lubricated, the braking effect is independent of the changes in viscosity with temperature to which lubricants are subject.

A yoke is pivoted between the bridge and gear wheel. The yoke serves as holder for a leaf spring fixed between the two weights. By rotating the yoke in one or the other direction, the leverage can be increased or decreased between the point of contact of the leaf spring with the weight on the one hand and the fixed pivot pin on the other. The leaf spring exerts no torque on the yoke. Therefore the yoke need not be screwed down or otherwise locked in position; its tension ensures adequate grip between the bridge and gear wheel. A balance is achieved by the symmetrical shape of the yoke and leaf spring, and the device is not thrown out of position by mechanical impact. The absence of a locking screw means that the dial speed can be very simply and rapidly adjusted. The adjustment is continuous and is simplified by the fact that both bridge and yoke are slotted to take a screwdriver, so that the yoke can be easily rotated in relation to the bridge.

The leaf spring is of stainless steel. If required, it can be replaced by a bimetallic spring. A bimetallic spring provides automatic compensation for changes in viscosity of the gear and bearing lubricant caused by fluctuations in temperature. A bimetallic spring is not required in the Ericofon, but it is a great advantage in outdoor telephones in climates subject to wide changes in temperature.

All contact springs (fig. 3) are mounted on a bridge which is electrically insulated from the frame, being secured to it by two screws. With the exception of one of the transmitter springs, all springs are assembled in two groups. One group comprises solely the springs of the standswitch for changing from signalling to speaking condition. When the Ericofon is standing on its base, the upper cylindrical portion of the switch plunger is fairly far advanced between the contact springs. When the instrument is lifted, switching does not take place until the button is nearly all the way out. The Ericofon can thus stand on an object of moderate size, such as its own cord, without remaining connected to the line. If the Ericofon is put down with its edge resting on a larger object, such as a matchbox, it will lean so far that the subscriber will immediately notice the tilt. The second group of springs consists of the dial springs and the transmitter and receiver terminals. The independent transmitter spring, which makes contact with the centre terminal of the transmitter

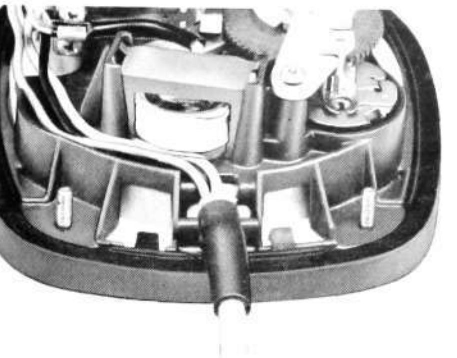


Fig. 7 X 2194

Attachment of cord and induction coil

At the bottom are the two lugs of the cord clip, which is held down by the housing in two slots in the frame. Above, to the left, the induction coil between the two U-shaped guideways, and the holding spring braced between them.

inset, is riveted direct to the bridge. A metallic connection is thereby made with one of the switch contact springs. The two upright receiver springs are pressed against two contact plates in the housing.

In addition to the impulsing springs, the dial springset contains two change-over contact units. The latter are actuated by a stud on the central gear wheel, one unit controlling the spark quench circuit during impulsing, while the other short-circuits the speaking equipment and the last impulse. The removal of the short-circuit from the speaking equipment takes place an appreciable interval after the last impulse has been short-circuited, so that the exchange impulse relay will work under the same conditions from first to last impulse. This is assisted by the fact that the unit forms a make-before-break contact and that, owing to the stepped stud on the central gear wheel, it operates in two steps.

The cord connects to screw terminals placed directly on the springsets, so that there is no need for a terminal strip nor for wiring between terminal strip and springsets. The strain on the cord is taken up by a press-on clip with two projecting metal lugs. These lugs engage with slots in the frame as shown in fig. 7.

The induction coil is placed between two U-shaped guideways in the frame. Between the guideways, as shown in fig. 7, there is a leaf spring which holds the induction coil in position. This spring can easily be removed with a screwdriver and used again when the induction coil is replaced. The induction coil is described in a separate article in this issue.

Operation of Dial

When the dial is rotated off-normal, the main spring is wound up. The central gear wheel, the intermediate spindle pinion and the clutch plate rotate, but the impulse wheel is prevented from joining in the movement by its upper detent spring which comes up against the bearing plate. At the same time the friction clutch on the intermediate spindle slips sufficiently to remove the braking torque from the governor. This means that virtually the only force to be overcome during the off-normal movement is that of the main spring and that, irrespective of the speed of rotation of the dial, the governor does not brake nor are the gears subjected to extra load.

When the finger wheel is released, the main and intermediate spindles rotate in the reverse direction and the clutch plate causes the impulse wheel to follow the movement. At the start of the return movement, the friction clutch on the intermediate spindle locks instantaneously and the governor immediately attains full speed. The run-out of the dial is perfectly smooth and uniform, since a quick-acting friction clutch is provided for the governor and a separate retaining clutch for the impulse wheel.

When the dial has returned to normal, the friction clutch disengages. The governor and intermediate gear wheel can thus continue to rotate, but with slowly diminishing momentum. The transition from full speed to stop is thus smooth and imposes no strain on the mechanism.

The dial speed is 10 impulses per second ± 10 %, but the Ericofon can also be supplied for 20 impulses per second.

The Ericofon is made for the usual impulse ratios, 40/60, 38/62 and 33/67.

The Circuit Design of the Ericofon

H G THAMES, TELEFONAKTIEBOLAGET L M ERICSSON, STOCKHOLM

U.D.C. 621.395.721.4

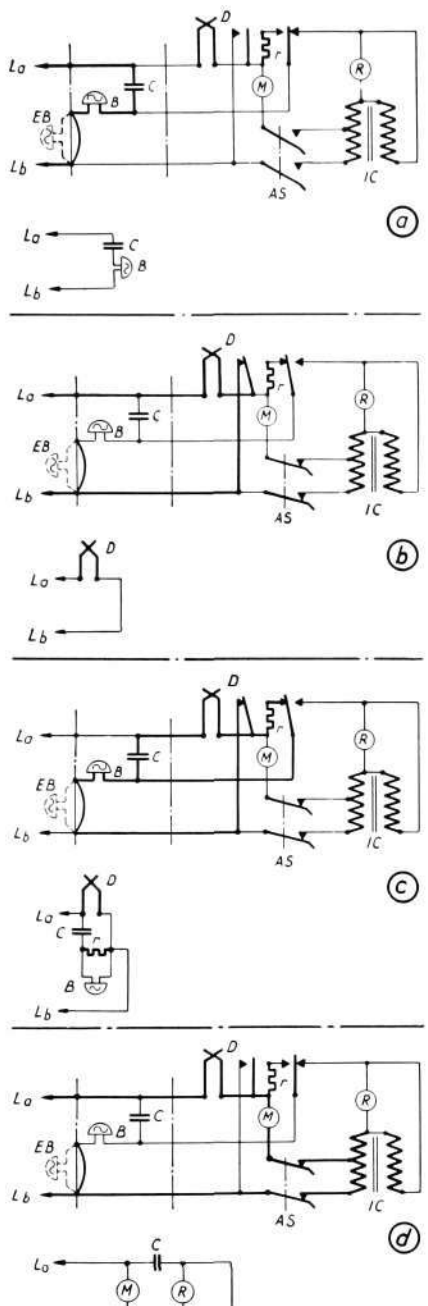


Fig. 1 X 2180

Circuits of the automatic instrument

a Signalling circuit b Impulsing circuit
c Spark quench circuit d Transmission circuit

AS	standswitch	IC	induction coil
B	bell set	L_a, L_b	line
C	capacitor	M	transmitter
D	dial	r	spark quench resistor
EB	extension bell	R	receiver

The space available for the various components of the Ericofon is very limited. Furthermore, the weight must be as low as possible. In addition to the employment of miniature components wherever possible, the circuit design has been arranged to incorporate a minimum of components by making some of them perform more than one function. In conjunction with the design of the Ericofon in other respects, this has led to a very simple and clear arrangement of the circuit connections.

To provide for various subscriber requirements, the Ericofon is made both as an ordinary automatic instrument and in two types of extension set.

The Automatic Instrument

This instrument, like the two other types, contains only one component of each kind. This is possible thanks to a method, not previously used, of switching over the instrument capacitor with the dial. As the explanation of the circuits will make clear, this single capacitor is incorporated in all circuits.

Signalling Circuit

The bell set *B* (fig. 1 a), which may be a buzzer, is permanently connected across the line L_a—L_b in series with capacitor *C*. The wall terminal box has facilities for the connection of an extension bell, *EB*, which may be placed in series or in parallel with the instrument bell set.

Impulsing Circuit

The transmission circuit—*IC*, *M* and *R*—is shunted in the normal way during impulsing (fig. 1 b). Contrary to the practice in conventional telephone instruments, the impulsing contact of the dial *D* is placed ahead of standswitch *AS*. This is made possible by the fact that the dial is accessible to the subscriber only when the instrument is lifted and thereby connected to the line. The location of the impulsing contact means that impulsing is not affected if the subscriber, despite the bevelled edge of the switch, should happen to press it while dialling.

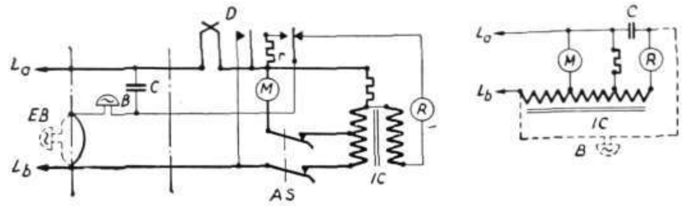
The impulsing contact is protected by resistor *r* in series with capacitor *C*, the latter being reconnected to this circuit by the operation of the dial (fig. 1 c). During impulsing, the bell set *B* is also connected to the spark quench circuit in parallel with the resistor. The bell set is thereby so heavily shunted that it cannot follow the dial impulses. Thus a bias spring to reduce the sensitivity of the signalling unit is not required, and the necessity of correct polarity in connection of the line is thereby eliminated. As stated above, the circuit also permits the use of a non-polarized buzzer as signalling unit.

Transmission Circuit

In the transmission circuit shown in fig. 1 d the capacitor is so connected that the entire line current passes through the transmitter *M*. This is possible

Fig. 2 X 8006

Circuit of automatic instrument with transmitter shunt



owing to the entire freedom from interruption and virtual independence of position of the transmitter, which therefore requires no shunt. The transmitter is described in a separate article. The receiver R is protected by the d.c.-blocking capacitor. During conversation a very weak direct current passes through the receiver. This means that the receiver is connected across "wet" contacts which would otherwise carry only an extremely small alternating current. The direct current through the receiver is so small as to lack all practical significance, but serves as an added contact safety factor.

Owing to the absence of a transmitter shunt, the circuit described above has the advantage of being easily matched to different feed systems. Matching is effected by providing the instrument with a transmitter inset of resistance matched to the particular feed system. None of the other components in the instrument need be changed. This is a great asset for telephone companies which do not employ the same system throughout their territory.

The Ericofon may also be supplied with the circuit shown in fig. 2. At the highest feed currents this circuit offers a certain improvement in transmission characteristics over that of fig. 1 d.

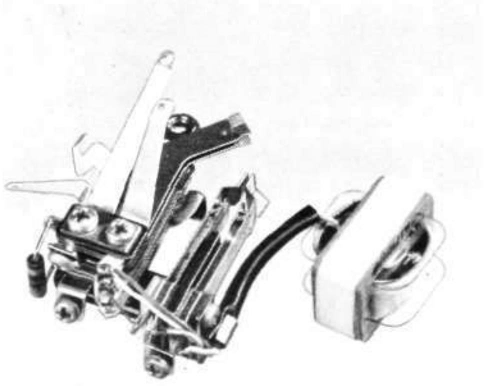
Wiring

The small number of components, their proximity to one another, and the mechanical construction of the Ericofon in other respects results in a very simple and clear arrangement of the wiring. The wires are so few and so short that a formed cable is not required. The number of terminal screws and soldering tags is barely half that required in a standard telephone with separate handset and dial.

Fig. 3 X 2183

Springsets and induction coil

The photograph shows the wiring in an automatic instrument. One of the terminal screws is located in the standswitch springset, the other two in the dial springset, which also contains contact springs for the transmitter and receiver. The spark quench resistor, is at the extreme left, the induction coil at the right.



The mechanical construction of the Ericofon is described in other articles in this issue; it will be dealt with here only in reference to its effect on the wiring design.

The contact springs—with the exception of one of the transmitter springs—are assembled in two groups placed close together on a common bridge. One group comprises the standswitch contact springs, and the other the dial, transmitter and receiver springs (fig. 3). The springset design is such as to eliminate external wiring to a large extent. For instance, there is a metallic connection between the separate transmitter spring and one of the standswitch springs via the springset bridge, and the second transmitter spring makes direct contact with two of the dial contact springs within the springset itself.

The induction coil—which is described in a separate article—is located within the instrument, and therefore the cord need contain only three conductors as against seven if the coil had been placed in the wall terminal box. The cord terminates at the instrument end in screw terminals on the springsets themselves, and at the wall box on a terminal block.

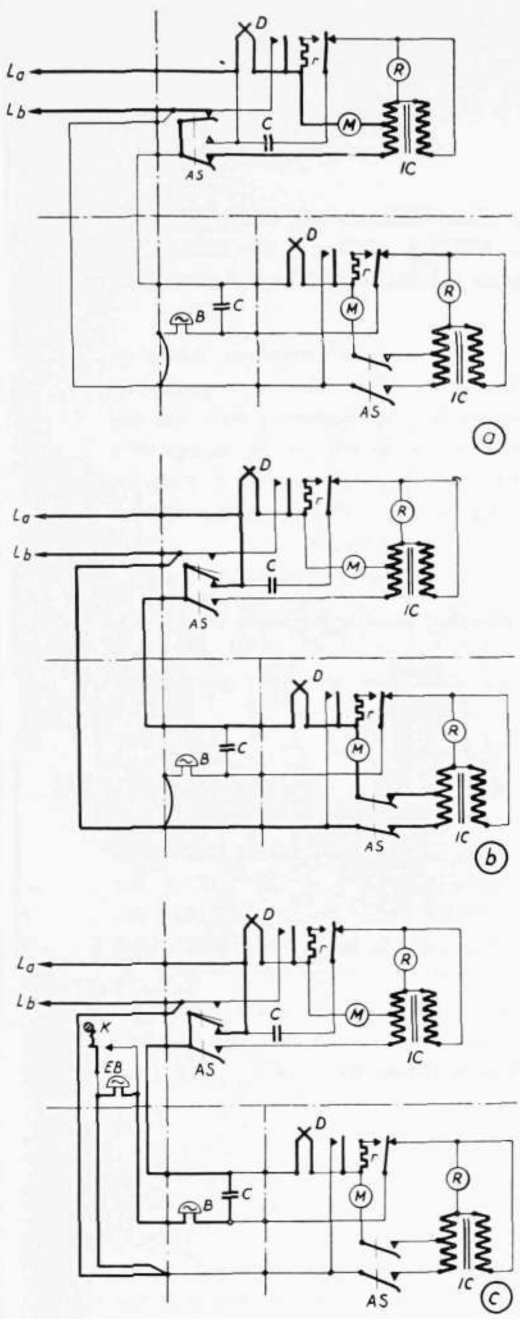


Fig. 4 X 2188

Circuit for intermediate and terminal stations

(In each pair of circuit diagrams, the intermediate station is represented above, the terminal station below.)

a **Intermediate station in conversation**
The connection between the two stations is short-circuited.

b **Terminal station in conversation**
The intermediate station is disconnected from one leg of the line and its transmitter and receiver are short-circuited.

c **Signalling circuit for intermediate station equipped with extension bell**

Despite the concentration of the electrical components on the chassis, they are easily accessible for inspection. Moreover, they can be entirely removed from the unit by backing out the two fixing screws in the springset bridge and releasing the induction coil retaining spring, as shown in fig. 3.

In the automatic instrument with the circuit of fig. 1, the wiring consists of:

in the housing, a two-wire lead between receiver and plate terminals

on the chassis, four insulated wires from the induction coil, two short bare wires, and spark quench resistor leads

in the wall terminal box, one insulated wire, the capacitor leads, and strapping.

Extension Sets

The term *extension set*, as used here, means a second instrument connected to a line. A supplementary instrument of this kind adds to the subscriber's comfort and efficiency. Extension instruments are supplied in the form either of intermediate or parallel instruments, neither of which is provided with its own bell set.

An extension set on the conference table in an executive's office saves him many steps between the conference table and his desk. Another saving is effected when several persons use the same line. It is a manifest advantage if each has his own instrument, without additional lines being required in the switchboard on that account.

An extension set adds to the comfort of a home by reducing the distance to the nearest telephone and increasing the privacy of conversation.

The intermediate station system is best suited to the home, since a conversation cannot be overheard from the other instrument. It is also to be preferred when the terminal instrument cannot be equipped to prevent bell tinkling while the intermediate station is dialling.

The parallel instrument is more suited to office use, since it allows several persons to take part in a conversation. This feature, of course, may be desirable in home use as well.

The Intermediate Set

This instrument is connected to the line between the switchboard and another telephone. A circuit of this kind is shown in fig. 4 a—b. The terminal station shown here is an Ericofon type, but it is apparent that the operation of the intermediate set is entirely independent of the terminal circuit design.

When the intermediate station is connected to the line, the terminal station is short-circuited (fig. 4 a), and conversation from the former cannot be overheard at the latter. When the terminal set is in use, the transmitter and receiver of the intermediate station are short-circuited, and privacy is likewise

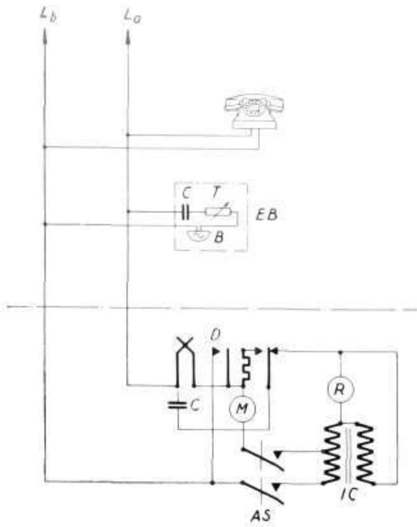


Fig. 5 X 2182

Circuit of parallel set

The parallel set is represented at the bottom of the diagram. Above it, the extension bell EB, the thermistor T, and the second station.

attained. Since the connection of the line between the two stations is make-before-break, a parallel connection cannot take place. Neither can a clearing or transfer impulse be set up to a P.A.B.X. with answering facilities if the intermediate station should happen to be switched in during a conversation on the terminal station.

As fig. 4 a—b shows, the intermediate station has no bell set, so it should be located within hearing distance of the terminal station. If the stations are farther apart, an extension bell can be connected near the intermediate station.

One model of the Ericofon for use as intermediate instrument, however, has the extension bell placed in the wall terminal box. This arrangement is shown in fig. 4 c. The bells of both stations ring to indicate a call, but the extension bell, *EB*, of the intermediate station can be cut out by means of a key *K*, also mounted on the wall terminal box. This has proved a desirable feature, especially when the telephone is located in a bedroom, as the subscriber may switch off the bell when he desires to be undisturbed.

If an extension bell is fitted at the intermediate station as shown in fig. 4 c, the terminal station must be so designed that its capacitor can be employed for the extension bell as well, as is the case with most telephone instruments of European make.

If the terminal instrument has a cord with only two conductors, the extension bell must be equipped with a capacitor and with arrangements to prevent bell tinkling during impulsing. In L M Ericsson's extension bell this is accomplished by a thermistor in series with the bell set. The size of the thermistor is such that the low amperages which occur during impulsing are insufficient to warm up the resistor. The considerably more powerful ringing current, on the other hand, warms up the resistor so quickly that the length of the signal is only very slightly reduced. In addition, the use of the thermistor makes the extension bell independent of line polarity and also allows using a buzzer, which is impossible when a bias spring is present.

The Parallel Set

As its name indicates, this set is connected in parallel with a second instrument. Fig. 5 shows that conversations on one station can be overheard at the other. The parallel station may be placed either before or after the second station. The bell set of the second station must be equipped with a bias spring or similar arrangement to prevent bell tinkling during impulsing at the parallel station. If simultaneous signals are required at the parallel station, an extension bell can be connected to the line as shown in fig. 5.

The Ericofon's Transmitter and Receiver Insets

S KARLSSON, TELEFONAKTIEBOLAGET L M ERICSSON, STOCKHOLM

U.D.C. 621.395.61

When the general shape of the Ericofon had been decided upon, the need arose for new transmitter and receiver insets, smaller and lighter than earlier types. Since the characteristics of the electroacoustical components are of the greatest importance for good speech transmission, an improvement in these properties was a desideratum.

These requirements have been successfully met by the adoption of modern electroacoustical principles and the use of high quality materials. The Ericofon insets have, in fact, become the basic types for L M Ericsson's new transmitter and receiver insets in conventional telephone instruments as well. The same components are used in the various types of insets, which differ only in their external dimensions and contact elements, but are identical in their characteristics. The frequency response curves of the new transmitter and receiver insets are shown in fig. 2.

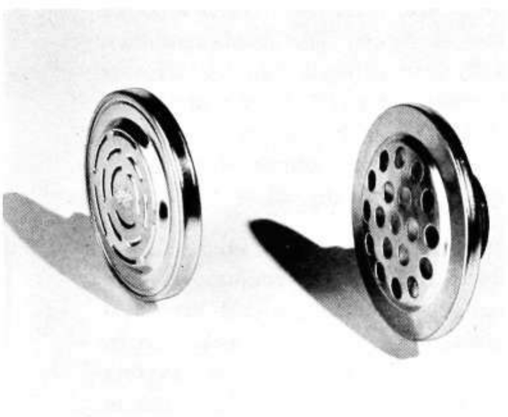


Fig. 1 X 2186

The RLA 204 Ericofon transmitter inset (left) and the RLA 18, earlier model

Transmitter Inset

The Ericofon transmitter inset differs from earlier types in the shape of the frame and of the grid. This has allowed a reduction of the overall diameter and height of the inset. The earlier model was 51.5 mm in diameter, 19.1 mm high, and weighed 57 g; the corresponding figures for the new inset are 47.8 mm, 14.9 mm, and 23 g. Thus, the weight has been cut by 34 g. Fig. 1 shows the new transmitter inset beside an earlier model.

The transmitter inset (fig. 3) is built around a frame (1) which also constitutes a partition between two chambers. The chambers communicate through a hole (2) in the frame, covered by a silk disc. One chamber is bounded by the diaphragm (6) and the frame, the other by the frame and the cover (11).

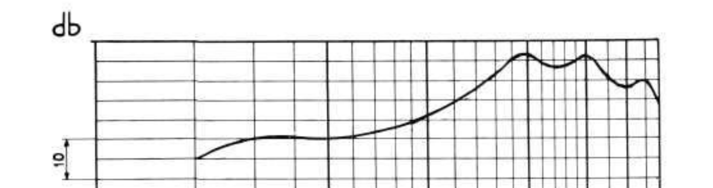
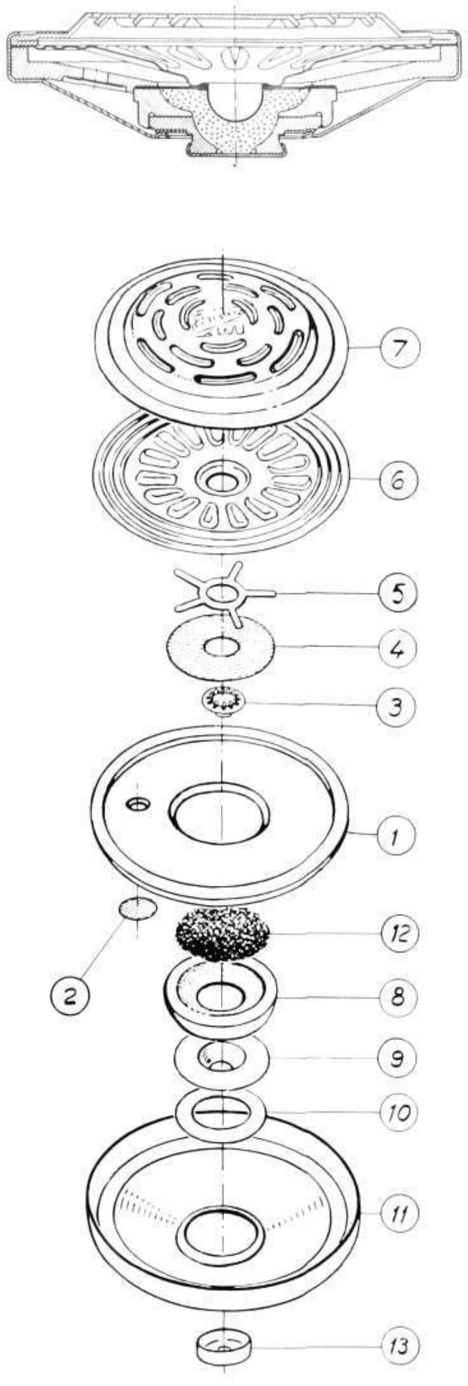


Fig. 2 X 8002 X 8001

Frequency response curves

a Transmitter inset RLA 204

b Receiver inset RLD 520



X 2109
X 2197

Fig. 3
The RLA 204 transmitter inset

The cover serves to hold the various parts of the transmitter together and acts as the terminal for the upper electrode. The diaphragm is rigidly clamped between the frame and the grid (7). The grid has slots with turned-in lugs and is fitted with a membrane inside. The granule chamber is formed by an insulating ring (8) and a gold-plated lower electrode (9) with a contact cap (13) which, with an insulating washer (10), are clamped between the frame and cover. A fabric disc (4) and star-shaped copper disc (5), together with the gold-plated upper electrode (3), are riveted to the diaphragm and provide a seal between the granule chamber and the diaphragm. The star-shaped disc serves both as conductor between frame and electrode and as stiffener for the diaphragm system.

The shape of the diaphragm system ensures a small mass and its flexural stiffness is suitably adjusted. In combination with the stiffness of the air chamber an appropriately located mechanical resonance and good response are obtained. The stiffness has been achieved by means of the arrangement in separate chambers referred to above. Thus at low frequencies the diaphragm works against a volume consisting of the two chambers connected by the hole. At higher frequencies the hole is, in effect, closed, since there is not time for full pressure equalization between the two chambers. The diaphragm then works against a smaller volume. As a result, the combined stiffness increases with the frequency, and the mechanical resonance curve of the oscillating system is displaced towards the higher frequencies. The covering of the hole in the frame with a fabric disc introduces an acoustic resistance which damps the resonance peak and smooths out the response curve (fig. 2).

The granule chamber of the transmitter has dome-shaped electrodes—a convex upper electrode and a concave lower electrode. In conjunction with the shape of the insulating ring, the electrode design ensures that the transmission is virtually independent of the angle at which the inset is held; that is, the ratio between the highest and lowest transmitter resistances at different angles is small. Limitation of the feed voltage by means of a d.c. shunt in the telephone circuit is therefore no longer necessary (see article on Ericofon circuit design). The insulating ring has a rough surface which, aided by the shape of the ring, counteracts the tendency of the carbon granules to pack and ensures good stability; that is, the transmission characteristics during conversation remain unchanged. Moreover, the shape of the granule chamber means that the power conversion of the transmitter is less dependent on current variations than in a transmitter with a cylindrical carbon chamber and cylindrical electrodes.

The slots in the grid are so placed in relation to the acoustic holes in the housing and mouthpiece that they prevent the entry of needles or other pointed objects which would damage the diaphragm. Inside the grid there is a membrane of oil-impregnated silk as protection against moisture. The turned-in lugs on the slots prevent the membrane from becoming dislodged and obstructing the openings.

The new transmitter inset design, with a cover which encloses and holds the parts together, precludes the need of sealing the cord inlet in the housing or handset for the prevention of acoustic leakage which, if it occurred, would affect the response curve. The design also ensures that the transmitter maintains its good characteristics under severe tropical conditions.

Receiver Inset

The shape of the Ericofon housing called for a new receiver inset of much smaller dimensions. The earlier design was 49 mm in outer diameter, 26 mm high, and weighed 80 g. The body of the inset was made of brass and contained an unsymmetrical base for the magnetic system. The body of the new receiver inset is made entirely of phenolic, it is symmetrical in shape, and its

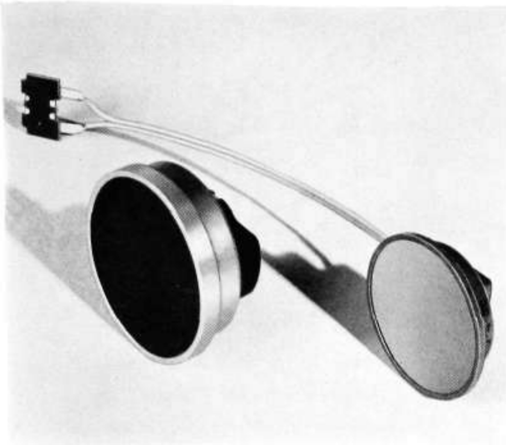


Fig. 4 X 2187
The RLD 510 receiver inset and (right) the new RLD 520

dimensions have been reduced by the use of high quality materials. Its outer diameter is 40 mm, its height 17.8 mm, and its weight 28 g. The reduction in weight is 52 g. The new receiver inset is shown beside an earlier model in fig. 4.

The receiver inset (fig. 5) is built upon a body (1) in which the magnetic system is rigidly mounted. The magnet (2) is of alnico steel of high coercive force and, with the pole pieces (3) fixed into the body by a new process. The pole pieces are made of ferronickel. A special fixing process is employed, by which the correct clearance between the pole pieces and the face of the diaphragm is obtained without grinding. Machining the pole pieces after heat-treatment to obtain the correct air gap would impair the magnetic properties.

The coils (4) are mounted in the body with the magnetic system and are firmly anchored to the base by their soldering tags. The upper ends of the bobbins form a damping back plate parallel with the diaphragm, dividing the receiver case into a front and a rear chamber. These chambers are connected by a hole (5) covered with a silk membrane (6). The upper ends of the bobbins are sealed to the body of the inset and pole pieces to prevent acoustic leakage between the two chambers.

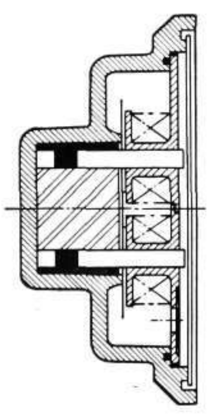
The diaphragm (7) is of ferrocobalt, which permits a high permanent flux density without impairment of the a.c. permeability.

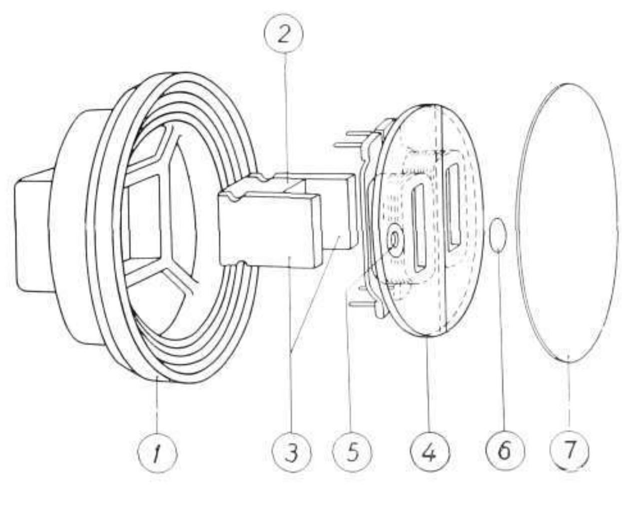
The new receiver insets have a smoothed frequency response curve (fig. 2) achieved on the same principle as used in the transmitter inset. The high response level is achieved by the use of high-grade materials in the magnetic system and diaphragm. The new shape of the bobbins avoids the loss in response that generally results from smoothing of the response curve.

Since the Ericofon receiver inset is rigidly fixed in the case and is safeguarded against tampering, it has not been provided with a grid. Receiver insets with grids are available for ordinary handsets to prevent the diaphragm from being removed and to prevent damage during transit or in the fitting or separate insets.

As with the transmitter inset, the design of the receiver inset, with the rear chamber entirely enclosed, makes sealing in the housing or handset unnecessary. The body of the inset is made of mica-filled phenolic in order to preclude dimensional changes under severe climatic conditions.

Fig. 5 X 2189 X 8005
The RLD 520 receiver inset





The Ericofon Induction Coil

H G THAMES, TELEFONAKTIEBOLAGET L M ERICSSON, STOCKHOLM

U.D.C. 621.395.661.1

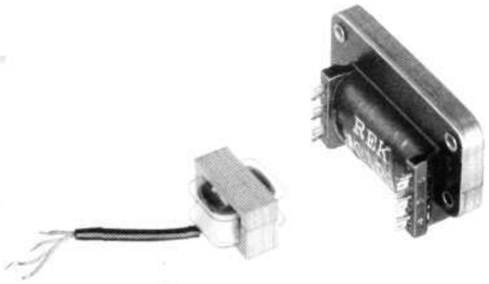


Fig. 1 X 2101
The new induction coil (left) compared with the larger type

The Ericofon required a much smaller induction coil than had been used in previous telephone instruments. The conventional types of coil were both too large and too heavy for use in the Ericofon. An induction coil of the usual size would have had to be placed in the wall terminal box, and the telephone cord would then have required seven conductors instead of three. The wall terminal box would also have been much larger than it is.

The requirements set for the new induction coil were the same as are aimed at in the development of every new miniature component:

equal or improved performance
low weight and small dimensions
reasonable cost.

The performance of the new induction coil is in the main equal to that of the older type, and in some respects better.

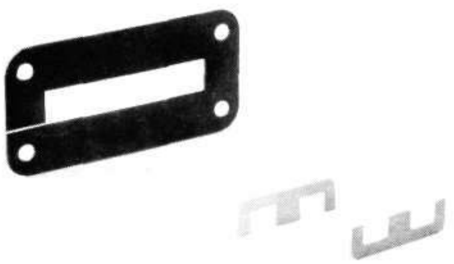


Fig. 2 X 2144
Core stampings
(Right) the new design

As is seen in fig. 1, there is a marked difference in size between the new and old induction coils. This is revealed even more clearly by the data below:

size reduction			81 %
total weight reduction			80 %
core	»	»	71 %
wire	»	»	85 %

The core stampings of the two induction coils are shown in fig. 2. As opposed to the old type, the core of the new induction coil is formed of E-stampings facing alternately in opposite directions, an arrangement which has certain advantages. Among the various core materials tested, a ferro alloy of high nickel content gave the best results.

Owing to the great reduction in the size of the core and in the number of turns and length of the winding, the new induction coil costs roughly the same as the old, despite the substantially higher cost of the transformer plate now employed.

Fig. 3 X 2145
Induction coil mounted in new bracket

The use of the new induction coil, which has been designated REK 171, is of course not confined to the Ericofon; it will also be employed in other instruments where its small dimensions are an asset. The method of mounting between two channel section guideways, as employed in the Ericofon, will often not be applicable in other instruments. Instead, a mounting clamp bracket of partly new design is used. The bracket, which is fitted when the core stampings are inserted, has two tongues which are bent up towards the core as illustrated in fig. 3. By this means all core stampings are retained in the coil until the whole assembly has been fitted in position.

Ericsson LM NEWS *from*

All Quarters of the World

Sweden's First Permanent TV Link Installed at L M Ericsson

Antenna Lifted to Top of Tower by Helicopter

Like a giant dragonfly a Sikorsky helicopter hovered a few feet above the top of L M Ericsson's 240 ft. radio tower one snowy Saturday morning in December. Below the machine there hung an unusual load: a 1,300 lb directional antenna, 16 ft. high and 10 ft. wide, for the first permanent TV link in Sweden. In the space of a couple of dramatic minutes the pilot of the helicopter, Capt. N. G. Grimskog, successfully transported his bulky load from the factory yard up above the tower and there, in the midst of the snowstorm, lined up and lowered the antenna into its socket. A precision job of an unusual nature had thereby been completed, and the helicopter returned with an elegant sweep to the ground with the roar of its engine echoing between the factory walls.

The reason for using a helicopter was the impossibility of lifting the voluminous parts and assembling them on top of the tower. The antenna manufactured by AB Svenska Metallverken is made to very exact tolerances which had to be maintained to within 1/20 mm per 10 ft. length of the assembled unit.

Immediately after installation of the antenna, the first trial pictures were transmitted from a TV camera at L M Ericsson to the Södertälje water tower some 15 miles away, from which they were retransmitted to Midsommarkransen. The quality of the returned picture was compared with a picture reproduced direct from the same TV camera. Which of the two pictures had been sent from Midsommarkransen to Södertälje and back was extremely difficult to determine.

L M Ericsson's and Sweden's first permanent TV link operates on a wavelength of 6 cm with a transmitting power of 5 watts. The directional antenna produces a concentration of power in the beam 10,000 times as great as if radiating in all directions.

The new link is provisionally intended for experiments in the television field, but may also be used for telephony.

A large Sikorsky helicopter was used to lift the 1,300 lb directional antenna to the top of the 240 ft. radio tower.

2—702835

Tremendous Reception for Ericofon

Overwhelming Praise for the New Telephone

The sale of the Ericofon started in March 1956. In view of the limited production capacity during the year it was decided that the initial campaign should be severely restrictive. Preliminary investigations had, in fact, indicated that the Ericofon could expect a very favourable reception. The decision was, therefore, not to awaken a need which could not be met. Orders received up to October exceeded the 1956 capacity by some 500 per cent, despite the extremely limited selling effort amounting to the distribution of sample instruments and technical and sales information to a limited number of markets.

L M Ericsson has not solicited the reactions of the public in these markets, but has nevertheless received a large number of spontaneous endorsements of the Ericofon. Extracts from these comments are given below in the original or in translation.

Regarding its form and use a leading Swedish newspaper writes:

... "The new instrument, which lies snugly in the hand and has the dial in its base, is made in various colours" ... "It is a much more stable 'phone than it looks; at least a typhoon would be needed to upset it. Our representative put through a trial call from L M Ericsson's offices: the 'phone was light and easy to handle."

In reference to the new style of instruments foreshadowed by the Ericofon, the newspaper went on:

... "The L M product brings to telephony an entirely new structural design."

In its September number "Form", the journal of the internationally famous Swedish Sloyd Association, an authority on matters of design, writes:

"L M Ericsson, in its Ericofon, has taken a decisive step towards a more functional shape of the telephone. Both in construction and design the Ericofon presents an unusually stimulating proof of new thought. Technical sculptures of this kind, more clearly than anything else, depict the art of our age."...

The Ericofon attracted considerable attention during the official visit of Queen Elizabeth to Sweden in June. The following extract from a press report on the preparations for the visit suggests the interest already shown for the Ericofon:

... "Some thirty journalists from different parts of the world are to camp here, waited upon by Swedish "Wrens", and with the world's most modern telephone at their disposal, the new L M 'cobra' up to now being sold for export only."

The Duke of Edinburgh was very enthusiastic when he saw the Ericofon during the State visit to Sweden. This was first page news in the News of the World on June 10, 1956:

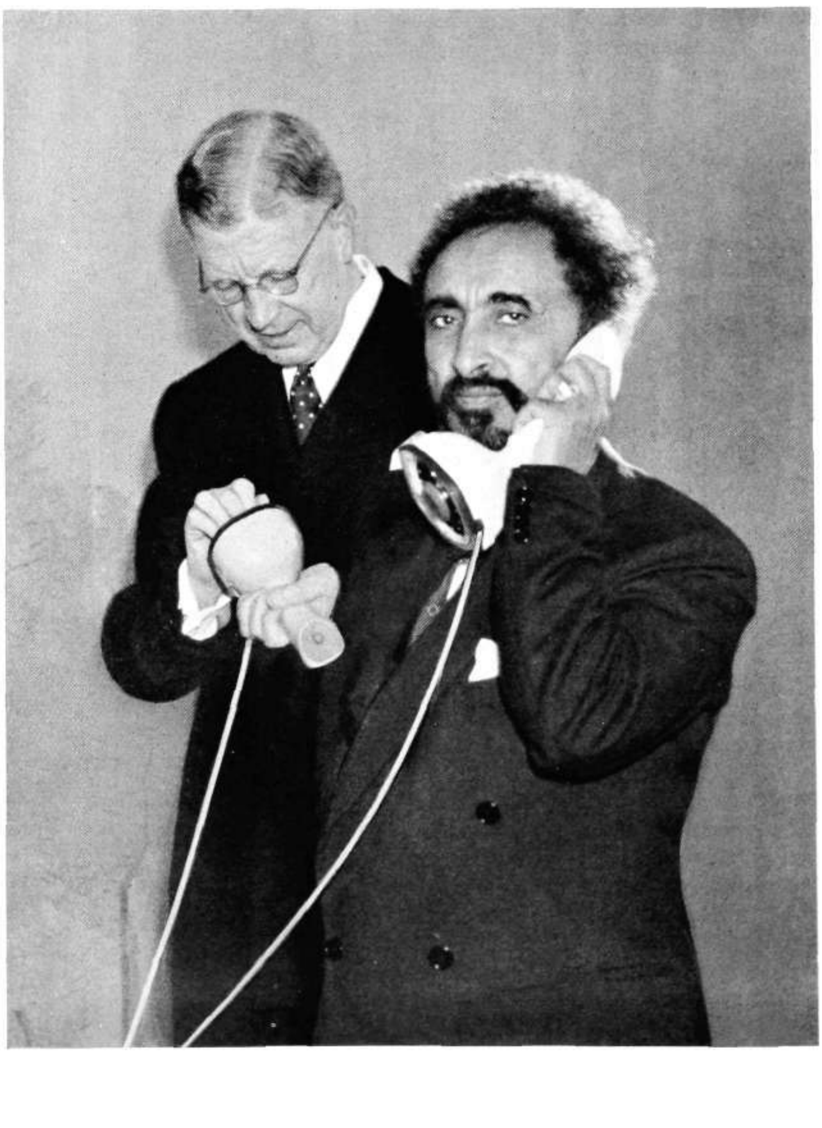
... "Within minutes of his arrival at the Royal Palace yesterday, his sharp eye for improvements in design alighted on one of Stockholm's new-styled telephones."

The paper continues:

"There is an Ericofon on a desk in his suite. It is pale green, streamlined, and consists of an earpiece, microphone and dial in one moulding. It is little larger and far lighter than an ordinary handpiece alone."

In a BBC commentary the Ericofon was referred to as "a Swedish telephone of entirely new and revolutionary design".

King Gustav Adolf of Sweden and the Emperor Haile Selassie of Abyssinia showed interest in the Ericofon when visiting L M Ericsson during the Emperor's latest visit to Sweden.



The President of Brazil, Dr. Juscelino Kubitschek, tries out his Ericofon.

The head of a Central American government writes as follows:

. . . "First of all I want to congratulate Ericsson on the success of the design and quality." . . .

When the Fourth Destroyer Flotilla of the U.S. Navy visited Stockholm at the end of June 1956, the Commander used an Ericofon on his ship. We quote the following from his letter of thanks:

. . . "All the time that we were in Stockholm one was on my desk, and I was immensely intrigued by it."

U Nu, former Prime Minister of Burma, making an Ericofon call.

The spontaneous reaction on board the U.S. warships was a small foretaste of what was to come in Chicago in the middle of October 1956.

It was on the 15th of October that the Ericofon was "unveiled" at the Annual Convention of the Independent Telephone Companies. The success was enormous, and the Ericofon captured the interest of all who attended the show. Reports of the new telephone spread through the American press, being published in some thousand newspapers, and via the news agencies out to the world press. *The Ericofon had become world news.*

The new telephone appeals greatly to the American bent for rationalization. On November 13th an American TV program showed the Ericofon and characterized it as the means to more rational telephoning. The program was headlined as a demonstration of an invention of great news value.

The same opinion on the Ericofon's importance was expressed by "My Weekly Reader", a weekly magazine for schoolchildren which imparts all kinds of everyday knowledge to its readers in simple terms. The paper devoted the greater part of its November number to how to telephone with the Ericofon. Supplementary details were given in the teachers' edition.

Space does not permit a survey of the American reaction in the form of citations. Of extraordinarily great interest, however, is the impression as a whole. The encouraging fact that nothing but good has been found in the Ericofon shows that it is a right step, and a large one, in the development of the telephone.

The above account may be said to be representative of the opinion on the Ericofon from the users' aspect.

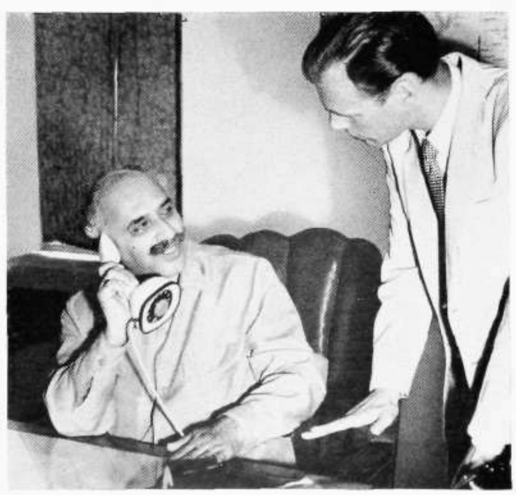
What are then the reactions of telephone engineers?

Although the Ericofon has only been available for a short period, it has aroused great interest in telephone circles. It has already been examined and evaluated by a large number of engineers of different telephone administrations. Telephone engineers from all parts of the world have given the Ericofon an overwhelmingly *positive reception.*

The President of Panama, Don Ernesto de la Guardia Jr., uses the Ericofon for his official business.

"This is really a wonderful telephone —indeed . . ."—Rear Admiral Charles H Lyman receives an Ericofon during the U.S. Naval visit to Stockholm in 1956.

The Pakistan Minister of Communications, M R Kayani, uses an Ericofon in his office.



Director General Soekardan, head of the Indonesian P.T.O., appears to like the Ericofon.

Below are a few extracts from reports by two of the world's largest and most advanced administrations:

. . . "The Ericofon is a good example of a telephone being designed as a whole, instead of a number of separately designed pieces."

and

. . . "The Ericofon presents a completely new design . . . it may well prove a forerunner of a new phase in design . . . There is little doubt that it will prove popular."

An American design expert visiting Sweden gave the Ericofon the highest testimonials in regard both to form and choice of colours. During a tour of lectures in USA he used it as an example of the design representative of a new epoch. He also writes of a visit he had from the head of an American telephone company who had heard of, but not previously seen the Ericofon. We quote:

. . . "He pondered the phone for some time, and the more he saw it, the more impressed he became. At last he asked if he might borrow the 'phone for a couple of days so that he might live with it for a longer time. I could not help thinking that this was the same thing as bringing coals to Newcastle." . . .

To these few gleanings may be added the fact that the Ericofon is daily used by a number of high officials and heads of States, who place very great demands both on usability and elegance in the objects employed in their everyday life. The enthusiasm and pleasure with which these men have had the Ericofon installed must be considered an extraordinarily high testimony to the new telephone.

Thirty Employees Complete 50 Years of Service

A festival gathering was held just before Christmas in honour of 20 of the oldest servants of the company who had completed at least 50 years of service. Each was presented with the company's large plaque in silver and, in addition, shares in L M Ericsson to a value of 1,000 kronor.

Of these 20 veterans no less than 11 had started their career with the company during last century and had thus served for more than 56 years! During the year, 10 other employees received silver plaques, the company's highest distinction, with the accompanying financial award. So great a number of employees with a half-century of service in one company is undoubtedly a unique occurrence in Swedish industrial history, and may very well be a world record. Most of these veterans, moreover, are still in service.

Distinctions were awarded to:

Karl Larsson with 60 years of service, Eric Kjellner 59 years, Ludvig Ljungqvist 59 years, Fabian Stagnell 59 years, Axel Lundgren 58 years, Hugo Olsson 58 years, Axel Ericsson 57 years, Sven Erlandsson 57 years, Carl Justin 57 years, Frans Ottosson 57 years, Sven Almgren 56 years, Gustaf Johansson 55 years, Gunnar Karlsson 55 years, Thure Pettersson 55 years, Reinhold Dahlén 53 years, Oskar Karlsson 52 years, Valfrid Hagberg 51 years, Thure Karlsson 51 years, Carl Pettersson 51 years, Axel Rydström 51 years, Adolf Dahlqvist, Lars Grahn, Helge Hammarlund, Knut Kullerstedts, Henning Larsson, Albert Milton, Marcus Nordlander, Bernhard Pettersson, Ture Rolf, Johan Wedberg and Olof Wiberg, all the latter with 50 years of service.

(Above) L M Ericsson's oldest employee, Karl Larsson, hardener, 82 years of age and 60 years of service in the company. Beside him a raw recruit, 17-year-old Lars Larsson. (Below) Three happy veterans, V Hagberg, R Dahlén and A Rydström with attendant Lucia maidens.

U.D.C. 621.355.721

ÅBERG, S T: *Ericsson Telephones*. Ericsson Rev. 33 (1956) No. 4, pp. 96—98.

Brief survey of L M Ericsson's achievements in telephone design culminating in the Ericofon.

U.D.C. 621.335.721.4

BLOMBERG, H: *The Ericofon—the New Telephone Set*. Ericsson Rev. 33 (1956) No. 4, pp. 99—109.

An account of the background to L M Ericsson's new telephone, the Ericofon, and the principles underlying its design. The construction of the Ericofon is described, and an account is given of its operating characteristics.

U.D.C. 621.375.721.4

SOHLBERG, C O & THAMES, H G: *The Ericofon Chassis*. Ericsson Rev. 33 (1956) No. 4, pp. 110—114.

In addition to the components normally mounted on a telephone chassis, the Ericofon chassis also carries the dial. The article describes the mechanical design of the chassis and the action of the dial.

U.D.C. 621.395.721.4

THAMES, H G: *The Circuit Design of the Ericofon*. Ericsson Rev. 33 (1956) No. 4, pp. 115—118.

Limitations of space and the low weight requirement for the Ericofon necessitated a circuit design that reduced the number of components to a minimum. This factor, in conjunction with the construction of the Ericofon in other respects, makes for simple electrical connections.

U.D.C. 621.395.61

KARLSSON, S: *The Ericofon Transmitter and Receiver Insets*. Ericsson Rev. 33 (1956) No. 4, pp. 119—121.

New smaller and lighter transmitter and receiver insets have been created for the Ericofon. These new insets, which also form the basic types for L M Ericsson's new transmitter and receiver insets in conventional two-piece telephones, are described in this article.

U.D.C. 621.395.661.1

THAMES, H G: *The Ericofon's Induction Coil*. Ericsson Rev. 33 (1956) No. 4, pp. 122.

A considerably smaller induction coil has been designed for the Ericofon than that used in other telephones. The characteristics of the new induction coil, which is 81 % smaller in volume, are generally equivalent to those of the older type and in some respects better.

The Ericsson Group

Associated and co-operating enterprises

• EUROPE •

Danmark

L M Ericsson A/S *København F*, Finsens Vej 78, Tel: Fa 6868, tgm: ericsson

Telefon Fabrik Automatic A/S *København K*, Amaliegade 7, tel: C 5188, tgm: automatic

Dansk Signal Industri A/S *København F*, Finsens Vej 78, tel: Fa 6767, tgm: signaler

Deutschland

Ericsson Verkaufsgesellschaft m. b. H. *Düsseldorf 1*, Worringer Strasse 109, tel: 84 461, tgm: erictel

España

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

France

Société des Téléphones Ericsson *Colombes (Seine)*, Boulevard de la Finlande, tel: CHA 35-00, tgm: ericsson

Paris 17e, 147 Rue de Courcelles, tel: Carnot 95-30, tgm: eric

Société Cinéric *Paris 20e*, 111 Rue Villiers de l'Isle Adam, tel: Ménilmontant 87-51, tgm: cin-ericsson

Great Britain

Swedish Ericsson Company Ltd. *London, W. C. 1*, 329 High Holborn, tel: Holborn 1092, tgm: teleric

Production Control (Ericsson) Ltd. *London, W. C. 1*, 329 High Holborn, tel: Holborn 1092, tgm: productrol holb

Italia

Setemer, Soc. per Az. *Milano*, Via dei Giardini 7, tel: 662241, tgm: setemer

SIELTE, Soc. per Az. — Società Impianti Elettrici e Telefonici Sistema Ericsson *Roma*, C. P. 4024 Appio, tel: 78 02 21, tgm: sielte

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

S.E.T. Soc. per Az. — Società Esercizi Telefonici *Napoli*, Via Roberto Bracco 20, tel: 50 000, tgm: set

Nederland

Ericsson Telefoon-Maatschappij, N.V. *Rijen (N. Br.)*, tel: 01692-555 tgm: erictel

den Haag—Scheveningen, Gevers Deynootplein 30, Kurhaus, tel: 55 55 00, tgm: erictel-haag

Norge

A/S Elektrisk Bureau *Oslo*, P. B. 5055, tel: Centralbord 461820, tgm: elektriken

A/S Industrikontroll *Oslo*, Teatergaten 12, tel: Centralbord 335085, tgm: indtroll

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

A/S Norsk Signalindustri *Oslo*, P.B. Mj 2214, tel: Centralbord 56 53 54, tgm: signalindustri

Portugal

Sociedade Ericsson de Portugal, Lda. *Lisboa* 7, Rua Filipe Folque, tel: 57193, tgm: ericsson

Schweiz

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

Suomi

O/Y L M Ericsson A/B *Helsinki*, Fabianinkatu 6, tel: A 8282, tgm: ericssons

Sverige

Telefonaktiebolaget L M Ericsson *Stockholm 32*, tel: 19 00 00, tgm: telefonbolaget

AB Alpha *Sundbyberg*, tel: 28 26 00, tgm: aktiealpha-stockholm

AB Ermex *Solna*, tel: 82 01 00, tgm: elock-stockholm

AB Ermi *Ulvsunda 1*, tel: 26 26 00, tgm: ermibolag-stockholm

AB Rifa *Ulvsunda*, tel: 26 26 10, tgm: elrifa-stockholm

AB Svenska Elektronrör *Stockholm 20*, tel: 44 03 05, tgm: electronics

L M Ericssons Driftkontrollaktiebolag *Solna*, tel: 27 27 25, tgm: powers-stockholm

L M Ericssons Svenska Försäljningsaktiebolag *Stockholm*, Kungsgatan 33, tel: 22 31 00, tgm: ellem

L M Ericssons Signalaktiebolag *Stockholm Sv*, tel: 19 01 20, tgm: signalbolaget

Mexikanska Telefonaktiebolaget Ericsson *Stockholm 32*, tel: 190000, tgm: mexikan

Sieverts Kabelverk *Sundbyberg*, tel: 28 28 60, tgm: sievertsfabrik-stockholm

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: 45-4494, tgm: inderic

New Delhi, 45, Indra Palace, Connaught Place, tel: 44490, tgm: inderic

Indonesia

Ericsson Telephone Sales Corporation AB *Bandung*, Djalan Dago 151, tel: 2133, tgm: javeric

Liban

Telefonaktiebolaget L M Ericsson, Technical Office *Beyrouth*, Rue du Parlement, Immeuble Bisharat, tel: 33555, tgm: ellem

Türkiye

Ericsson Türk Ltd. Şirketi *Ankara* Âdil Han, Zafer Meydani, Yenişehir, tel: 28379, tgm: ellem

• AMERICA •

Argentina

Cía Sudamericana de Teléfonos L M Ericsson S. A. *Buenos Aires*, Belgrano 894, tel: 332071, tgm: ericsson

Corp. Sudamericana de Teléfonos y Telégrafos S. A. *Buenos Aires*, Belgrano 894, tel: 332071, tgm: cartefe

Cía Argentina de Teléfonos S. A. *Buenos Aires*, Perú 263, tel: 305011, tgm: cecea

Cía Entrerriana de Teléfonos S. A. *Buenos Aires*, Perú 263, tel: 305011, tgm: cecea

Cía Comercial de Administración S. A. *Buenos Aires*, Perú 263, tel: 305011, tgm: cecea

Industrias Eléctricas de Quilmes S. A. *Quilmes FCNGR*, 12 de Octubre 1090, tel: 203-2775, tgm: nidelqui-buenosaires

Brasil

Ericsson do Brasil Comércio e Indústria S. A. *Rio de Janeiro*, C. P. 3601, tel: 43-0990, tgm: ericsson

São Paulo C. P. 5677, tgm: ericsson

Empresa Sul Americana de Telefones S. A. *Rio de Janeiro*, C. P. 4684, tel: 43-0990, tgm: emsulatel

Canada

Ericsson Telephone Sales of Canada Ltd. *Montreal 8, Que.*, Bates Road, tel: RE 1-6428, tgm: caneric

Toronto, 18, 34 Advance Road, *Ont.*, tel: BE 1-1306

Chile

Cía Ericsson de Chile S. A. *Santiago*, Casilla 10143, tel: 82555, tgm: ericsson-santiagodechile

Colombia

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

México

Cía Comercial Ericsson S. A. *México D. F.*, Apartado 9958, tel: 46-46-40, tgm: coeric-mexico

Teléfonos de México S. A. *México D. F.*, Paseo de la Reforma 107 tel: 21-91-00, tgm: elmex-mexico

Perú

Cía Ericsson S. A. *Lima*, Apartado 2982, tel: 34941, tgm: ericsson

Soc. Telefónica del Perú, S. A. *Arequipa*, Casilla de Correo 112, tgm: telefonica

Uruguay

Cía Ericsson S. A. *Montevideo*, Casilla de Correo 575, tel: 84433, tgm: ericsson

USA

The Ericsson Corporation *New York 17, N. Y.*, 100 Park Avenue, tel: Murray Hill 5-4030, tgm: erictel

North Electric Co. *Galion, Ohio*, P. O. B. 417, tel: 24201, tgm: northphone-galion-ohio

Venezuela

Cía Anónima Ericsson *Caracas*, Apartado 3548, tel: 543121, tgm: ericsson

Teléfonos Ericsson C.A. *Caracas*, Apartado 3548, tel: 557467, tgm: tevela

• AUSTRALIA & OCEANIA •

Australia

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

Agencies

• EUROPE •

Belgique

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

Greece

»ETEP», S. A. Commerciale & Technique *Athens*, 41, Stadiou Street, tel: 31 211, tgm: aeter

Ireland

E. C. Handcock, Ltd. *Dublin*, C 5, 17 Fleet Street, tel: 76 501, tgm: forward

Island

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

Yougoslavie

Merkantile Inozemna Zastupstva *Zagreb*, P. O. B. 23, tel: 25—222, tgm: merkantile

Österreich

Inglomark, Industrie-Belieferungs-Gesellschaft Markowitsch & Co. *Wien XV*, Maria Hilferstrasse 133, tel: R 32-0-11, tgm: inglomark

• ASIA •

Burma

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

Ceylon

Vulcan Trading Co. (Private) Ltd. *Colombo*, 19 York Street, tel: 3636, tgm: vultra

China

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

Hongkong

The Swedish Trading Co. Ltd. *Hongkong*, Prince's Building, Ice Hause Street, tel: 20 171, tgm: swedetrade

Iran

Irano Swedish Company AB *Teheran*, Khiaban Sevom Esfand 201-203, tel: 36761, tgm: iranoswede

Iraq

Swedish Oriental Company AB *Baghdad*, Azzoz Building 269 A/195 King Faisal II Street, tel: 848 19, tgm: swedeorient

Israel

Jos. Muller, A. & M. Engineer (Representations & Import) Ltd. *Haifa*, P.O.B. 243, tel: 3160, tgm: mullerson

Japan

Gadelius Co. Ltd. *Tokyo*, Shiba Park No. 7 Minato-ku, tel: (43)-1847, tgm: goticus

Jordan

H. L. Larsson & Sons Ltd. Levant *Amman*, P. O. B. 647, tgm: larsonhus

Kuwait

Latiff, Supplies Ltd. *Kuwait*, P.O.B. 67, tgm: latisup

Liban

Swedish Levant Trading Co. *Beyrouth*, P. O. B. 931, tel: 31624, tgm: skefko

Malaya

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

Pakistan

Vulcan Trading Co. (Pakistan) Ltd. *Karachi City*, P. O. B. 4776, tel: 32506, tgm: vulcan

Philippines

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

Saudi Arabia

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

Syrie

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

Thailand

The Vichien Radio & Television Co., Ltd. *Bangkok*, 299-301, Prasitsin Bldg. Suriwongse Road, tel: 318 69, tgm: vision

Vietnam, Cambodja & Laos

Compagnie Internationale de Commerce *Saigon, (Vietnam)*, P. O. B. 204 tel: 20253, tgm: intercom

• AFRICA •

British East Africa

Transcandia Ltd. *Nairobi, Kenya*, P. O. B. 5933, tel: 3312, tgm: transcanda

Congo Belge

Société Anonyme Internationale de Télégraphie sans Fil (SAIT) *Bruxelles (Belgique)*, 25, Boulevard de Régent, tel: 12 50 70, tgm: wireless

Egypt

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

Ethiopia

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

Gold Coast (Ghana)

The Standard Electric Company *Accra*, P. O. B. 17, tel. 2785, tgm: standard

Moçambique

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

Nigeria

Scan African Trading Co. *Yaba Lagos* 32, P. O. B. 1, tgm: swedafrica

Rhodesia & Nyasaland

Reunert & Lenz, (Rhodesia) Ltd. *Salisbury* (Southern Rhodesia), P. O. B. 2071, tel: 27001, tgm: rockdrill

Tangier

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

Union of South Africa

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

• AMERICA •

Bolivia

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

Costa Rica

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

Cuba

Mc Avoy y Cía *Habana*, Apartado 2379, tel: U-2527, tgm: macavoy

Curaçao N. W. I.

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

República Dominicana

García & Gautier, C. por A. *Ciudad Trujillo*, Apartado 771, tel: 3645, tgm: gartier

Ecuador

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

Guatemala

Nils Pira *Ciudad de Guatemala*, Apartado 36, tel: 3311, tgm: nilspira-guatemala

Haïti

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

Honduras

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

Jamaica and Brit. Honduras

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

Nicaragua

J. R. E. Tefel & Co. Ltd. *Managua*, Apartado 24, tel: 387-1169, tgm: tefelto

Panama

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

Paraguay

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

El Salvador

Dada-Dada & Co. *San Salvador*, Apartado 274, tel: 4860, tgm: dada

Surinam

C. Kersten & Co. N. V. *Paramaribo*, P. O. B. 216, tel: 2541, tgm: kersten

USA

State Labs. Inc., *New York 12, N.Y.*, 649 Broadway, tel: Oregon 7-8400, tgm: statelabs. Only for electron tubes

• AUSTRALIA & OCEANIA •

New Zealand

ASEA Electric (N Z) Ltd. *Wellington C 1*, Huddart Parker Building, Post Office Square, tel: 70-614 tgm: aseaburd

ESSELTE, STHLM 57