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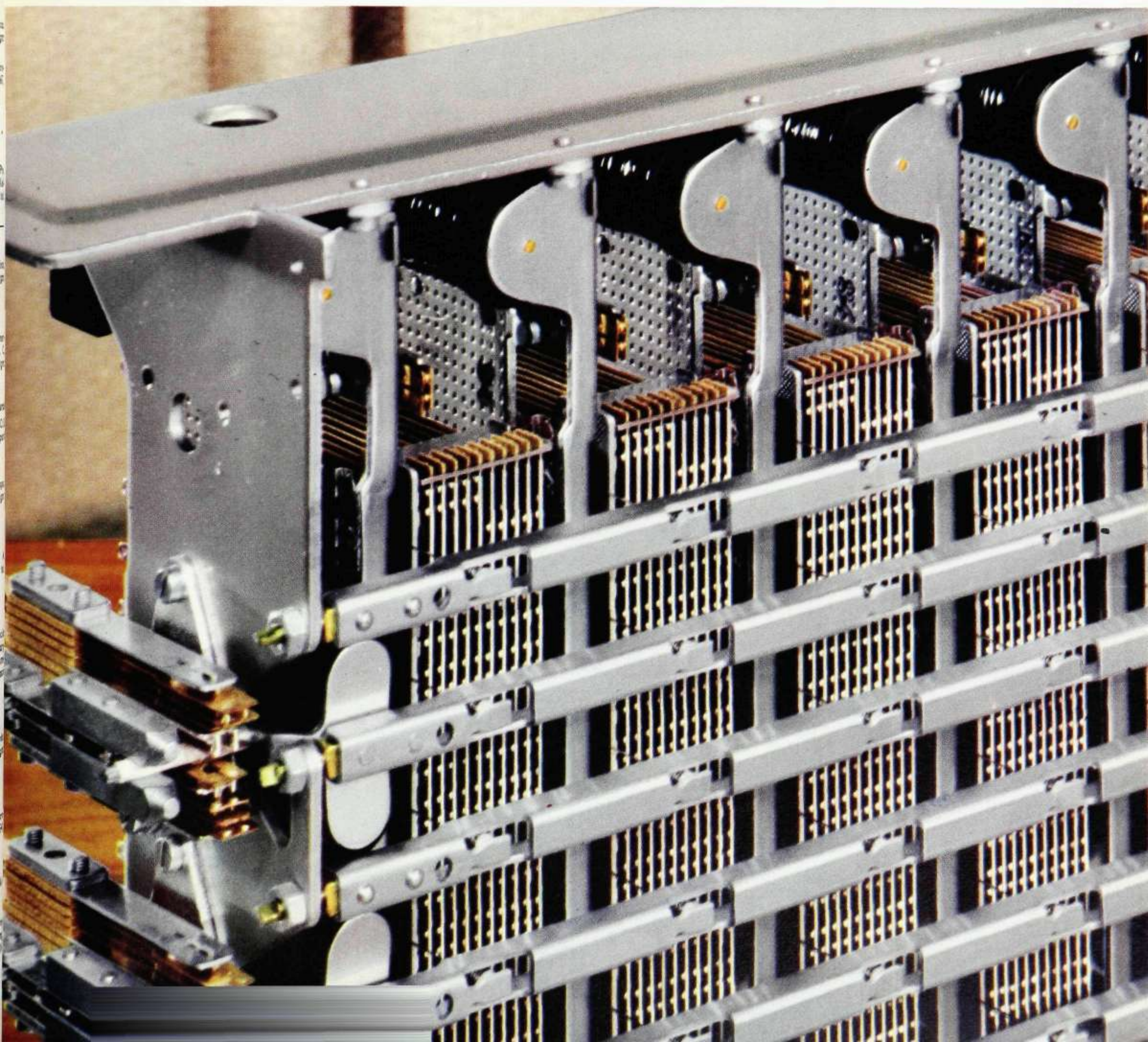

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On cover: L M Ericsson's 6-bar crossbar switch.

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

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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

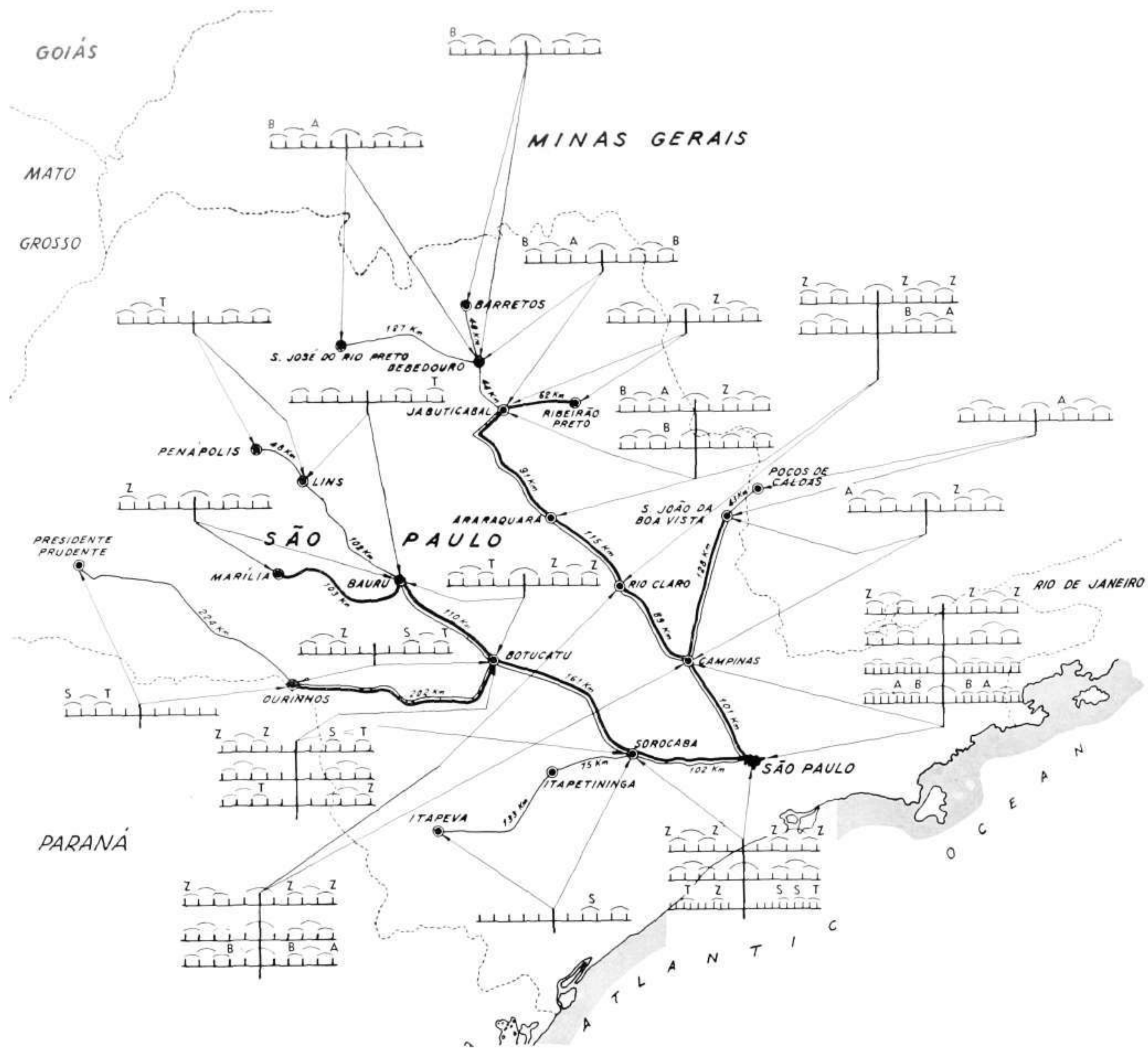
The electrical performance and equipment features of the ZAA 8 carrier telephone system have been described in the article "New 6- and 8-channel carrier telephone systems for open wire lines" (Ericsson Review No. 2, 1956). Those characteristics, however, which are of particular interest for the state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

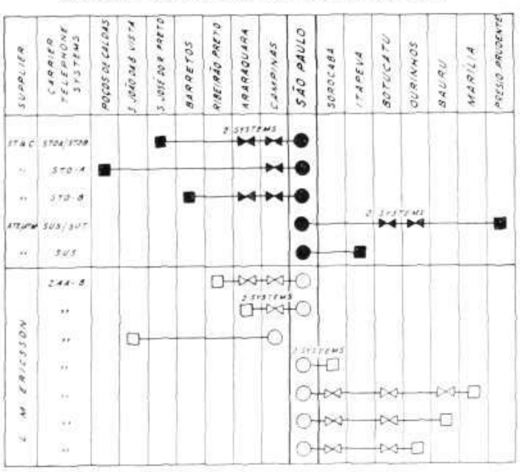
The ZAA 8 is so designed that, in 4-wire operation, levels from — 14 dbm to + 1 dbm can be accepted from, and — 8 dbm to + 7 dbm delivered to, the toll board. The 2/4-wire terminating units introduce an overall loss of 7 db from terminal to terminal. Output level per channel to the line is + 17 dbm and 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 subassemblies 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

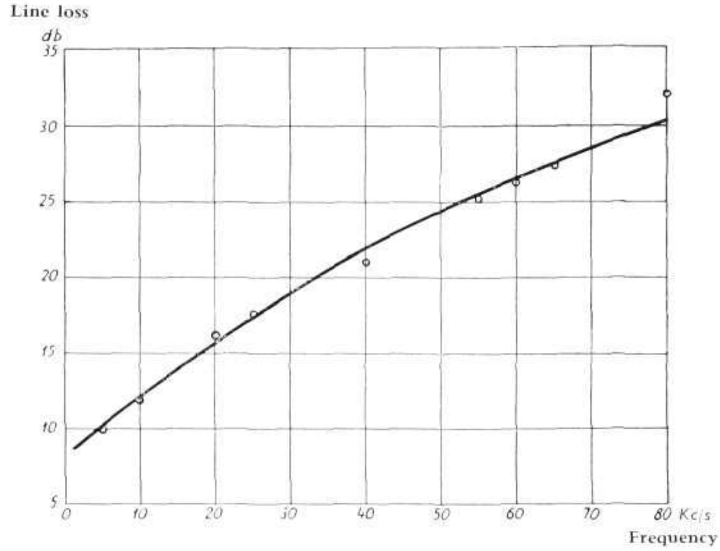


Fig. 2 X 6988

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

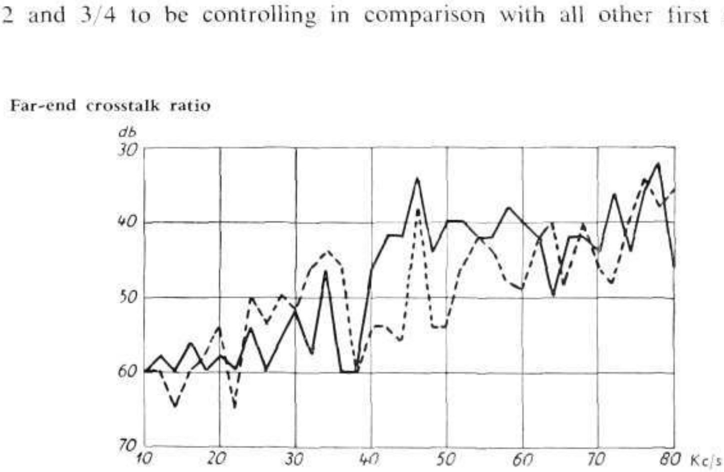


Fig. 3 X 6989

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.

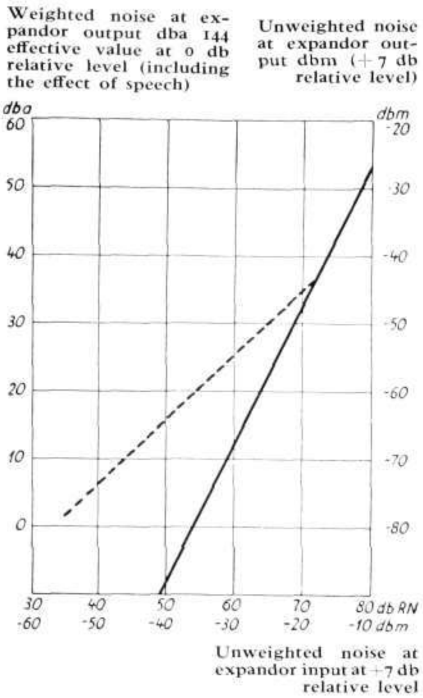


Fig. 4 X 2175

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

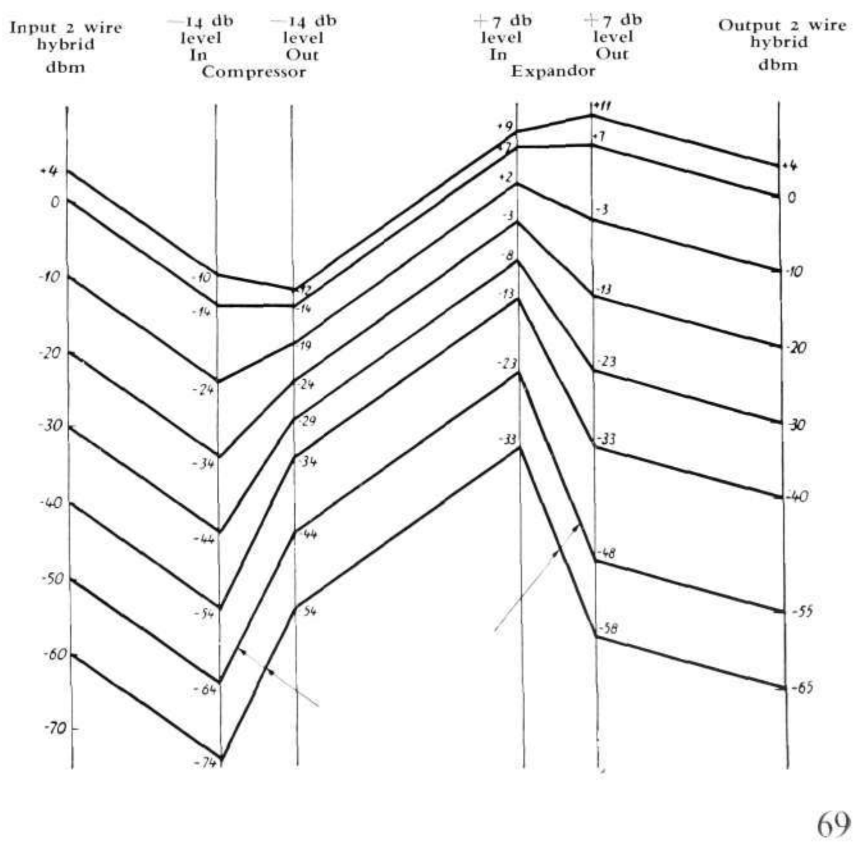


Fig. 5 X 6990

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

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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.

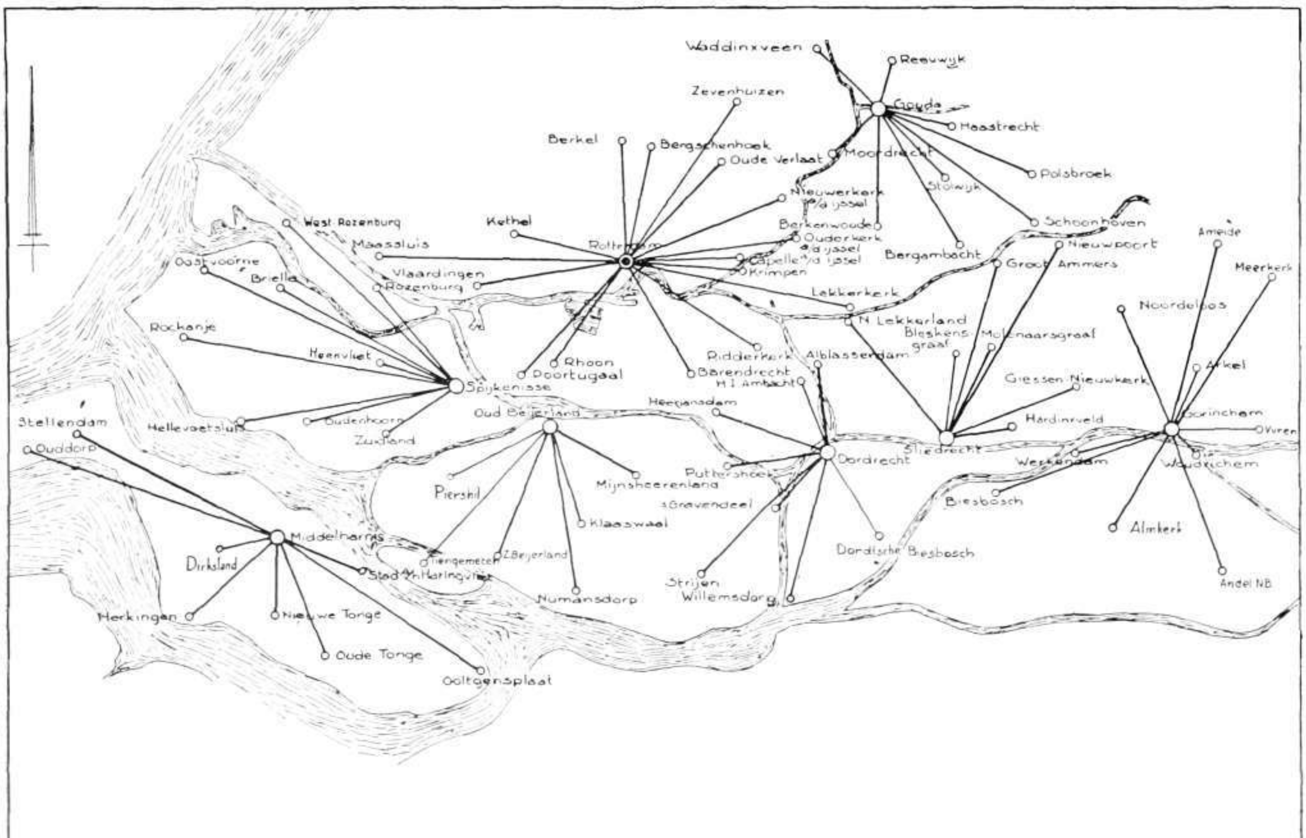


Fig. 1 X 7698

Map of Rotterdam zone with associated group centres and terminal exchanges

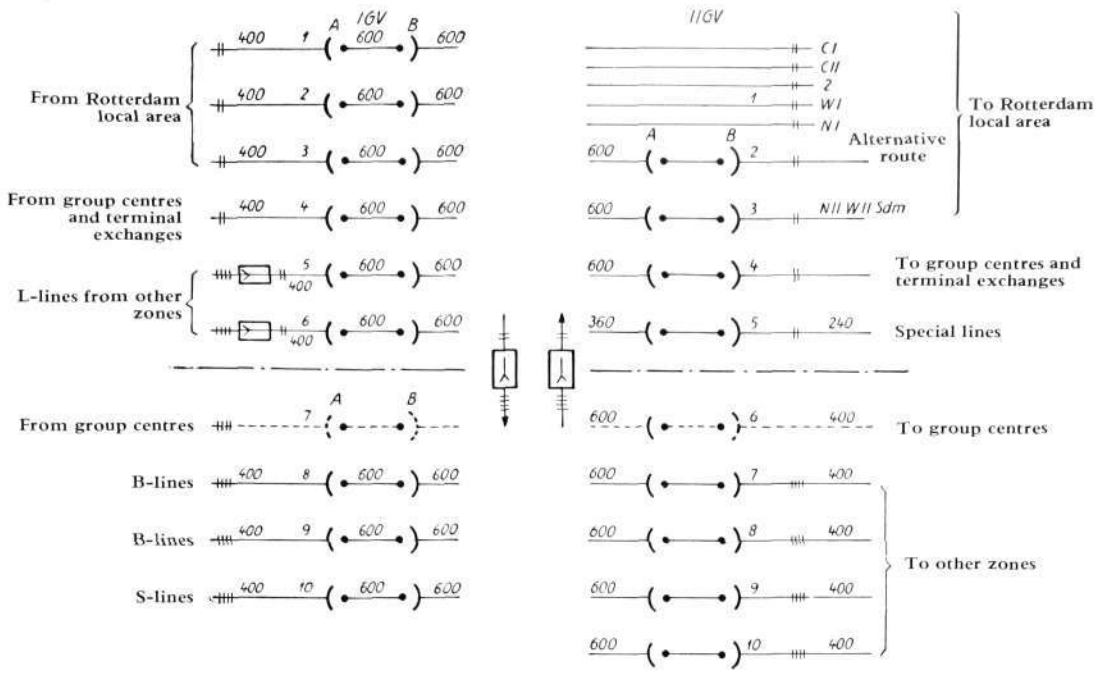


Fig. 2 X 6994

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.

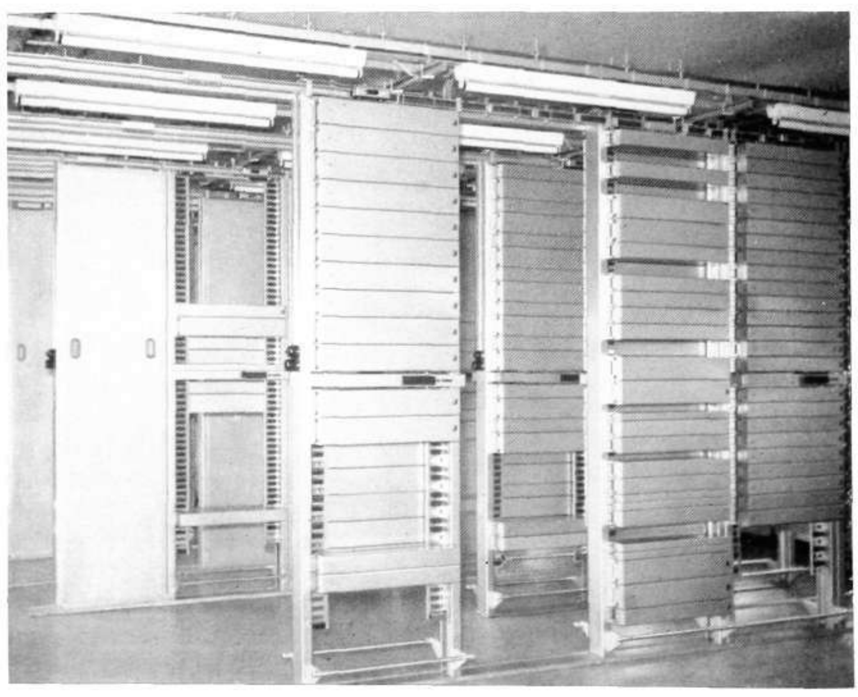


Fig. 6 X 6972

Middelharnis group centre

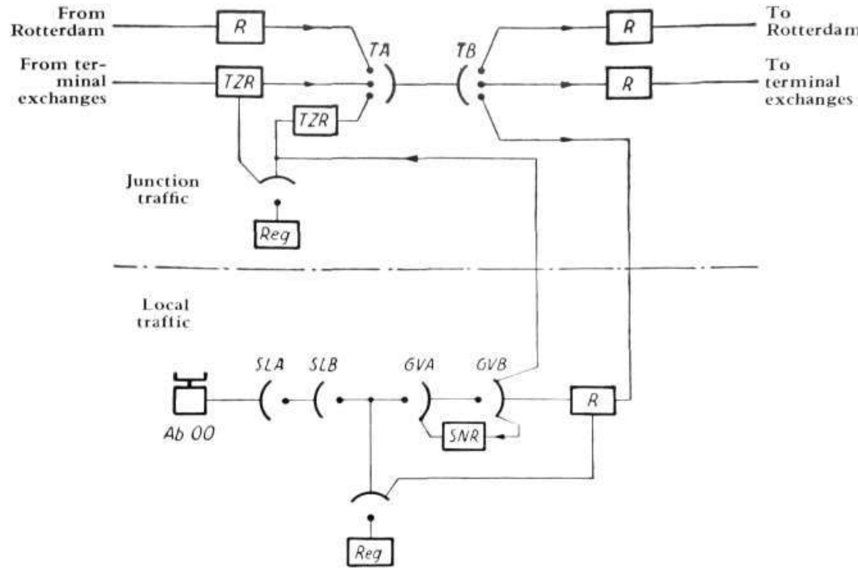


Fig. 7 X 6993
Trunking scheme of Middelharnis group centre

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.

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.

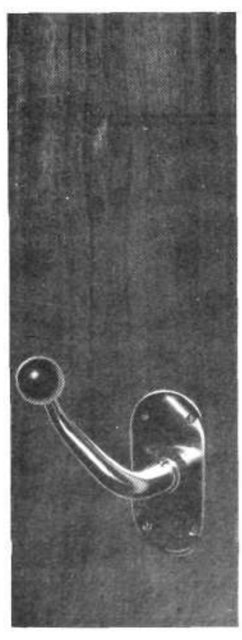
Fig. 4 X 6980 X 2154

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.



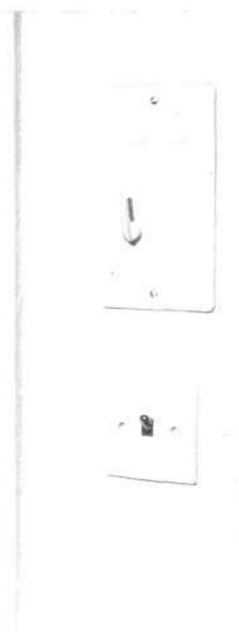


Fig. 5 X 6981

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.

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**

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.

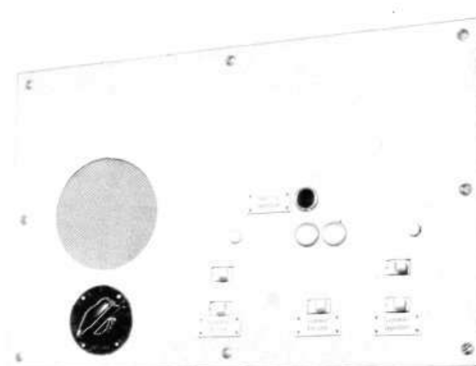


Fig. 7 X 6983

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.

Fig. 8 a X 2171
Pushbutton switch KEH 1001

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.)

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.

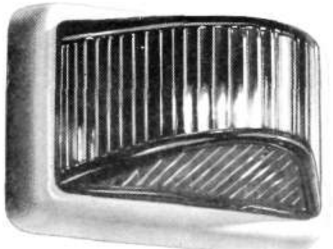


Fig. 8 c X 2173
Lamp indicator KNH 832

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.

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

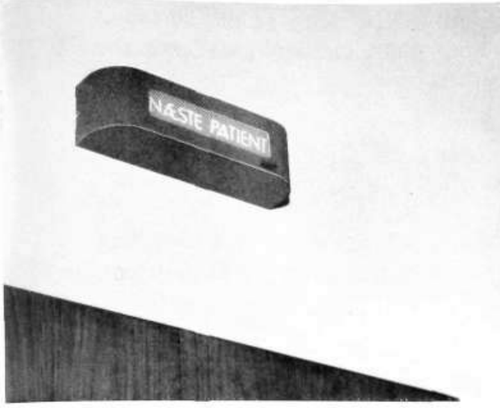


Fig. 9 X 2156

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

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.

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.

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.

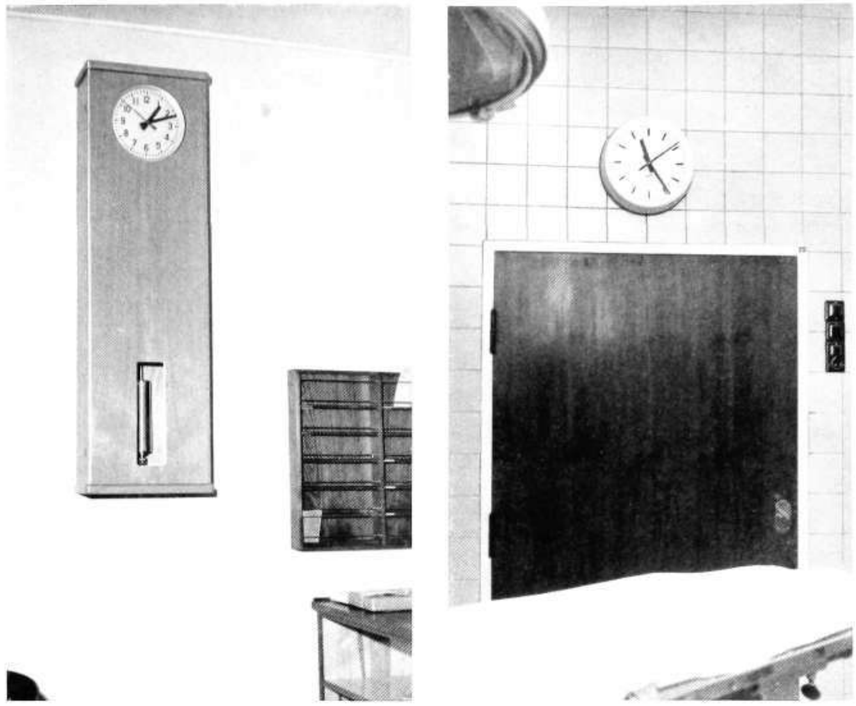


Fig. 11 X 2158 X 2159

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.

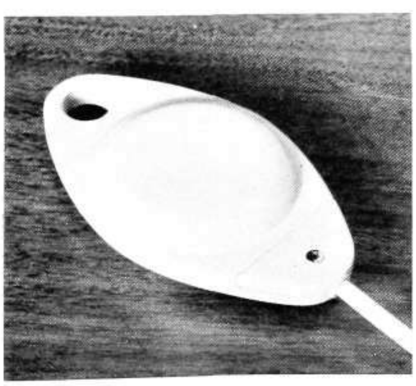


Fig. 12 X 2160
Pillowspeaker

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,

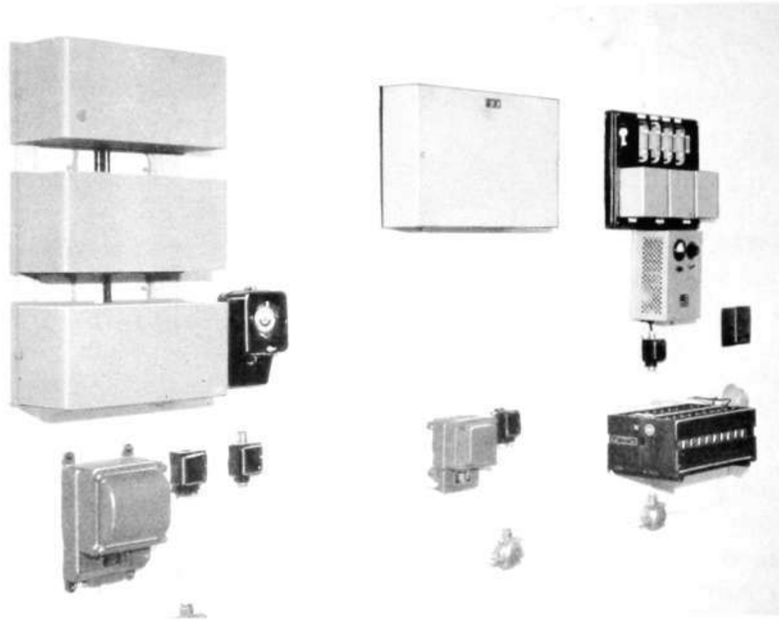


Fig. 13 X 6994

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.

Ericsson LM 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.

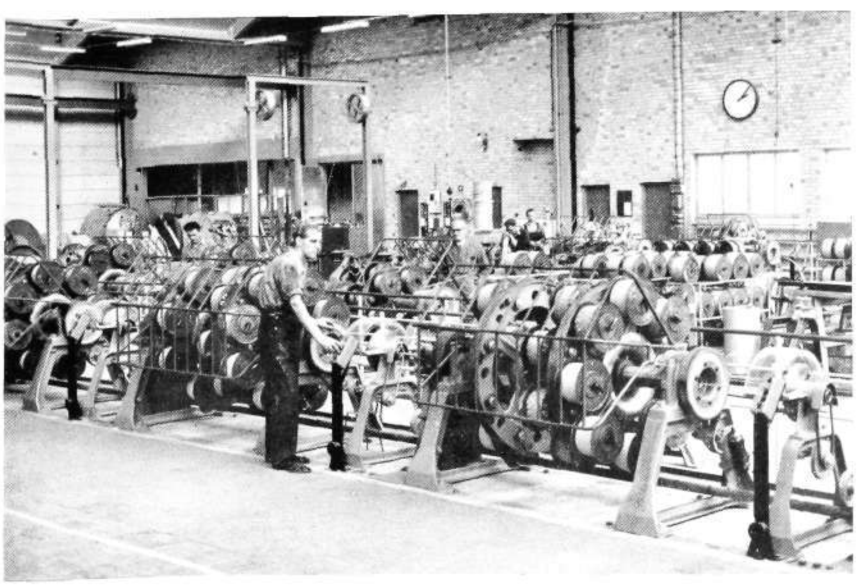
Cable and wire are an important part of every telephone network and telesignalling system. The merging of the Älvsjö Cable Works with the L M Ericsson group in 1921, after its launching by AB Stockholmstelefon a few years earlier, was thus a natural development. In 1928 L M Ericsson also took over Sieverts 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.

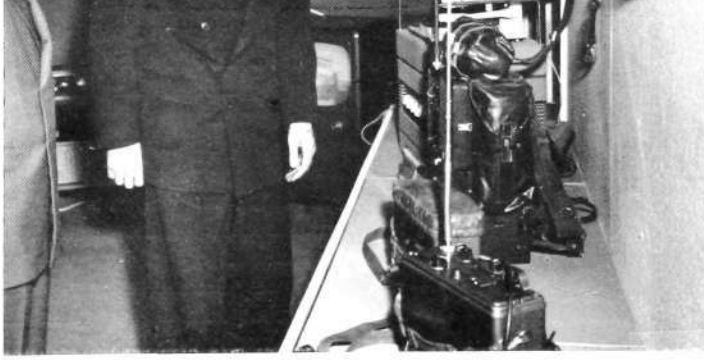
A great step forward in the conversion of Copenhagen to dial working was taken on the night of October 21, 1956, when the Lyngby exchange was cut over. The exchange equipment, consisting of crossbar system ARF 10 for 10,000 lines, was delivered and installed by L M Ericsson. This system now covers 49,000 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.

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.

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

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

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

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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

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

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

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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

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

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

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

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

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Yougoslavie

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

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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

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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

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

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

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The Standard Electric Company *Accra*, P. O. B. 17, tel. 2785, tgm: standard

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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: 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

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