

*New Dial System
in Aarhus*

with LM Ericsson's Crossbar Switches



One of the most up-to-date telephone systems in the world has been put in service in Aarhus, one of Denmark's oldest cities. It contains 32,000 lines and is at the same time the largest crossbar plant of the by-path system yet installed by L M Ericsson.

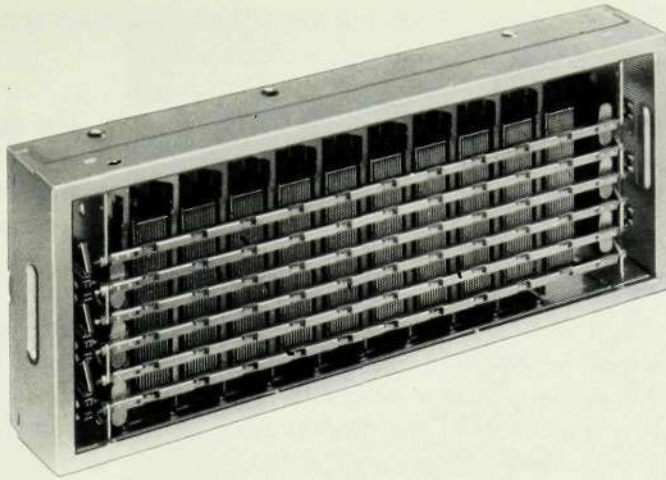
The production of the equipment was undertaken by L M Ericsson in collaboration with Danish factories, primarily Telefon Fabrik Automatic. The responsibility for the extensive work of installation, which was performed exclusively by Danish manpower under the guidance of Swedish experts, fell to the lot of L M Ericsson's Danish associate. The effort has been made, in intimate cooperation with the Jutland Telephone Co., to produce a telephone plant representative of the highest developments in modern telephone engineering.

Aarhus is the first large Danish town to automatize its telephone network which, in addition to Aarhus itself, includes a number of exchanges in the surrounding suburbs. The main exchange in the centre of Aarhus, contained in the newly erected block on

Fiskergade, caters for 20,000 lines. Risskov and Aabyhøj have each had 3,000 lines installed, Aarhus South 4,000, and Skåde and Brabrand 1,000 lines each. In the Fiskergade exchange, in addition to the 20,000 local lines, there is an automatic trunk and toll exchange with cordless boards.

The numbering of telephones in the Aarhus group of exchanges consists of a five-digit series running from 20,000—99,999. This allows for 80,000 subscriber numbers. When more than 80,000 numbers are required, the present numbers can be converted to six digits by adding 1 as first digit.

The automatization of the entire Aarhus network constitutes a great improvement in the telephone communications of the capital town of Jutland, which is at the same time one of Denmark's most important commercial and industrial centres and among the largest seaports in the country.



L M Ericsson crossbar switch

Characteristic Features of the System

L M Ericsson's many years of experience in the construction and operation of automatic telephone exchanges has proved its value in the development of the Aarhus system. The highest demands that can be made on a modern telephone system have been met both as regards good transmission, rapidity in establishing connections, reliability and a wide range of traffic facilities, combined with the minimum of maintenance costs.

Throughout the Aarhus telephone system the crossbar is the sole type of switch employed. The crossbar switch was invented in Sweden in 1917—18, and the first large crossbar exchange was built in 1924—26. Crossbar exchanges installed in Sweden since that time cater for more than 340,000 lines. In America, too, a large number of crossbar exchanges have been installed in the course of the last 15 years.

The *crossbar switch* may most simply be described as a number of relays combined with common equipment for controlling the relay springsets.

The use of precious metal (silver alloy) twin contacts in each springset reduces the risk of contact faults and improves transmission.

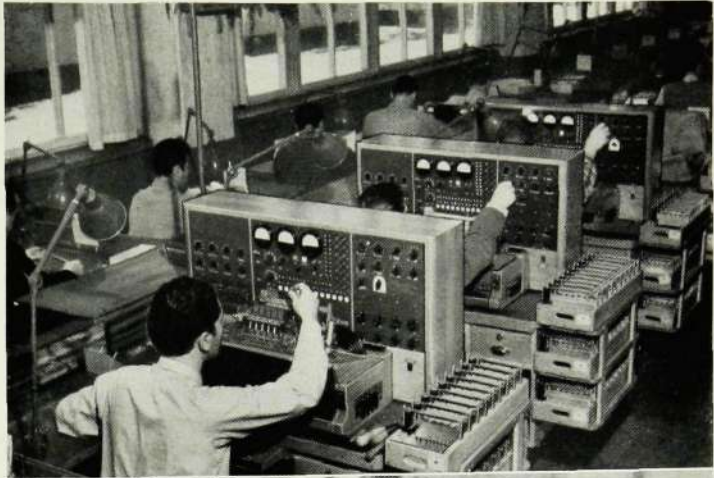
The operation of a crossbar switch is remarkably simple. The energization of three magnets actuates two sets of contact springs. Two of the magnets thereupon release, so that only one magnet remains operated during the conversation. Thus the switch performs very little mechanical movement, and wear is reduced to a minimum.

In other telephone systems each switch has normally a number of relays to guide and control its operation. These relays are far from fully utilized because time taken to operate a switch is very short compared with its time of occupation during a call. In the Aarhus crossbar system, on the other hand, the control of the switches' operation is concentrated to a small number of common devices, called markers, each controlling a large number of switches. This enables the controlling relays to be put to far more economical use, which at the same time makes it economically possible to introduce all imaginable kinds of safety devices. The advantage is also gained that, with so little relay equipment to supervise the operation of the switches, maintenance is reduced.

The impulses from the subscriber's dial are received in a register, which transmits impulses to the markers in the various selector stages and controls the routing through the selector stages. The system is thus register-controlled, and there is a considerable margin of freedom in the choice of the numbering scheme for exchanges within the group. Moreover, the number series can be well utilized before converting to a six-digit series.

The *group selectors* have 400 outlets that can be allotted to routes with 20 or 40 outlets in each. The number of routes in one group selector stage may thus vary between 10 and 20. Since there are a large number of routes, only a small number of group selector stages will be required, even in a large exchange.

Automatic instruments
for testing the springsets
in a crossbar switch

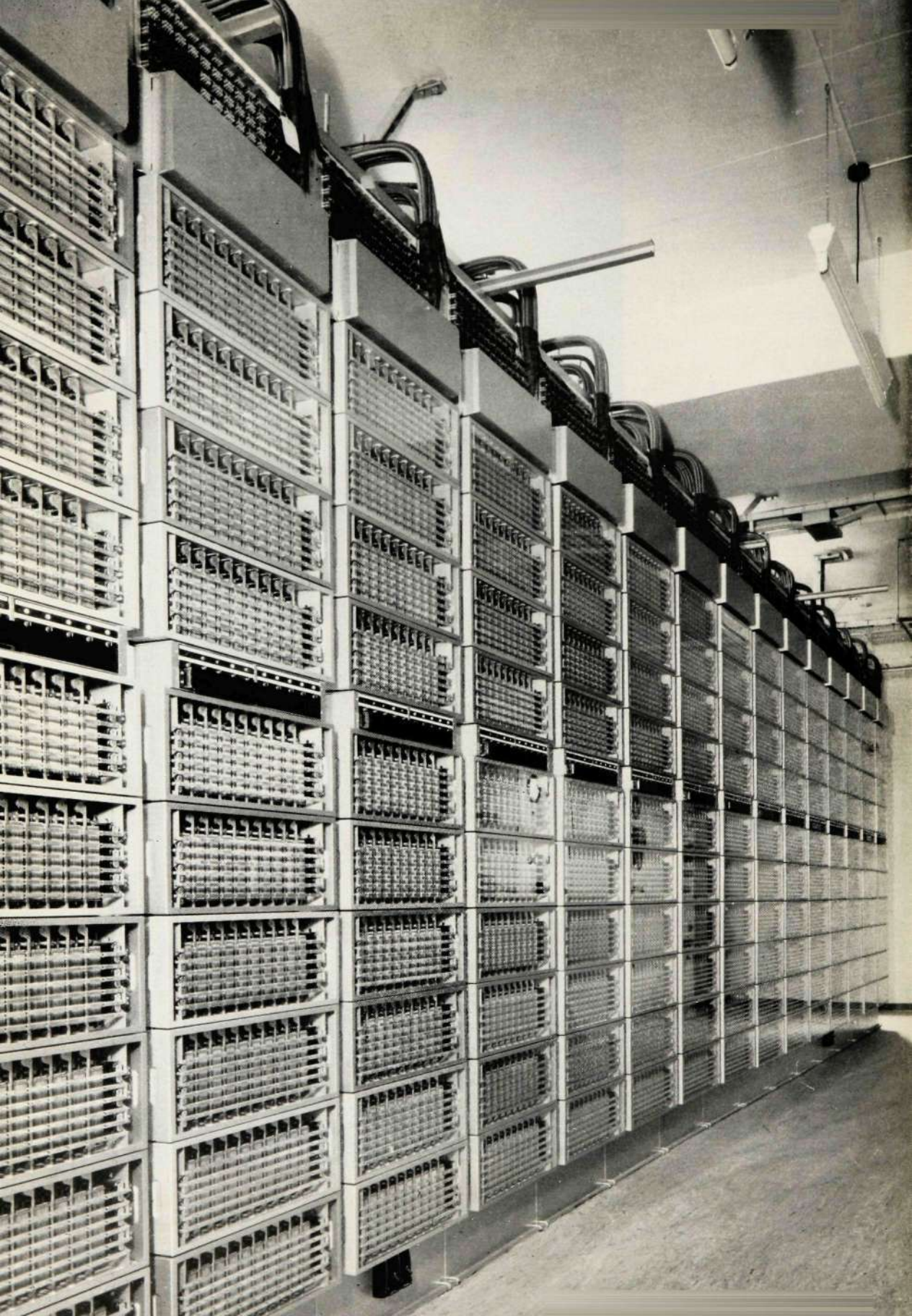


Final adjustment of
crossbar switch



Wiring up crossbar
switch frames





Left: Racks of crossbar switches in Aarhus trunk exchange



Right: Register racks for a 10,000 group in local exchange



Inter-rack cabling

Local Exchange

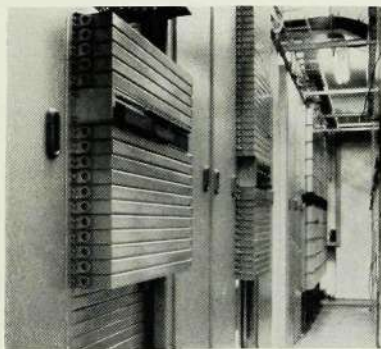
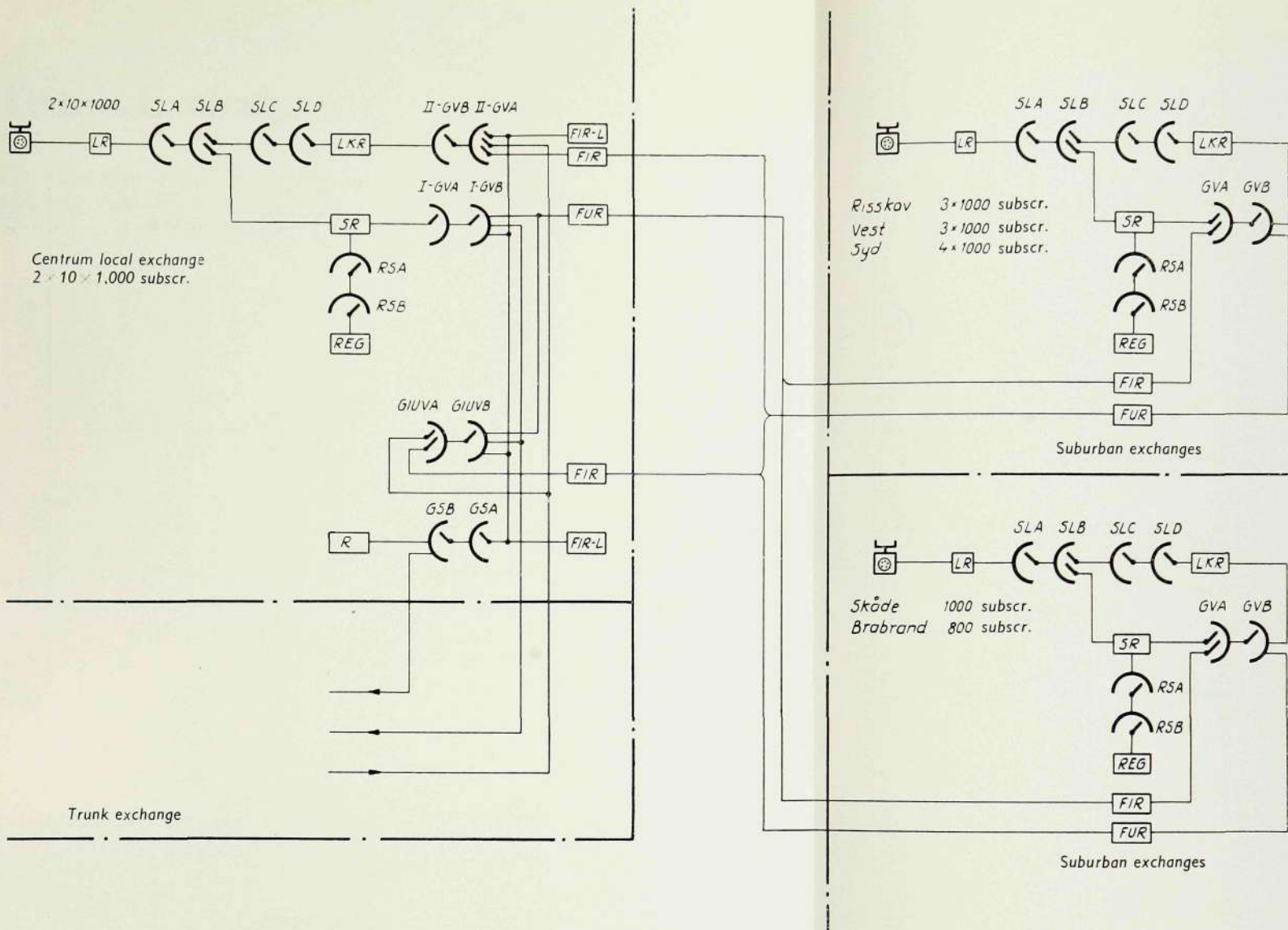
Finders and final selectors for a group of 1,000 lines are assembled in a so-called subscriber stage *SL*, consisting of four partial stages *A*, *B*, *C* and *D*. *SLA* and *SLB* serve both incoming and outgoing traffic, *i. e.* both as finders and final selectors.

Connection is obtained to a register via a register finder *RS*. One group of registers serves 10,000 lines.

A first group selector *IGV* selects the route to the wanted exchange, or 10,000 group in the home exchange. In smaller exchanges the 1,000 group is also selected in the *IGV* stage, whereas in the main exchange this choice is made over the second group selectors *IIGV*.

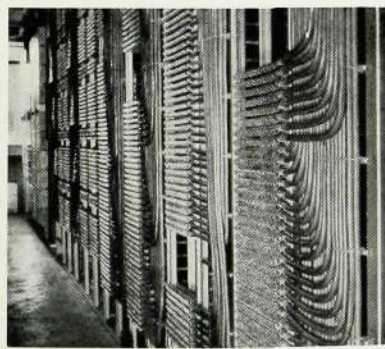
The special service lines are served by a group selector *GS* in the main exchange.

Junction traffic passes over two-wire exchange lines. The entire connection is controlled by the register in the calling subscriber's exchange.

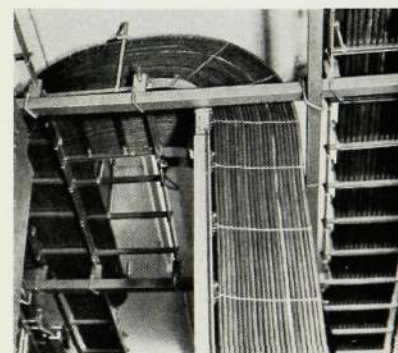


Left: Rear view of a 1,000 group

Right: I. D. F. of a 10,000 group



Right: Cables connecting M. D. F. to a 10,000 group



Trunk Exchanges

The Centrum trunk exchange consists of manual boards with 70 operators' positions and of automatic crossbar switching equipment.

The operators' positions are of the cordless type. They have neither cords nor multiple, all calls being established by means of keys, buttons and lamps. The operator has a keyset on which she can "dial" a number either to an automatic subscriber, a manual exchange in the Aarhus group or a trunk line, the connection being completed by the automatic equipment.

All local calls in Aarhus and its surroundings are fully automatic and thus require no operator. Such outgoing traffic from Aarhus as cannot be handled from the subscriber's dial must be put through by operators. For this purpose the Jutland Telephone Co. have a toll exchange with 40 operators' positions and 30 special positions allotted to enquiries, records, absent subscriber service etc. In addition the Posts and Telegraphs control 30 operators' positions for dealing with trunk calls to areas outside the jurisdiction of Jutland Telephone Co.



From the automatic equipment calls are routed to the Centrum local exchange, from which connection is obtainable to all automatic exchanges in Aarhus. Circuits also run to all manual exchanges within the Aarhus group, and to the national and international networks.

Calls in Aarhus and Suburbs

Automatic subscribers in Aarhus and suburbs can communicate without an operator's assistance by dialling the relevant five-digit number.

Calls within Aarhus Group

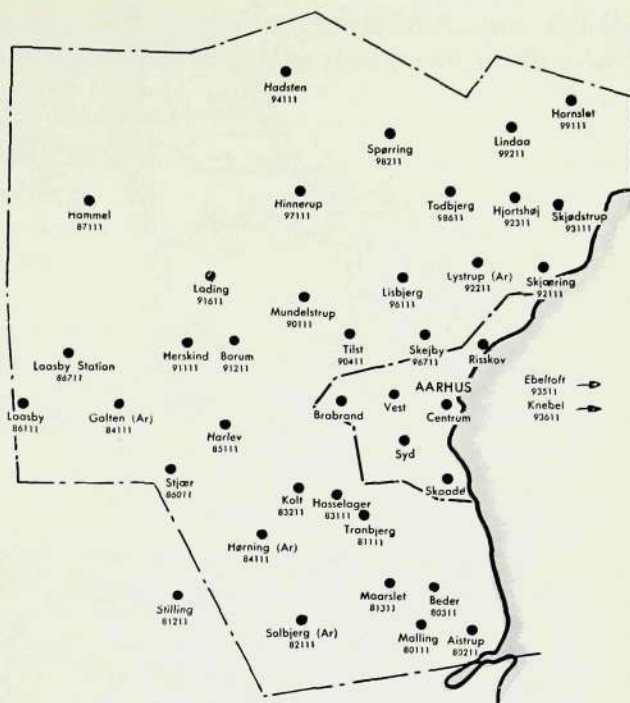
When a dial subscriber in Aarhus wishes to speak to a subscriber connected to a manual exchange within the group, he dials the call number of that exchange. The call is thereupon passed through the automatic exchange via the switching equipment in the trunk exchange to the manual exchange, where it is handled by the operator.

To obtain enquiries, telegrams, time etc., an automatic subscriber dials the three-digit number of the service in question.

Should all outgoing lines from Aarhus to the wanted exchange be engaged, the call is automatically put through to an Aarhus operator who records the demand.

The manual exchanges have junctions to the automatic equipment in the trunk exchange, so that an operator can dial any subscriber in Aarhus.

As new exchanges in the Aarhus group become automatized, connections will naturally be established without the assistance of an operator.



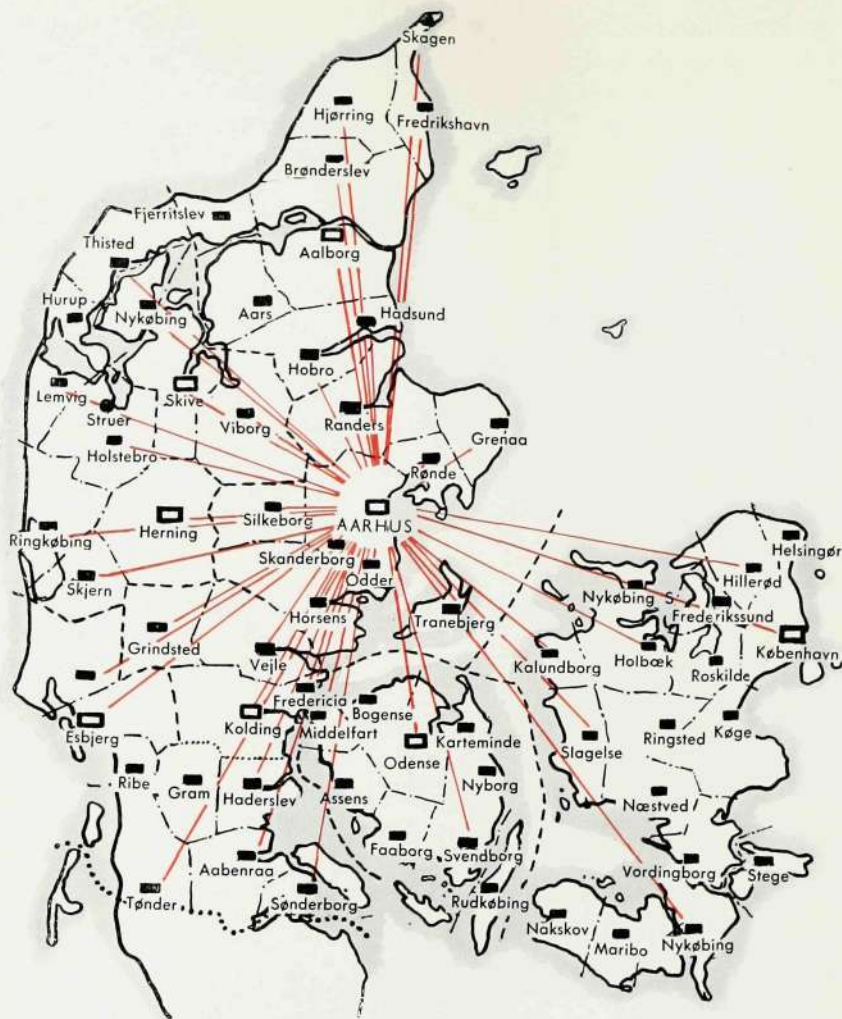
Exchanges in Aarhus group with direct junctions to Aarhus Centrum, Ebeltoft, Knebel, and Stilling are actually situated outside the group area, but have numbers within the group series.

National Network Calls

The Danish national network is divided up under prefixes commencing with 0, *e. g.* Aalborg 081, Copenhagen 01.

A dial subscriber wishing to call a dial subscriber in another part of Denmark first dials the required prefix and then the subscriber's number. The call is passed from the Aarhus local exchange via the trunk exchange over a trunk line to the distant exchange. If all trunk lines leading to that exchange are engaged, the call goes to an Aarhus operator who records the demand.

Due to the insufficiency of lines to some Danish exchanges, subscribers cannot always reach them by dialling. Such calls must therefore be recorded by an operator in Aarhus. For calls within the area of the Jutland Telephone Co. the operators are called by dialling 001, while calls to places outside this



Main exchanges in Denmark showing those having direct communication with Aarhus automatic exchange. From Aarhus international lines also exist to Oslo, London, Hamburg, and Kiel.

area are recorded by P. & T. (009). As nationwide subscriber dialling becomes more general, two automatic subscribers will be able to call one another without an operator's assistance by dialling first the two or three-digit prefix of the distant exchange followed by the called party's number.

Incoming trunk calls to an Aarhus subscriber are automatically established by the distant operator. The operator has a keyset on which the Aarhus subscriber's number is transmitted by voice frequency code impulses over the

trunk line. The number is received by the trunk exchange in Aarhus, and the call is extended to the subscriber over the switching equipment in the trunk and local exchanges.

In a similar manner an operator at a manual exchange can effect a transit connection via the trunk exchange. On her keyset she taps the number of the wanted exchange, and her line is then connected to it through the trunk exchange over another trunk line.

The larger exchanges of the group are also equipped with keysets which are used for calls to Aarhus subscribers and on transit connections. The other exchanges in the group can effect these connections automatically with a dial.



Voice frequency receiver
in the trunk exchange

Some Technical Points of Interest

All charging of fully automatic calls is done by means of individual subscriber's meters which are installed at the exchange. During a call the meter advances a number of units depending on the length of the call and the distance between the calling parties. The subscriber is charged per meter unit.

On a call to a PBX subscriber, automatic hunting takes place over all the subscriber's exchange lines until an idle circuit is found. The numbers allotted to a PBX subscriber may be spread arbitrarily through a 1,000 group.

A subscriber, who for any reason wishes all calls to his number answered by an operator, can order *absent subscriber's service* by dialling 004. All calls to his number will then pass automatically to an operator, who sees on a lamp panel which number is being called and, from data recorded in a card index, can instruct the caller accordingly.

When a subscriber's number is changed, the old number is put on absent subscriber's service and callers to that number are informed of the new number by the operator. Vacant numbers can also be put on absent subscriber's service.

The automatic trunk exchange has *queue control* equipment by means of which an operator, when all lines to an exchange are busy, can book a position in the "queue" for that exchange and obtain connection in order of precedence. Calls from dial subscribers to operators automatically take their place in the queue when all operators are engaged. As operators become free, the queue calls are automatically connected to them in the proper sequence. This arrangement is used for demand calls (001 and 009) and for enquiries (003).

The time taken to effect a connection in the exchange by means of crossbar switches and markers is extremely short. The subscriber is connected to the register in under half a second, and the handset hardly reaches the caller's ear before dial tone commences. A local connection between two Aarhus subscribers is established by the exchange in less than one and a half seconds. The rapidity of connections is of particular help to operators who, by means of their keysets, can put through a call in a few seconds.



Above: Mr. P. Draminsky, Man. Dir. of Jutland Telephone Co., bids farewell to the old exchange and thanks the operators for their loyal service.



Left: Cut-over of the new exchange at 2.30 a. m. on May 1, 1953.

Below: The first call on the new exchange takes place between the Chairman of the Board of Jutland Telephone Co., Mr. P. Schack Eyber, and the Managing Director, Mr. P. Draminsky.





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