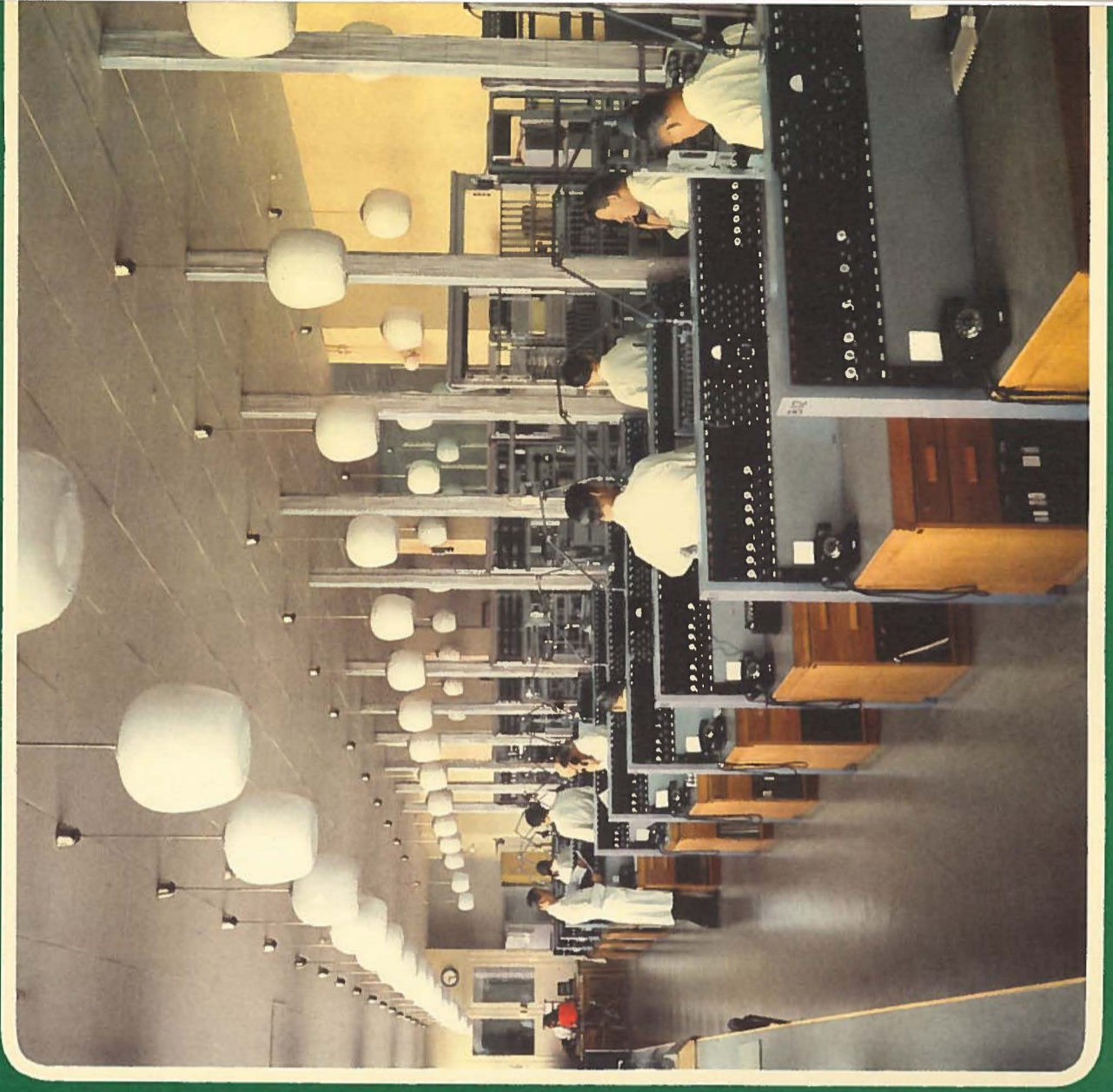


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# Influence of the Size of Selectors on the Number of Selectors in Telephone Plants

C. JACOBÆUS, TELEFONAKTIEBOLAGET L. M. ERICSSON, STOCKHOLM

U.D.C. 621.395.341.2

The purpose of telephone traffic technique is to study the nature of the telephone traffic and, on the basis of the results obtained, to draw up rules for the quantitative dimensioning of the connecting devices in the telephone exchanges and of the junction circuits between the exchanges. In this connection it has been found — as is only natural — that the construction of the connecting devices employed in the building up of the exchanges has considerable importance, not only in respect of the quantity of devices but also as regards the number of junction circuits.

In each individual case, i.e. for each exchange or telephone network, a comparison can obviously be made as to how the requirements of material will be for selectors of different capacities. If the plant considered is not too small, it has been found in every case that larger selectors permit of a saving in numbers of devices and circuits. The results of a general and systematic comparison, however, have not been presented so far as we know. The following article will show that, using certain simplified assumptions, it is possible to arrive at results of general application.

## Basis of the Investigation

It has been assumed that the telephone system is built up throughout of the same kind of selectors. We then get a lay-out diagram in accordance with Fig. 1, with call finder AS,  $x$  group selector stages GV and one final selector stage LV. The selectors employed are assumed to have the capacity  $V$ . When the selectors are used as line finders or final selectors, then obviously subscriber lines are put in their multiples. When the selectors are employed as group selectors the multiples are assumed to be divided into routes with  $k$  lines in each route. The number of routes in each stage is assumed to be  $b$ , from which we get  $k \cdot b = V$ . The exits from the different selectors are connected in gradings. They thus have the availability  $k$ .

The total capacity of the exchange is  $S$  lines. The traffic in the exchanges is  $A$ . It is worth mentioning that the lay-out diagram as per Fig. 1 is likewise applicable to a telephone network, if there is the same number of selector stages in all traffic routes. Some networks with direct-driven exchanges are laid out in this manner. In register-operated exchange-groups on the other hand, advantage is often gained by skipping or inserting selector stages as needed.

Fig. 1 Lay-out diagram for exchange

x 8242

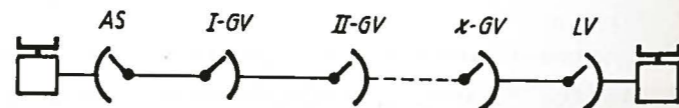
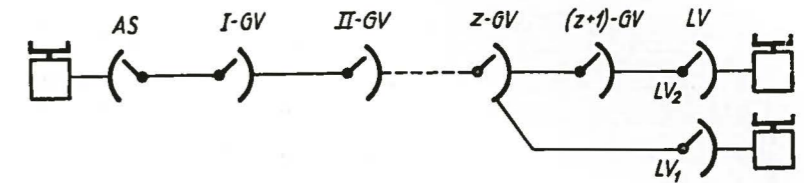


Fig. 2 Lay-out diagram with fractional number of selector stages

x 8243



It is now possible to set up the following equation for the number  $x$  of group selector stages in the exchange:

$$b^x = \frac{S}{V} \text{ or } \left(\frac{V}{k}\right)^x = \frac{V}{S} \text{ which gives}$$

$$x \log \frac{V}{S} = \log \frac{V}{S} \text{ and } x = \frac{\log S - \log V}{\log V - \log k}$$

$x$  is generally a fraction, which may be expressed  $= z + u$ , where  $z$  is a whole number and  $u < 1$ . The lay-out diagram of the exchange will therefore be as per Fig. 2, with the last selector stage partially executed.

## Comparison of Various Types of Selectors Using Only the Formula for Gradings

In a selector group where the selectors are reached from a preceding selector stage over a grading, there applies according to the British Post Office the formula

$$n = \frac{A + 0.53 \cdot k \cdot p_n^{1/k} - 0.53 A_{k, p_n}}{0.53 \cdot p_n^{1/k} + \frac{0.47 \cdot A_{k, p_n}}{k}} \dots \dots \dots (1)$$

- where  $n$  = number of devices in the group
- $A$  = the traffic in erlang applied to the group
- $k$  = the availability for the grading
- $p_n$  = the grade of service
- $A_{k, p_n}$  = the traffic intensity which, with the grade of service  $p_n$ , can be applied to a group of devices arranged with full availability, the number of lines being equal to the availability  $k$  (determined according to Erlang's formula for busy system).

The formula may also be written  $n = c \cdot A + d$ , where  $c$  and  $d$  are variables of  $k$ ,  $p_n$  and  $A_{k, p_n}$ . The relation between  $n$  and  $A$  for given values of  $k$ ,  $p_n$  and  $A_{k, p_n}$  may therefore be graphically expressed as a straight line.

Table I Relation between  $k$ ,  $c$  and  $d$  for  $p_n = 0.002$

k	5	10	15	20	25	30	35	40	45	50
c	4.23	2.28	1.80	1.60	1.50	1.42	1.37	1.33	1.30	1.28
d	1.15	2.28	3.06	3.85	4.50	4.95	5.50	5.85	6.25	6.80

Table I shows related values for  $c$  and  $d$  with  $k$  varying and  $p_n = 0.002$ . The constant  $c$  decreases, while  $d$  increases with growing  $k$ . If the traffic  $A$  is very large,  $d$  can clearly be neglected in relation to  $cA$ . We then get the number of selectors  $n = c \cdot A$ . This equation therefore applies with good accuracy if the group in question is large. Consequently it would apply to an exchange as per Fig. 1, if it has a fairly large total traffic and if one considers all

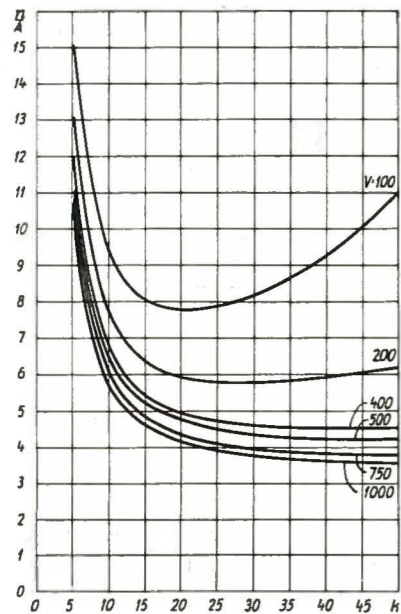


Fig. 3  
 $\frac{n}{A}$  as function of the availability  $k$  for various sizes of selectors. Approximation according to the grading formula.

selectors in each selector stage (actually all the selectors at the exchange) as connected in one group. The number of selectors per selector stage will be  $= c \cdot A$ , where  $A$  is the total traffic in the exchange. In the exchange there are  $x$  group selector stages, so that the total number of selector stages in the exchange will be  $x + 2$ . The total number of selectors will be

$$n = (x + 2) \cdot c \cdot A$$

Hereafter there will be employed as measure of the number of selectors the quotient  $\frac{n}{A}$ , which will be called the *specific number of selectors*. It may be said to constitute the number of selectors per traffic unit in the exchange. In this case therefore

$$\frac{n}{A} = (x + 2) \cdot c \dots \dots \dots (2)$$

The specific number of selectors therefore will in the case be dependent solely on the number of selector stages and the availability  $k$ .

Investigation has been made into how  $\frac{n}{A}$  varies for alteration of the magnitudes  $V$ ,  $b$  and  $k$ . For each selector size  $V$ ,  $k$  has been varied from 5 to 50. In turn, the values 100, 200, 400, 500, 750 and 1000 have been assumed for  $V$ . For an exchange with  $S = 10000$  the results shown in Fig. 3 have been obtained. There is obtained for each size of selector a curve with a minimum for a given availability. This is surprisingly large in that for  $V = 100$  it is 20, for  $V = 200$  it is 35, for  $V = 500$  it is 45. According to these results, therefore, the disposition of selectors now usual is incorrect, as a more economical result would be achieved by increasing the availability at the expense of the number of routes.

As regards the dependence of the specific number of selectors on the selector capacity it is apparent that the larger selectors are appreciably superior to the smaller. The difference, however, is most pronounced between the capacities of 100 and 200 lines. If the size of selector is increased over 400 lines not much is to be gained.

The results shown in Fig. 3 apply to constant grade of service  $p_n = 0.002$  in each selector stage. If instead there is reckoned a constant total grade of service in the exchange, the selector minima move towards a smaller  $k$ , as the number of selector stages rises with  $k$ . Moreover the large selectors will be still more superior than shown by Fig. 3.

### Computation of Selector Numbers Basing on the Division into Groups at the Exchange

The results arrived at in the preceding section are noteworthy in that they demonstrate that the selectors should be built for greater  $k$  than has generally been done. Further investigation has therefore been carried out to see if the approximations made have caused appreciable errors in the results. In Fig. 1 the selector stage  $AS-I-GV$  is connected to the lines with full availability, so that the grading formula does not apply. The number of  $AS-I-GV$  groups is  $\frac{S}{V}$  and the traffic in such a group  $\frac{A}{S} \cdot V$ . The number of devices is arrived at according to Erlang's formula. In the other  $GV$  stages and in the  $LV$  stage an error has been made in not including the constant term  $d$  in the grading formula. With knowledge of the number of »closed groups» in the exchange, however, this addition may be computed as the product of this number and  $d$ . In Fig. 1 there are obtained in  $II-GV$   $b$  closed groups, in  $III-GV$   $b^2$  closed groups and finally in the  $LV$  stage  $b^{x-1}$  closed groups. The total number of closed groups will be  $g = b + b^2 + \dots + b^{x-1} = \frac{b(b^x - 1)}{b - 1}$ .

If instead we consider Fig. 2, where  $x$  is a fraction  $= s + u$  and the last  $GV$  stage is only partially executed, the number of selector groups will be  $g = b + b^2 + \dots + b^{s-1} + r + \frac{S}{V}$ , where  $r$  is the number of groups in  $(s + 1)-GV$  and  $\frac{S}{V} = b^s$  the number of  $LV$  groups.

$r$  is obtained from the equation system

$$\left. \begin{aligned} b^s &= r + LV_1 \\ rb &= LV_2 \\ LV_1 + LV_2 &= b^s \end{aligned} \right\} \begin{array}{l} LV_1 \text{ and } LV_2 \text{ are numbers of groups in the } LV \\ \text{stage reached from } s-GV \text{ and } (s + 1)-GV \text{ re-} \\ \text{spectively} \end{array}$$

From this  $r = \frac{b^s - b^s}{b - 1}$

If this value is inserted in the formula for the number of groups we get  $g = b + b^2 + \dots + b^{s-1} + \frac{b^s - b^s}{b - 1} + b^s = \frac{b(b^{s-1} - 1)}{b - 1} + \frac{b^{s+1} - b^s}{b - 1} = \frac{b(b^s - 1)}{b - 1} = \frac{b^{s+1} - b}{b - 1} = \frac{S - b}{b - 1} = \frac{S - V}{V - k} = \frac{S - k}{V - k} - 1 \approx \frac{S}{V - k} - 1$  since  $k \ll S$  in normal cases.

If  $S$  is fairly large, unity may be neglected in relation to  $\frac{S}{V - k}$ , so that

$$g = \frac{S}{V - k} \dots \dots \dots (3)$$

Thus the number of groups will be directly proportional to the size of the exchange. It should moreover be observed that the usual summation formula for terms in geometric progression has also its significance if the terms  $x$  are fractions.

The total number of selectors in an exchange is therefore made up of:

- 1)  $AS-I-GV$  stage,  $2 \cdot \frac{V}{S} \cdot n_0$  where  $n_0$  is the number of devices Erlang's formula gives for busy systems with traffic  $\frac{A}{S} \cdot V$ .
- 2) Other  $GV$  stages and the  $LV$  stage corresponding to the factor  $c$  in the grading formula,  $A \cdot x \cdot c$ , where  $x$  as before give the number of  $GV$  stages.
- 3) Addition for group dividing in  $II-GV$  and following stage  $= d \cdot g$ .

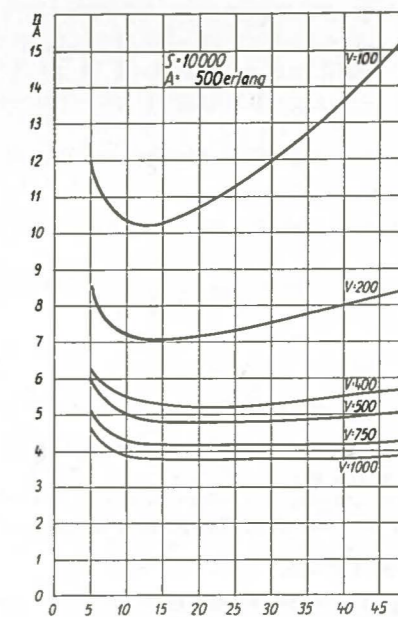
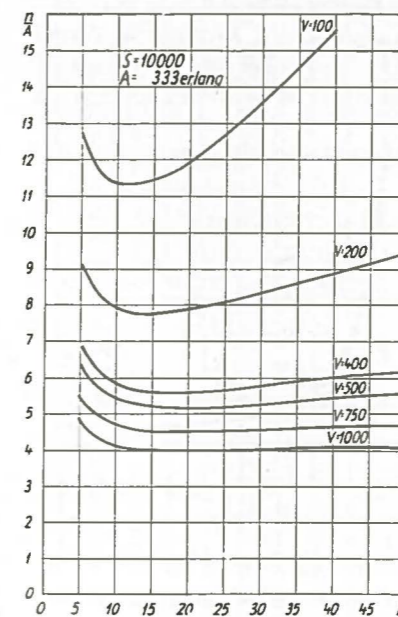
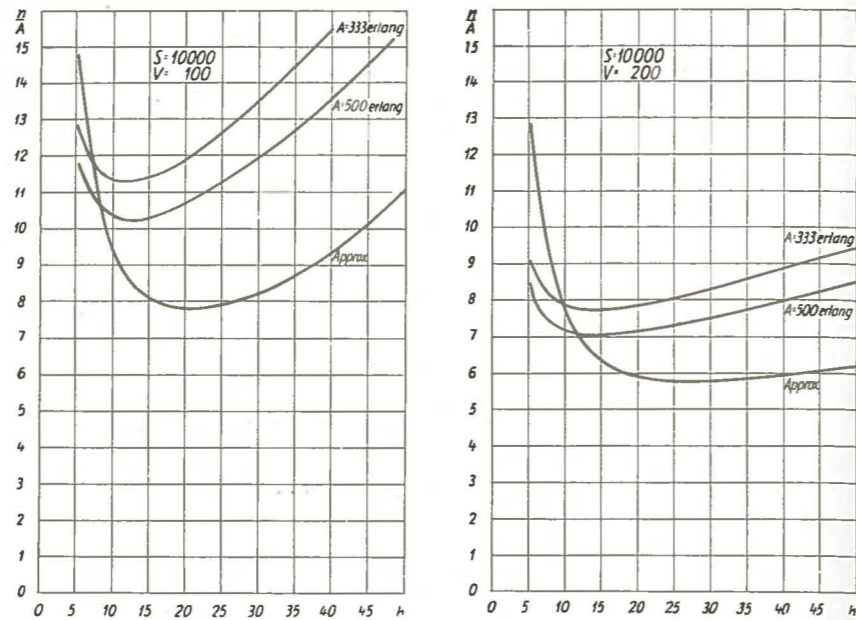


Fig. 4 and 5  
 $\frac{n}{A}$  as function of the availability  $k$  for various sizes of selectors. Approximation according to the grading formula.

X 4467  
 X 4468

Fig. 6 and 7  
 $\frac{n}{A}$  as function of  $k$ . Comparison between  
 Fig. 3, 4 and 5.  
 for selector capacities 100 and 200

X 4469  
 X 4470



The total number of selectors  $n$  will be

$$n = 2 \cdot \frac{S}{V} \cdot n_0 + A \cdot cx + dg = 2 \cdot \frac{S}{V} \cdot n_0 + A \cdot cx + d \cdot \frac{S}{V-k}$$

The specific number of selectors  $\frac{n}{A}$  will be  $= \frac{S}{A} \cdot \left( \frac{2n_0}{V} + \frac{d}{V-k} \right) + c \cdot x$

Introducing  $\frac{I}{y}$  instead of  $\frac{S}{A}$ , where  $y$  designates outgoing traffic per subscriber line, we get

$$\frac{n}{A} = \frac{I}{y} \cdot \left( \frac{2n_0}{V} + \frac{d}{V-k} \right) + c \cdot x \dots \dots \dots (4)$$

In this case therefore the specific number of selectors will not be independent of the traffic. The expression is made up of a part in inverse ratio to the traffic/subscriber and a part proportional to the number of group selector stages. Computations have been made for  $y = 0.033$  and  $0.05$  Erlang. On Fig. 4 and 5 may be seen in curve form the specific number of selectors for the two traffic amounts for different types of selector. Fig. 6—11 show the curves of Fig. 3—5 drawn separately for each size of selector. From these curves it will be seen that the approximation made in Fig. 3 must be considered as very rough. For small selectors particularly it is unsatisfactory.

Fig. 8 and 9  
 $\frac{n}{A}$  as function of  $k$ . Comparison between  
 Fig. 3, 4 and 5.  
 for selector capacity 400 and 500

X 4471  
 X 4472

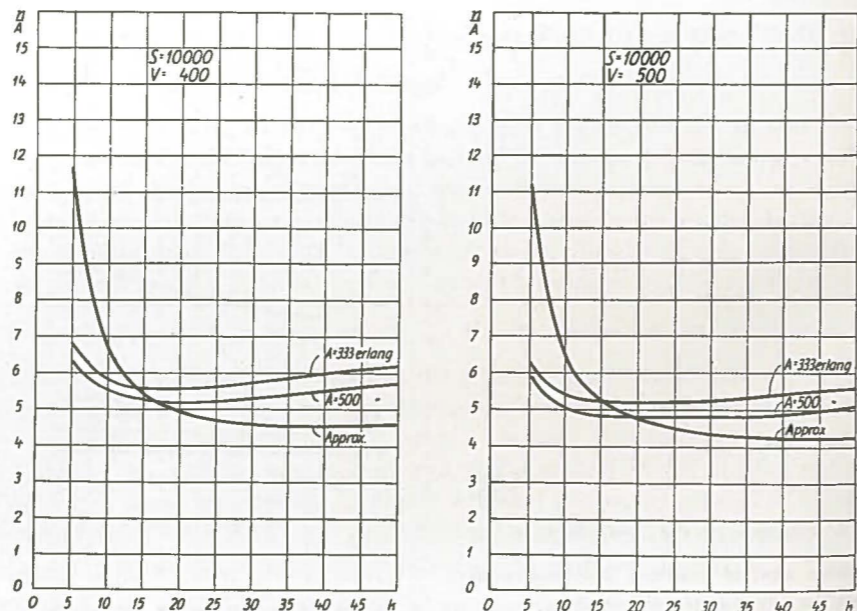
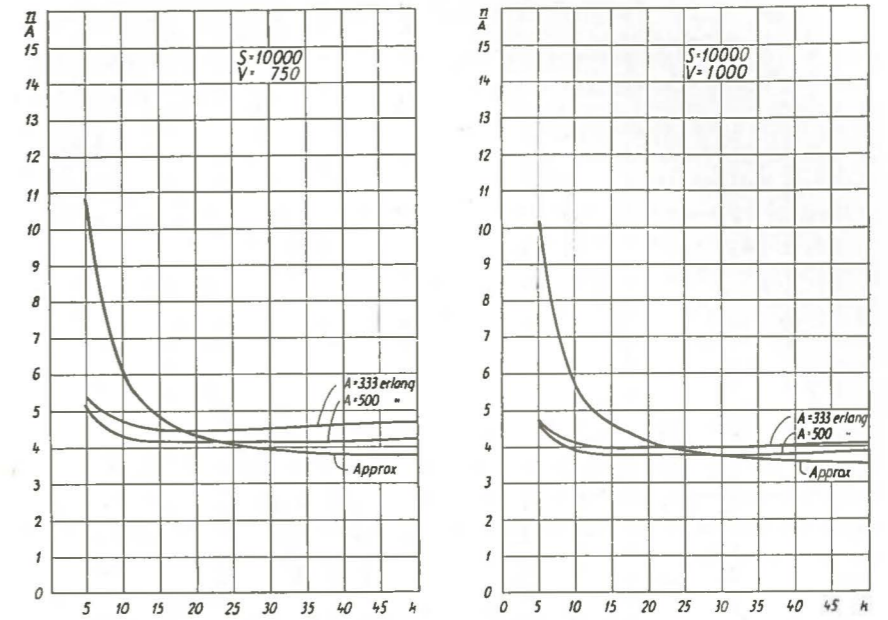


Fig. 10 and 11  
 $\frac{n}{A}$  as function of  $k$ . Comparison between  
 Fig. 3, 4 and 5.  
 for selector capacity 750 and 1000

X 4473  
 X 4477



Moreover there is displacement of the disposition of the selector capacity towards lower availability and higher number of routes with maximum utilisation. For  $V = 100$  the best utilisation of selectors is obtained if  $k = 12$ . For  $V = 500$  the minimum curve will be very flat for  $k = 20$ . It may therefore be considered that the prevailing selector types are in the main correctly built up. It can also be seen that the specific number of selectors, except for comparatively small values of  $k$ , lies higher than given by the approximation according to Fig. 3. This applies particularly to the small selectors. The large selectors therefore are still more superior relatively than is shown by Fig. 3.

In comparing Fig. 4 and 5 there is obtained confirmation of the fact previously known that the superiority of the large selectors will be less pronounced the greater the traffic is. The specific number of selectors does not fall much with the large selectors as traffic increases, owing to the selectors being well utilized already, whereas with the small selectors the diminution of the specific number of selectors is not inconsiderable for higher traffic.

### Number of Selectors for Various Sizes of Exchanges

The results shown on Fig. 3—11 are computed for an exchange size of 10000 lines. Starting out from equation (4) it is possible to compute the specific number of selectors for any size of exchange. The different terms in (4) for the case  $V = 100$ ,  $k = 10$ ,  $y = 0.033$  Erlang is given in Fig. 12. Along the abscissa the exchange size  $S$  is given in logarithmic scale. Of the terms, the

first  $\frac{I}{y} \cdot \frac{2n_0}{V}$  is entirely independent of the size of exchange. The second term,

$\frac{I}{y} \cdot \frac{d}{V-k}$ , is likewise independent of the size of exchange for constant  $V$  and  $k$ .

Finally, the third term,  $c \cdot x$ , is proportional to  $\log \frac{S}{V}$  and will thus be a straight line in the diagram.

On Fig. 13 the terms  $c \cdot x + \frac{I}{y} \cdot \frac{d}{V-k}$  for different sizes of exchange are shown for different hunting capacities. It is found that for small sizes of exchanges the term  $\frac{I}{y} \cdot \frac{d}{V-k}$  is the dominating one. At larger exchanges, however, the term  $c \cdot x$  will be the decisive one. As may be seen from the curve, a selector made for low capacity is most economical for small exchanges. For larger and very large exchanges, the best economy is achieved if the selector

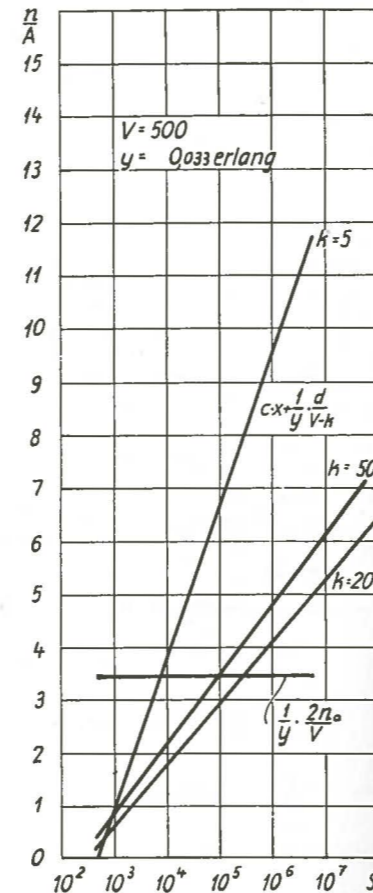
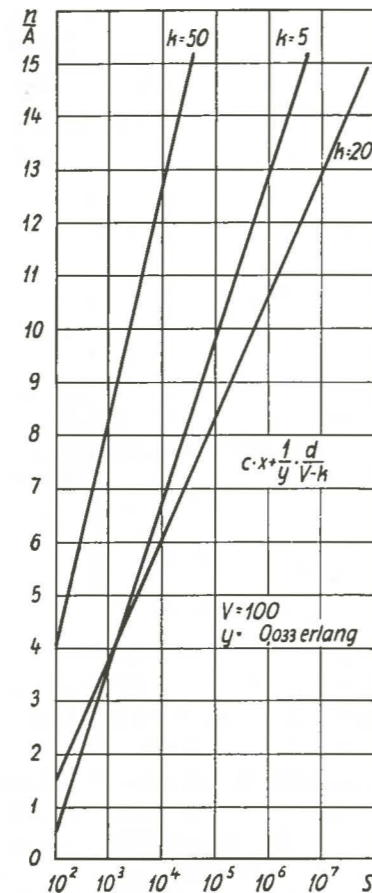
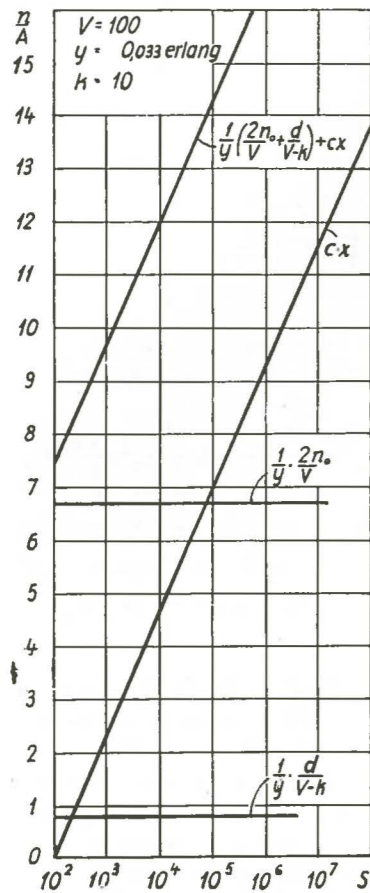


Fig. 12, 13 and 14  
 $\frac{n}{A}$  as function of size of exchange

X 4474  
 X 4475  
 X 4476

has a hunting capacity = 20 (for  $V = 100$ ). This optimum figure agrees with the result in Fig. 3 for  $V = 100$ , which is quite natural as in point of fact only the term  $c \cdot x$  [or more properly  $c \cdot (x + 2)$ ] has been taken into account.

Corresponding curves for a 500-line selector are obtained on Fig. 14. For different  $k$  values there are obtained different slopes on the line representing  $c \cdot x + \frac{1}{y} \cdot \frac{d}{V-h}$ . However, the difference between  $k = 20$  and  $k = 50$  is rather insignificant, as may also be seen from the flat minimum on the curve for  $V = 500$  in Fig. 3.

### Number of Selectors with Constant Total Grade of Service

In the comparisons made up to now it has been assumed that the grade of service in each selector stage is maintained constant. It may be questioned if it is not justified to consider the total grade of service for the whole exchange, no matter the type of selector with which it is built up. It may be expected that with this there will be still further displacement to the advantage of the larger selectors, as smaller grade of service per selector stage may then be tolerated. Moreover the optimum distribution of selector capacity will be displaced somewhat towards greater number of routes and smaller availability. On Fig. 15 is shown the result of an investigation for  $V = 100$  and 500 with  $S = 10000$ ,  $A = 333$  with constant grade of service/stage  $p = 0.002$  and with total grade of service  $\sum p = 0.006$ . As may be seen the difference is rather insignificant, obviously due to its being concerned with fairly small variations of the tolerated grade of service.

The results arrived at can obviously, along with the curves 12-14, be generalized to apply to all sizes of exchanges if only the reasonable assumption is made of allowing the total blocking to rise with the logarithm for the number of subscribers. This means that for each type of selector one has the same grade of service/selector stage as previously.

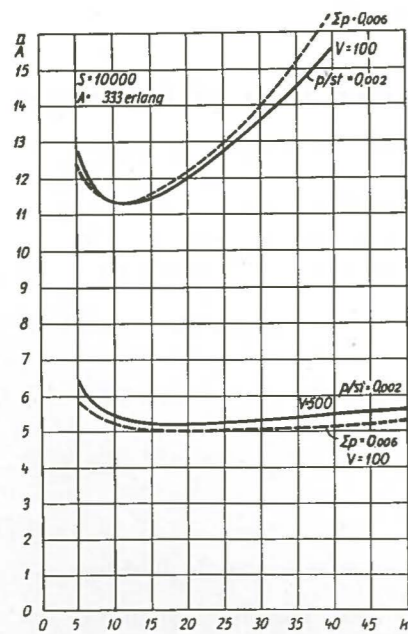


Fig. 15  
 $\frac{n}{A}$  as function of  $k$ . Comparison between given total grade of service and constant grade of service/stage.

X 4478

### Discussion of the Results

The results arrived at confirm the opinion previously held that selectors with large capacity allow of a considerable saving in the number of devices compared with those required with small selectors. Nevertheless when one reaches a certain selector size there does not seem so much to be gained by increasing the selector capacity. Thus an increase of selector capacity from 100 to 500 is equivalent to a fall of the specific number of selectors from about 11 to about 5, whereas still further raising of the selector capacity to 1000 brings the specific number of selectors only down to about 4. The low specific numbers of selectors for the large selectors is evidence that these selectors are well utilized. This is accompanied by the disadvantage that they are more sensitive to overloading.

In respect of the disposition of the selector capacity it has been found that the selectors now generally used have in the main the correct build up. It should, however, be noted that in very large plants better results are attained by disposing the selectors with higher availability and lower number of routes than would be most suitable for smaller plants. Nevertheless, it is doubtful whether this condition would also hold good in practice. The formulae derived for the number of closed groups in a telephone system is not wholly correct for practical conditions, as it is not possible to form groups of unlimited size. In *II-GV*, therefore, the number of groups will be larger than it should be theoretically. This will be particularly noticeable if the number of routes is small. Moreover, if it is taken that the system is to be built with a given total grade of service, the minimum will also be displaced towards lower availability and higher number of routes. It appears therefore that there is a certain amount of justification for considering the results arrived at for an exchange size of 10000 lines as in the main general. A contributing reason is that the minimum in general are very flat.

If the results attained are to be employed as guidance for work of construction for selectors and telephone systems, it should not be forgotten that there are a number of costs in an exchange which are not usually assigned to the selectors but which nevertheless are more or less proportional to their number. This is, of course, quite obvious in regard to selector multiples and operating relay sets, but is not so evident in respect of racks, demands for space, registers etc. The cost of the selector itself is often a small part of these costs directly associated with the selector.

A selector design problem, therefore, cannot be attacked without the consequences to the whole system of the selector type chosen being clearly recognized. Connected with this also is that the selector shall be made to work in a decimal number system without the translating devices (the registers) being too complicated and the grouping too involved. In practice, therefore, one will be bound to the capacity of selector types already available. Naturally, the field remains open for improvements in design and such measures as ensure simpler operation.

In the investigation smaller selectors than for 100 lines have not been included. In systems with selectors working with full availability or gradings it has not been possible successfully to operate economically with smaller ones. In what are called link systems, however, use is made of selectors with 10 or 20 lines capacity, in which two selectors connected in sequence correspond to one selector stage in a conventional system. Thus there is formed a 100-line selector with two 10-line selectors connected one after the other, a 400-line selector with two 20-line selectors, a 200-line selector by means of one 20-line and one 10-line selector. The equivalence is not quite complete, however, as there is a certain amount of internal blocking in the link systems. Nevertheless, the results obtained should be approximately correct for link systems also and utilisable at least for comparison between such systems.

# New Traffic Meter for Telephone Plants

B BJUREL, ROYAL SWEDISH BOARD OF TELEGRAPHS, STOCKHOLM

U.D.C. 621.395.66

The Technical Division of the Board of Telegraphs in conjunction with Telefonaktiebolaget L M Ericsson has worked out for large telephone plants a new traffic meter, especially adapted to the new traffic unit *Erlang*. This meter, now comprised in the standard equipment of all new Swedish telephone exchanges with 500-line selectors, is described in this article.

## General Observations

To be in a position properly to dimension the traffic routes in a telephone plant, there is required good knowledge of the traffic falling on the various groups of devices. In collaboration between the Technical Division of the Royal Board of Telegraphs and Telefonaktiebolaget L M Ericsson, there has been designed a new traffic meter, enabling quick and reliable counting of the traffic in a large number of groups of devices to be done.

The new traffic meter is adapted to the traffic unit Erlang and allows a simultaneous metering of the traffic density in no fewer than 40 groups of devices, each comprising a maximum of 30 devices. It is built up of modern connecting components and the diagram has been drawn up with the aim of the greatest possible simplicity in the metering procedure.

At the present time most of the new plants of the 500-line selector type throughout the country, as well as most of the older 500-line selector plants, are being provided with the new traffic meter. At the exchanges, the meter is mounted in traffic metering racks, Fig. 1, which in addition to one or more traffic meters also contain congestion meters and occupation meters for the more important groups of devices in the telephone plant.

## Metering Principle

To determine the traffic density in a group of devices, the traffic meter counts at given intervals the number of busy devices in the group concerned. The total number of busy devices for all through meterings in the metering period is recorded on a *traffic counter* one of which is allotted to each group. To arrive at the mean traffic density in Erlang, the figure read on the traffic counter is divided by the number of through meterings during the metering period and, with appropriate choice of metering period, may be read direct on the traffic counter.

The counting of the number of occupied connecting devices is done on the basis of the current intensity in a *metering conductor* common to each *metering group*, i. e., group comprising up to 30 devices. The metering conductor is connected in each connecting device to a *traffic metering resistance* which is connected to the exchange tension on occupation of the device concerned.

## Data

In selecting the fundamental data for the design of the meter, e. g. the maximum number of devices per group, the number of groups that can be connected at one time to the meter, the through counting speed, the principle of

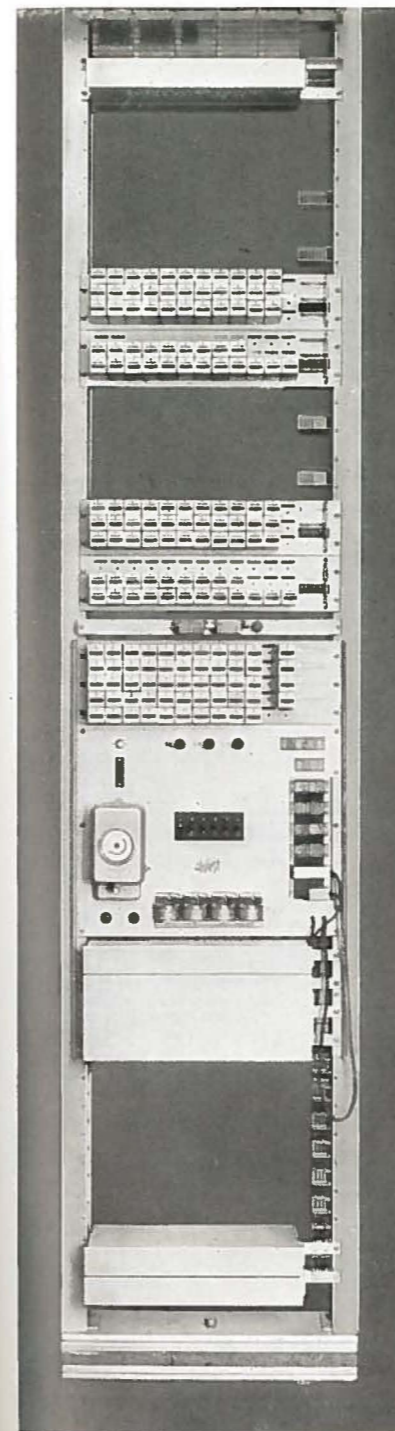


Fig. 1  
Traffic metering rack  
with traffic meter, congestion and occupation  
counters

the meter for counting busy devices etc., particular attention was directed to the demand for adequate metering accuracy, high reliability and simplicity of metering procedure. In addition, the data for the meter were chosen in consideration of the demands imposed by telephone plants for metering capacity.

## Number of Devices per Metering Group

The maximum number of devices per metering group has been fixed at 30. This figure ensures good utilization of the metering groups, as the rack of the 500-line selectors commonly has the capacity of 30 + 30 or 60 devices.

## Number of Metering Groups to Be Connected

The number of metering groups that can be connected at one time to the meter has been fixed at 40. This figure has been reckoned as giving an economic optimum, as with this capacity a single meter per exchange will normally cover the needs of the majority of telephone plants throughout the country.

## Through Counting Speed and Metering Accuracy

The through counting speed for the meter has been taken as 100 through countings per hour in each metering group. This through counting speed provides sufficient accuracy and the mean traffic density may, after one hour of metering, be read direct on the traffic counters in hundredths of Erlang.

As examples of metering accuracy, computed according to probability calculations, it may be stated that this amounts to  $\pm 1.4\%$  for a measured traffic magnitude of 15 Erlang hours and  $\pm 0.45\%$  (the three sigma rule) for 150 Erlang hours, provided there is a mean call period of 3 minutes for the metered traffic.

## Metering Process

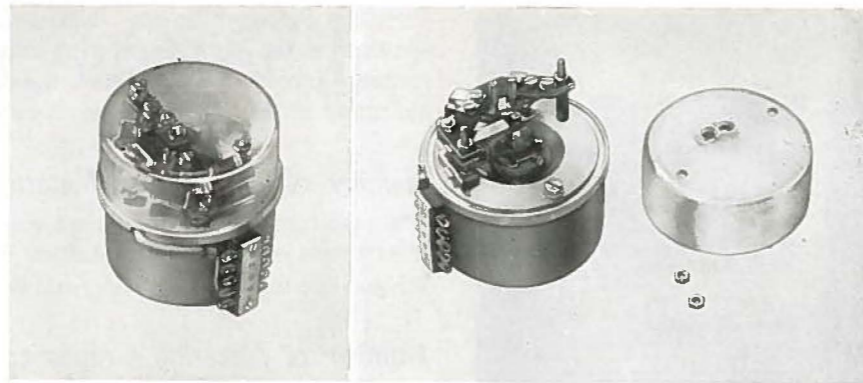
As stated above, the meter counts the number of occupied devices in a given metering group on the basis of the current intensity in a metering conductor belong to the group, this conductor being connected in each busy device to the exchange battery via a traffic metering resistance. For metering, the meter compares the current in the metering conductor with the current in an internal comparison circuit. This internal circuit is progressively built up in the meter by parallel-connected comparison resistances with exactly the same resistance values as the traffic metering resistances in the connecting devices. For each comparison resistance connected to the comparison circuit the traffic counter of the traffic meter is stepped forward one step, the process being interrupted when the current in the comparison circuit has attained the same value as in the metering conductor. The traffic counter, therefore on through counting is moved forward a number of steps equivalent to the number of devices occupied in the group metered.

Comparison of the two currents requires a particularly sensitive device. For this purpose there is employed a plunger coil relay, requiring only a power of app.  $5 \mu\text{W}$  for operation. The appearance of the plunger coil relay may be seen from Fig. 2. The principle of connection of the relay for control of the currents is shown by Fig. 3. From this figure it will be seen that the relay is arranged as a zero indicating instrument in an ordinary bridge connection.

In the connection shown, the plunger coil relay will be without energy when the comparison circuit resistance  $r_i$  attains the same value as the resistance  $r_j$ , of the external circuit. As the connecting in circuit of the traffic counter  $SR$  is controlled over the plunger coil relay the counting process will be interrupted when the relay is without energy and breaks the connecting contact. After the plunger coil relay  $R$  has released owing to equality in the resistances of the internal and external circuits, the current through the relay on connection of the next control resistance will change direction. Nevertheless the relay will remain without energy owing to its current direction indication action.

Fig. 2  
Plunger coil relay  
right, with cover removed

X 6252



### Connection of Metering Groups and Traffic Counters to the Plunger Coil Relays during the Counting

The build-up in principle of the more important circuits of the meter will be seen in Fig. 4. As already stated, the meter allows of simultaneous metering of 40 groups of devices with up to 30 devices to each group. As all the groups of devices are through counted 100 times per hour this means that as a maximum no fewer than  $30 \times 40 \times 100 = 120000$  steps per hour will be marked on the 40 traffic counters of the meter. In order that the step speed shall not be too high for the counters, the meter has been furnished with four complete units of exactly the same build-up as that shown in Fig. 4. All these units work in parallel, which means that metering takes place simultaneously in four separate groups of devices. The speed of step for the traffic counters is thus reduced to 10 steps per second.

From Fig. 4 it will be seen that in each of the meter's four units 10 metering groups and 10 traffic counters are progressively connected to a common plunger coil relay ( $R_{31}$ ) over a selector  $SOR$  with wipers  $a$  and  $b$ . This selector consists of a spiral selector, comprising eight contact bars and it has therefore been made to serve the meter's four units jointly.

The internal comparison circuit is built up in the meter over relays, designated in the skeleton diagram, Fig. 4, by  $R_1-R_{29}$ . Over this relay chain circuit the four control circuits of the meter are built up.

In order to avoid the necessity of totalling manually the readings of a number of counters when metering is done of groups of devices with more than 30 devices, the meter has been provided with 10 adding counters,  $SSR$ , only one of which is shown in Fig. 4. These adders may be connected to two or more traffic counters, according to certain rules, and then give direct the total of the recordings on the traffic counters connected. The connection is made by a special grading plug.

Fig. 3  
Skeleton diagram of plunger coil relay  
 $r_b$  bridge resistance  
 $r_i$  resistance in comparison circuit  
 $r_y$  resistance in external circuit  
 $R$  plunger coil relay  
 $SR$  traffic meter

X 6249

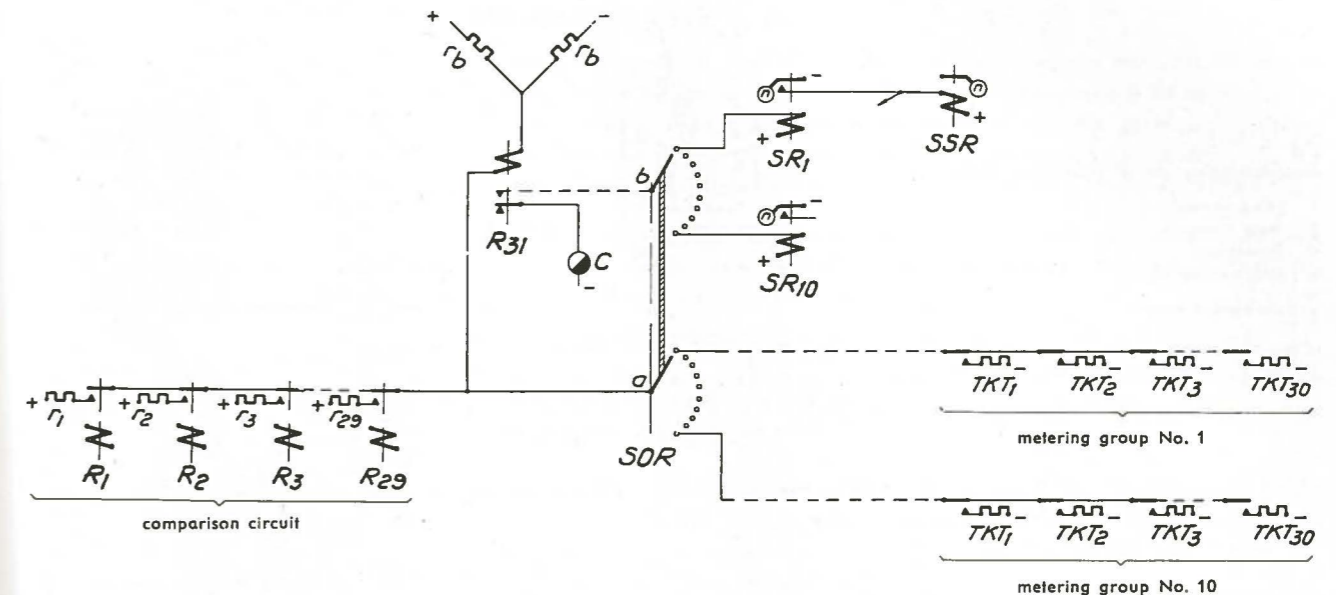
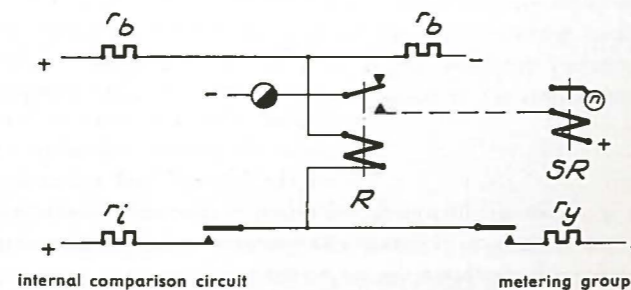


Fig. 4  
Skeleton diagram of the traffic meter's chief circuits

X 7434

- $a$  } wipers
- $b$  }
- $C$  impulse deliverer
- $r_b$  bridge resistance
- $r_1-r_{29}$  comparison resistances
- $R_1-R_{29}$  relays
- $R_{31}$  plunger coil relay
- $SR_1, SR_{10}$  traffic meters
- $SOR$  spiral selector
- $SSR$  adding counter
- $TKT_1-TKT_{30}$  traffic metering resistances

### Time Control of Metering Process

The operation of the meter requires impulses which direct the counting process with sufficient accuracy as regards time. For this purpose there is employed an operating relay, directly driven by 50-cycle A.C.

The operating relay consists of a polarized relay, Fig. 5, designed by Telefon-aktiebolaget LM Ericsson. This relay works synchronously with the 50-cycle A.C. in such a manner that a halving of frequency is obtained, *i. e.*, each 20 ms the relay switches its contacts from the one external position to the other. The coupling employed, Fig. 6, has been worked out and used in conjunction with Dr. Conny Palm's investigations as per his work »Intensitätsschwankungen im Fernsprecherkehr», Ericsson Technics No. 44, 1943.

The operating relay's impulses are transmitted to trains of relays which take care of the connecting of the comparison resistances and the stepping forward of the traffic counters, besides the progressive connection of the various metering groups and their traffic counters to the plunger coil relays.

### Advance Setting of Metering Periods

To make the meter convenient to deal with, it has been provided with devices which enable certain metering periods to be set in advance. The setting may be done for automatic connection of the meter for one hour at any desired time 5 days running or 10 days running with two days pause after the 5th day. The first setting is intended for metering of *busy hour* traffic for a week and the second for two weeks running on Mondays to Fridays inclusive. The meter can also be connected in manually at any time, being then set for continuous operation or for one hour only.

Automatic connecting in of the meter several days running is handled by an electric synchronous clock. Each metering period is broken off over the internal comparison circuits, normally after one hour's operation, *i. e.*, after 100 through countings.

### Supervisory Counters

Besides the above-described traffic and adding counters, the meter is furnished with four special supervisory counters  $SM_1-SM_4$ .

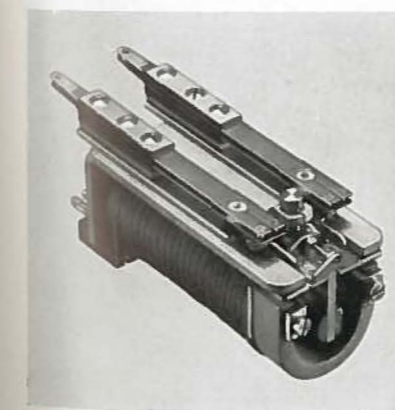


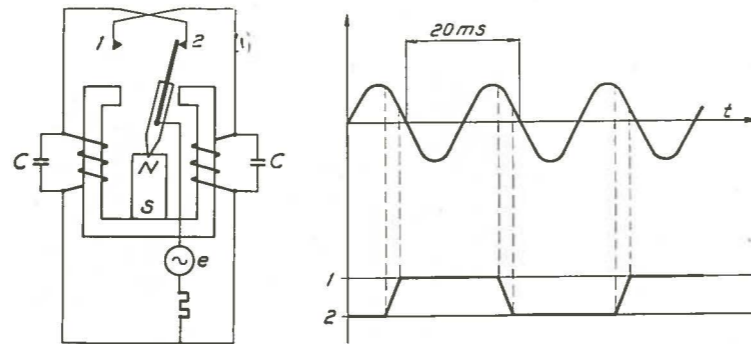
Fig. 5  
Polarized relay

X 4483

Fig. 6  
Skeleton diagram of polarized relay

X 6246

- 1 relay contact
- 2 relay contact
- C condenser
- e A.C. current source
- N } permanent magnet
- S }



The counter  $SM_1$  records the number of hours the meter has been in operation, i. e., days of automatic operation.

The counter  $SM_2$  records the number of times all devices have been through counted.

The counters  $SM_3$  and  $SM_4$  are purely technical supervisory counters.  $SM_3$  supervises the functioning of the spiral selector  $SOR$ , and  $SM_4$  checks that the contacts of the plunger coil relays are in good order.

### Testing

To make it possible to observe quickly whether the meter is operating properly, it has been furnished with built-in metering groups corresponding to 1, 15 and 29 occupied connecting devices. These groups are connected to a special test-jack and are coupled to the meter via the same plug as the metering groups of the telephone plant.

### Alarm Signalling

For supervision of the meter there are alarm circuits which announce failure of mains or exchange tension. If the mains tension is interrupted this is signalled by a special alarm lamp »L~» and, if the exchange tension fails, by an alarm lamp »L=>».

In both cases the alarm is small if the meter is connected but metering is not being done. If metering is proceeding, mains stoppage causes intensive alarm.

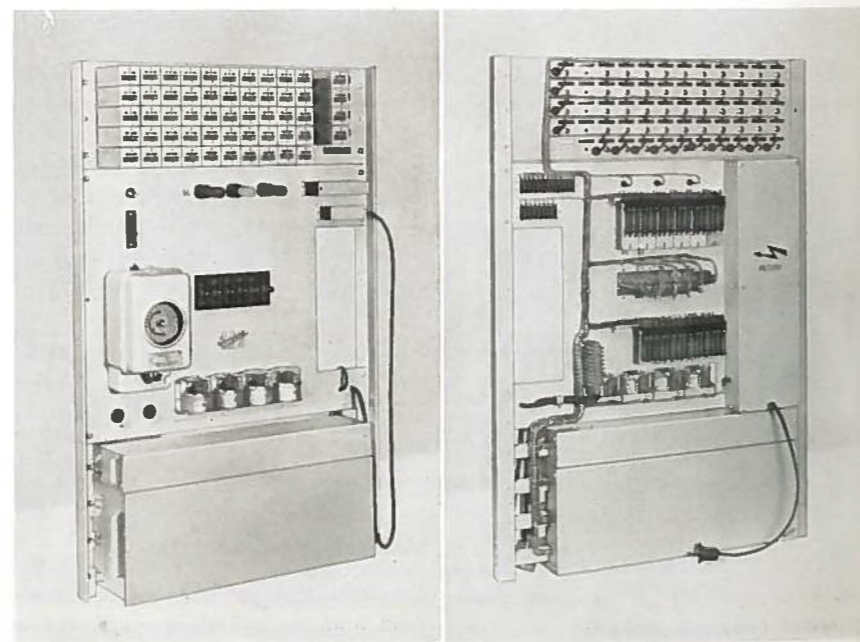


Fig. 7  
Traffic meter

X 6250

left, front view; right, back view; in first row: traffic counters  $SR_1$ — $SR_{40}$ , adding counters  $SSR_1$ — $SSR_{10}$  with supervisory counters  $SM_1$ — $SM_4$  at the right; in second row: switch, alarm lamps; in third row: electric clock, switch and, below, plunger coil relays

### Mechanical Assembly

All the devices of the meter are combined to a common unit, which can be mounted in an ordinary relay rack, Fig. 1. The appearance of the meter is shown in Fig. 7. On the front of meter there are the 40 traffic counters  $SR_1$ — $SR_{40}$  and below them the 10 adding counters  $SSR_1$ — $SSR_{10}$ . To the right of these adding counters are the four supervisory counters  $SM_1$ — $SM_4$ .

Below the counters may be seen a switch for the mains current with its pilot lamp and two alarm lamps for the mains and exchange tensions. In addition there is an alarm lamp for intensive alarm.

To the right of the alarm lamps there are a 60-pole jack and a 40-pole jack. By inserting a loose grading plug in the 60-pole jack the desired connection of the adding counters to the traffic counters is obtained. The 40-pole jack is the test jack referred to above.

In the middle of the meter there is a control panel for the operation of the meter. Below this the plunger coil relays and the meter relay equipment are located. The electric clock is also to be found on the front of the meter.

For connection of the meter to the different groups of devices in the exchange there is a 40-pole plug and for connection to the panel equipment a 20-pole plug, both having connecting cords. The exchange's groups of devices are connected to 40-pole jacks located in the traffic metering rack. These jacks are fitted in such a way that they project in the slot on the right-hand side of the meter.

At the back of the meter, see Fig. 7 to the right, may be seen the connecting flex for the mains tension and to the right of that the enclosed strong current equipment.

### Operation

#### Setting of the Electric Clock

The electric clock, Fig. 8, is driven by a self-starting synchronous motor. The desired starting time for the meter is set by a special connecting lug on the hour dial of the clock. The starting impulse released by the connecting lug, see Fig. 9, is broken by a separate disconnecting lug, installed in immediate proximity to the connecting lug.

#### Testing

For testing the meter, the different counters are set at zero and the 40-pole plug is inserted in the test jack. After the mains tension has been connected by the mains switch and the exchange tension by the switch »Connection», Fig. 10, the desired switch »1 counter», »15 counter» or »29 counter» is thrown. The meter is then started up by momentary working of the switch »1 hr.», and the test is interrupted at the desired moment by momentary working of the switch »Stop».

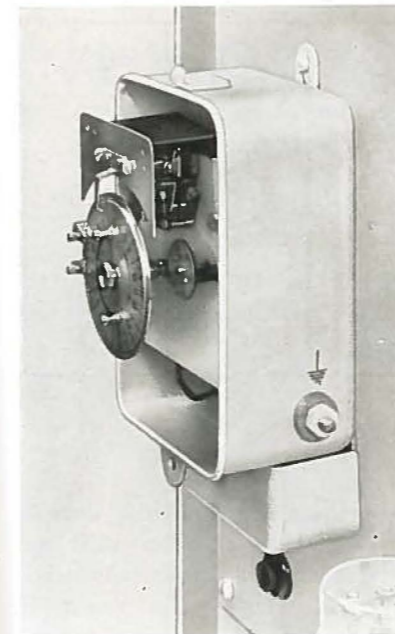


Fig. 8  
The electric clock in the traffic meter

X 4482

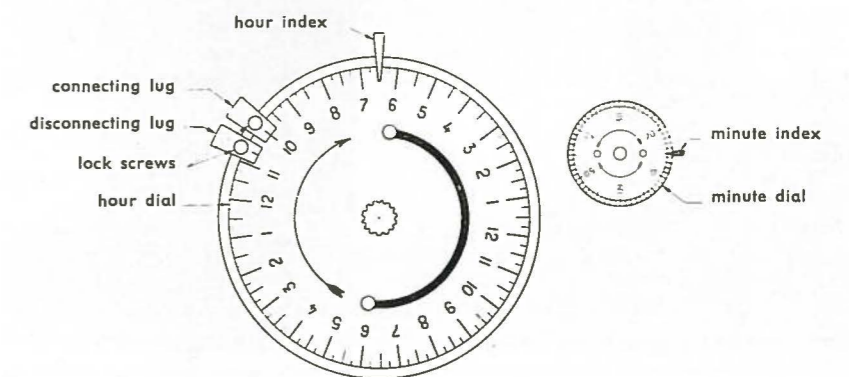


Fig. 9  
Hour and minute dials on the electric clock

X 6247

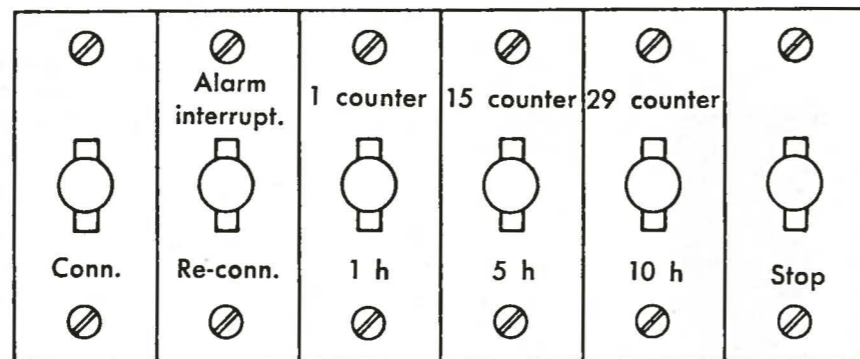


Fig. 10  
Switch panel for operating the meter

X 6248

### Metering

When traffic metering is to be done, the 40-pole plug of the meter is inserted in the desired exchange jack and the counters are set at zero. After mains and exchange tensions have been connected, the procedure will depend on whether the meter is to be started manually for metering during a given hour or if it is to be automatically connected in several days running.

If the meter is to be started manually, the switch »1 hr.» is actuated momentarily. In this case the metering process will be automatically broken off after one hour of metering. Continuous metering is obtained if the switch is kept at »on».

Automatic connection 5 days running is obtained if the switch »5 hr.» is thrown, and 10 days running, with two days pause after the 5th day, if the switch »10 hr.» is thrown. The time of the day connection shall take place is to be set on the synchronous clock.

### Reading

For the reading of the meter, the following applies: that after one hour of running each traffic counter indicates the mean traffic density in hundredths of Erlang and after 10 hours of running in thousandths of Erlang. For other periods of running the mean traffic density is obtained in Erlang, if the figure read on the counters is divided by the number of through countings, *i. e.*, by the figure recorded on the supervisory counter *SMz*.

# New Svenskradio Receivers

C F R E D I N, S V E N S K A R A D I O A K T I E B O L A G E T, S T O C K H O L M

U.D.C. 621.366.621

Svenska Radioaktiebolaget opened the working year by putting on the market two improved Svenskradio models partially re-designed. The present article describes a large exclusive radiogramophone, Svenskradio 478, and a smaller table model, Svenskradio 474, both provided with localized short-wave.

### Svenskradio 478

This receiver, Fig. 1, is the fourth edition of the big radio gramophone introduced by Svenska Radioaktiebolaget in 1942. With the exception of fresh and discreet embellishment, still further enhancing the elegant exterior of the receiver, it remains unaltered as a piece of furniture. It may be had in light or dark mahogany or in light or dark elm. A newly designed large loud-speaker, *HP 1230*, contributes to an appreciable augmentation of the sound intensity and range of tone. In the reproduction of the new gramophone records especially the expansion of the register is outstanding.

The block diagram of Fig. 2 shows the relation between the various parts of the radiogramophone.

### Tuning

The radio part is dominated by a large distinct scale, amply provided with names of stations on the long and medium wave. Above each of the five wave-length graduated scales for short-wave there is a prepared line on which favourite stations may be marked, *calibrated*. In addition to the usual station pointer operated by the tuning knob, there is another pointer which shows the wave range tuned in at the moment. The magic eye for correct tuning has two halves, one for strong and one for weak stations, so that it shows equally distinct deflection for all transmitters. Moreover the size of the deflection provides an approximate measure of the intensity of the station received.

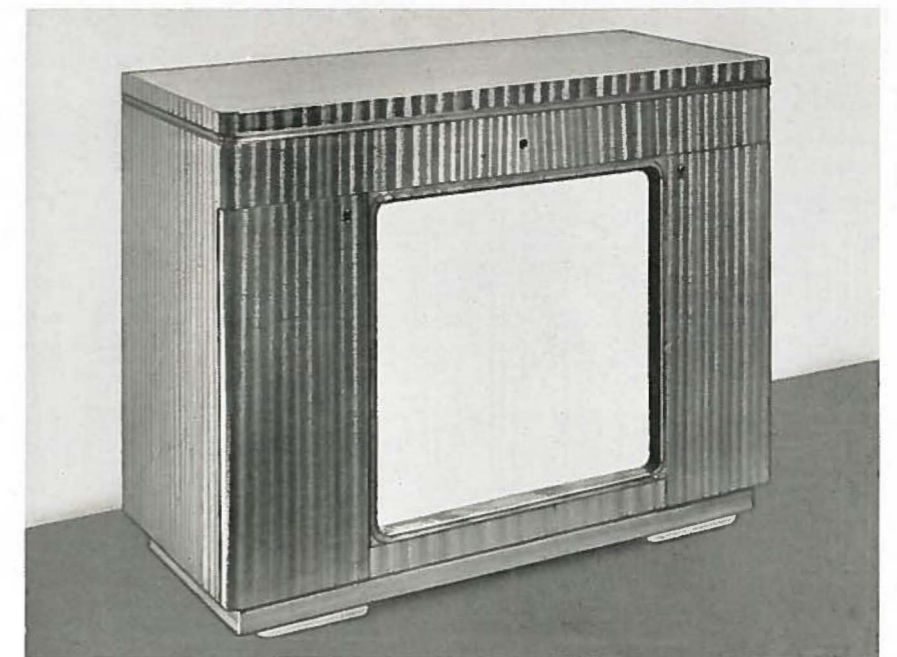


Fig. 1  
Svenskradio 478

X 6244

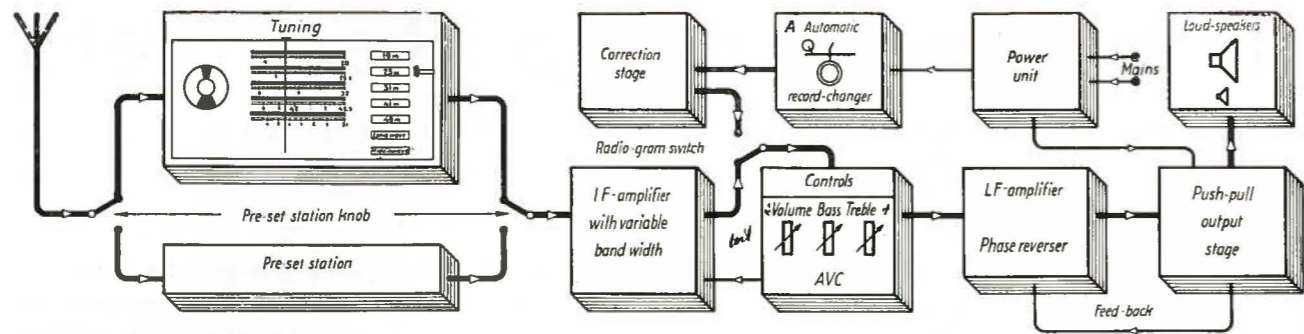


Fig. 2 X 7443  
Block diagram of Svenskradio 478  
showing the relations between the various parts  
of the radio-gramophone

The internationally fixed bands for short-wave of 19, 25, 31, 41 and 49 meters are located, one for each scale, below each other. The scales are graduated so that those bands in which people are most generally interested are favoured in preference to intermediate bands. The reading of the band is fully comparable with the reading facilities provided for medium-wave.

As the ratio between the pointer's movement and the tuning knob's rotation is constant, it follows that the manual tuning is also facilitated to the same degree as the reading.

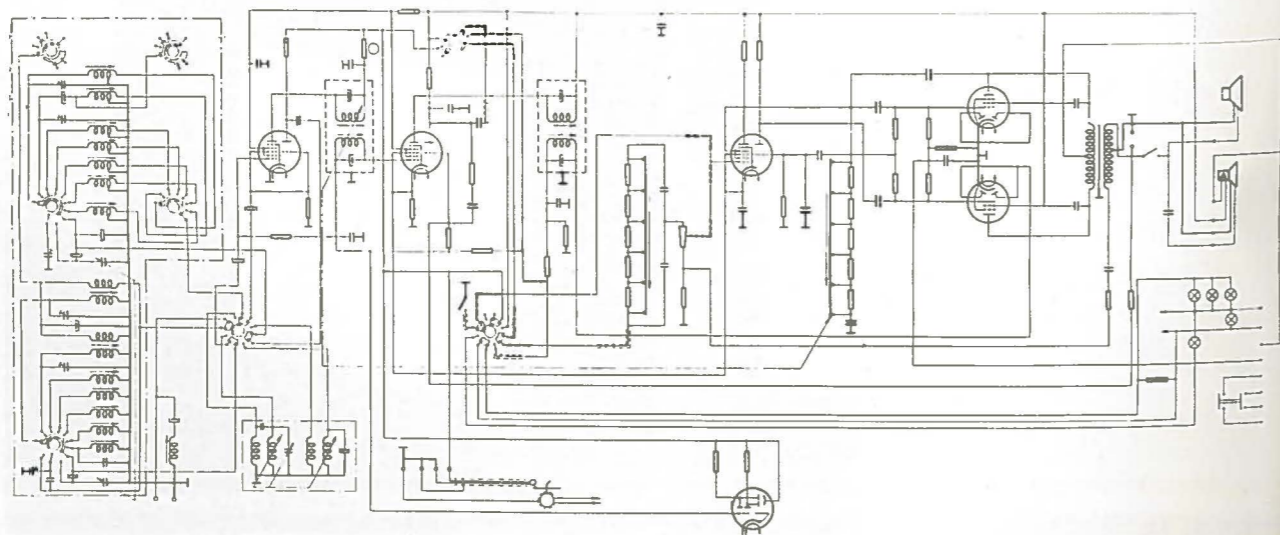
The handling of the problem of short-wave tuning, briefly described above, is designated *localized short-wave*. In addition to its rational arrangement for mass production, the system has a couple of other good properties. Localized short-wave is, in fact, almost free from frequency slip and from microphone effect between loud-speaker and variable condenser.

Short-wave offers great possibilities for bridging the greatest distances. Nevertheless it is necessary when selecting wave-lengths to bear in mind distance, time of the year and time of the day. Thus the same stations will have a number of wave lengths suited for different occasions. In such conditions it is hardly possible to provide station names on the scale. Instead, as stated above, there is facility for doing one's own calibrating.

#### Button for Pre-set Station

Despite all the facilities provided by the receiver, it is probable that a nearby local station will be most listened to. That station is tuned in once for all and is switched on — no matter how the receiver may be tuned in at the moment — by the button.

Fig. 3 X 7428  
Skeleton diagram for Svenskradio 478



By means of the button, the tuning unit or the pick-up are disconnected. Instead, a small permeability tuned unit is connected to the mixing valve. The unit is manipulated from the back of the radiogramophone by a small knob, which may be rotated or moved sideways until the station comes in at full strength. The pre-set station tuning unit is very stable and may be set at wave lengths between 190 and 1500 m without re-connection.

#### Radio Amplifier

All the aerial circuits and oscillator circuits are assembled to a switchable trimming circuit system connected to the mixing valve. After frequency conversion to the intermediate frequency 467 kc/s, the selectivity is increased in the intermediate frequency amplifier, the first filter of which is variable. The band width may be varied 3—6 kc/s at 6 dB. The selectivity, measured as band width at 40 dB, is 20 kc/s maximum. The intermediate frequency amplifier is terminated by a demodulator from which the low frequency component is transmitted to the low frequency amplifier. There is also re-transmitted from the demodulator the D.C. to the automatic sensitivity regulation and the magic eye.

#### Low Frequency Amplifier and Phase Reverser

The low frequency amplifier contains a triode heptode, the two electrode systems of which are coupled as triodes, each operating an output valve. The triode control grid is operated from the heptode's anode, so that the triode anode circuit works in opposite phase to the heptode anode circuit. The triode's amplification is decreased by linear feed-back just far enough for the two output valves to be equally operated.

#### Power Amplifier

The power amplifier has two pentodes in push-pull and a particularly well dimensioned output transformer. The transformer's secondary side consists of two windings, one for the loud-speakers and one for feed-back. Through a series of connecting units a part of the output voltage is returned to the potentiometer for sound volume regulation, the effect of which is tone compensation in simple manner.

The power amplifier delivers 10 W in 478 A.C. and 8 W in 478 A.C./D.C.

#### Loud-speaker

The two loud-speakers of the radiogramophone are fitted on a common baffle, Fig. 4. The smaller, a field-fed HF-716 in 478 A.C. and a permanent HP-716 in 478 A.C./D.C., takes care of the treble. The larger loud-speaker is a new design of giant size with a cone area of not less than 600 cm<sup>2</sup>. The permanent magnet — also of impressive dimensions — provides a field intensity exceeding 12000 Gauss.

The loud-speaker combination gives a first-class reproduction, which if required can be raised to an impressive intensity, powerful enough for large halls.

#### Sound Regulation

The sound volume is regulated both manually and, for radio, automatically. Along with the volume regulation the character of the sound is also modified, so that the correct balance between bass and treble is maintained for all volumes. The character of the sound may be regulated manually by the two register buttons. With one of these, the treble button, the band width of the intermediate frequency amplifier is also regulated.



Fig. 4 X 4480  
Baffle with loud-speakers  
The larger one, with a cone area of 600 cm<sup>2</sup>,  
reproduces the bass register, the smaller one the  
top register

### Correction Stage

Great advances in the production of gramophone records have been made, both in respect of material and recording. Developments from recording method adapted to portable gramophones have proceeded through a compromise stage to a characteristic, stated to be straight between 256—12000 c/s. Below 256 c/s the amplitude is limited by lowering the characteristic by 6 dB per octave.

A pick-up to be perfect for these new recordings, therefore, should give constant voltage for the register above 256 c/s and a doubling of the voltage for each octave below that frequency. However, in the design of the pick-up a number of other factors have to be taken into consideration, such as keeping down wear on records and needle scratch and remedying pinch-effect — the characteristic may be corrected electrically.

On *Svenskradio 478* the cut-down bass is restored and the pick-up peaks are levelled in a special correction stage. In *478 A.C./D.C.* this stage has been designed specially to meet the strict stipulations of the Swedish Electrical Material Inspection Institute (Svenska Elektriska Materielkontrollanstalten). That institution, for reasons of safety, does not permit protector condensers exceeding 12000 pF in each circuit branch, so that usually still more of the deeper bass register is lost. A definite solution of this problem has been reached by means of the correction stage.

### Automatic Record-changer

The record-changer plays up to 8 records of different sizes and then stops automatically. The records may be played one after the other, with intervals adjustable between each or every other record. The record-changer is operated by a row of buttons with their functions clearly marked. Among the buttons are one for direct switching from one record to another and one for repetition.

The pick-up armature moves easily and its pressure during running on the record is unusually light. This ensures long life for both records and sapphire.

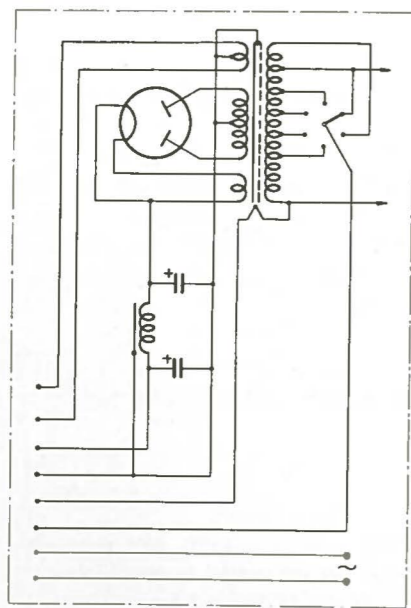


Fig. 5 X 4479  
Connecting diagram of mains unit in Svenskradio 478 A.C.

### Mains Unit

The mains units for A.C. and A.C./D.C. are of different types. The unit for *478 A.C.*, see Fig. 5, comprises a large mains transformer with primary windings for 110, 127, 140, 150, 220 and 245 V. The gramophone motor is connected to the tapping for 220 V and consequently never requires switching over. A screen is fitted between the primary and the secondary windings, which prevents the high frequency noises of the mains current from reaching the sensitive parts of the receiver. The secondary windings, three in number, feed filaments and the anodes of the rectifier valve. The mains transformer has a thermo-fuse. This breaks the mains voltage if the transformer windings for some reason exceed the tolerated maximum temperature. Other features of the unit are the rectifier valve 5Y3G, choke and electrolytic condenser 16  $\mu$ F + 16  $\mu$ F.

The mains unit for *478 A.C./D.C.* consists of series resistance, disturbance choke, rectifier valve, smoothing choke and electrolytic condenser. The reservoir condenser is 32  $\mu$ F, with working voltage 450 V. The equivalent value

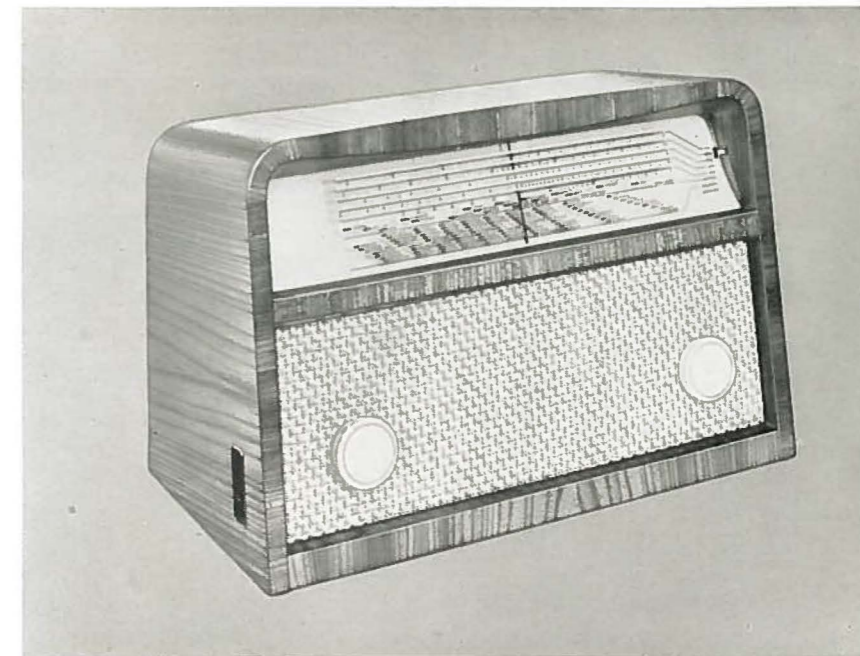


Fig. 6 X 6245  
Svenskradio 474  
The controls are, from left to right: mains switch, volume and selectivity control, combined tuning knob and band switch.

for the filter final condenser is 64  $\mu$ F, 300 V. The unit is switchable for voltages 110—130, 135—150 and 220 V. In the filament circuit there is inserted a fuse and in the anode circuit a more sluggish thermo-fuse.

### Svenskradio 474

This receiver, Fig. 6, is a smaller table model in estrade form. *Svenskradio 474* has 4 valves with double function and 6 tuned circuits. Outstanding features include localized short-wave for rapid tuning and stable reception and strong corrected feed-back for correct fidelity with any intensity of sound.

*Svenskradio 474 A.C.* operates with two triode-heptodes *MECH 21*, one of which acts as mixing valve and the other as intermediate frequency and low frequency valve. The demodulator and output valve is *MEBL 21* and the rectifier valve *MAZ 1*. The *474 A.C./D.C.* has corresponding U-valves and the rectifier valve *MUY 1*. The valve equipment provides good sensitivity, about 10  $\mu$ V for 50 mW, and great output, about 3.5 W. Owing to the low current consumption of the valves, the power consumption figures are as satisfactory as 48 W for *474 A.C.* and 38 W for *474 A.C./D.C.*

The controls consist of switch and two knobs, one for sound intensity and tone and one for bands and stations. The scale is distinct with clear pointers both for bands and stations. A large number of station names are provided for long- and medium-wave. Above each of the five short-wave scales there is a prepared line on which favourite stations may be marked in pencil or colour.

As regards sound reproduction, particular attention has been devoted to the correct balance between bass and treble at normal sound intensity. The type of cone for the loud-speaker has been selected with the greatest care to suit the acoustic properties of the case.

	478 A.C. (A.C./D.C.)	474 A.C. (A.C./D.C.)
<i>Controls</i>		
Separate mains switch	—	x
Switch- Volume control	x	—
Station knob with band selector	x	x
Volume control	x	—
Volume-tone control	—	x
Register buttons	x	—
Local button	x	—
Gram.-radio switch	x	—
<i>Connections</i>		
For A.C. only, 50 c/s	478 A.C.	474 A.C.
For all currents	478 A.C./D.C.	474 A.C./D.C.
Adjustable for mains voltages	110, 127, 140, 150 220, 245 (110—130, 135—150) (220)	110, 127, 140, 155 220, 245 (110—120, 130) (150, 220)
Connection for extra loud-speaker with $Z = 20 \Omega$	x	x
Connection for pick-up	—	x
<i>Valve Equipment</i>		
Number of valves	7	4
Mixing valve	MECH <sub>21</sub> (MUCH <sub>21</sub> )	MECH <sub>21</sub> (MUCH <sub>21</sub> )
IF and LF valve	MECH <sub>21</sub> (MUCH <sub>21</sub> )	MECH <sub>21</sub> (MUCH <sub>21</sub> )
LF and phase reverser valve	MECH <sub>21</sub> (MUCH <sub>21</sub> )	—
Demodulator and output valve	MEBL <sub>21</sub> (MUBL <sub>21</sub> )	MEBL <sub>21</sub> (MUBL <sub>21</sub> )
Output valve	MEBL <sub>21</sub> (MUBL <sub>21</sub> )	—
Magic eye	MEM <sub>4</sub> (MUM <sub>4</sub> )	—
Rectifier valve	5Y3G (MUY 1)	MAZ 1 (MUY 1)
Scale illumination lamps		
6,5 V 0,15 A	5	3
6,5 V 0,10 A	—	(3)
Fuse		
400 mA	—	(x)
600 mA	(x)	—
<i>Technical Data</i>		
Longwave	m 690—2000	m 690—2000
Mediumwave	m 194—580	m 194—580
Shortwave	m 49 m (42.3—51) 41 m (32—42.3) 31 m (25.8—32) 25 m (20—25.8) 19 m (16—20)	m 49 m (42.3—51) 41 m (32—42.3) 31 m (25.8—32) 25 m (20—25.8) 19 m (16—20)
Band width at 40 dB in kc/s	18	18
Band width at 6 dB in kc/s	3—6	3—6
Image frequency ratio in dB	60	60
Sensitivity $\mu V$ (50 mW output)	10	10 (20)
Power consumption for 220 V in W	75 (98)	48 (38)
Gramophone power consumption in W	15 (20)	—

		478 A.C. (A.C./D.C.)	474 A.C. (A.C./D.C.)
Output (220 V)	W	10 (8)	3.5
Loud-speaker		HP 1230	HF-618 (HP-918)
Effective cone area	cm <sup>2</sup>	600	200
Treble loud-speaker		HF 716 (HP-716)	—
Effective cone area	cm <sup>2</sup>	135	—
<i>Dimensions in mm</i>			
Height		730	306
Width		975	470
Depth		422	242
<i>Weight in kg</i>			
Net		60	10.5 (8.8)
Packed		90	13.1 (11.4)

# New LM Ericsson Exchanges 1946

According to information now available the following exchanges and switchboards on the LM Ericsson system with 500-line selectors were put into service during 1946:

t o w n	e x c h a n g e	number of lines
Mendoza, Argentine	Main exchange	1000
Santiago del Estero, Argentine	(extension)	500
Juis de Fora, Brazil	(extension)	500
Ministère des Travaux Publics, Paris, France	P.A.B.X.	500
U.N.R.R.A. Rome, Italy	P.A.B.X.	250
Roma, México D.F.	(extension)	2000
Tacubaya, México D.F.	(extension)	500
Lillehammer, Norway	(extension)	1500
Sandnes, Norway	(extension)	500
Gothenburg, Sweden	5 P.A.B.X.	440
Gothenburg, Sweden	4 P.A.B.X.	(extension) 180
Karlskoga, Sweden	(extension)	1000
Kristinehamn, Sweden	(extension)	500
Lidköping, Sweden		3000
Linköping, Sweden		11000
Norrköping, Sweden	(extension)	1500
Stockholm, Sweden	North	(extension) 5000
Stockholm, Sweden	Aspudden	(extension) 3000
Stockholm, Sweden	Enskede	(extension) 6000
Stockholm, Sweden	Hässelby	(extension) 500
Stockholm, Sweden	Saltsjöbaden	1500
Stockholm, Sweden	Viggbyholm	1500
Stockholm, Sweden	Älgö	500
Stockholm, Sweden	Örby	(extension) 2000
Stockholm, Sweden	18 P.A.B.X.	2560
Stockholm, Sweden	5 P.A.B.X.	(extension) 170
Trollhättan, Sweden		3500
Upsala, Sweden	(extension)	2000
Värnamo, Sweden		2000
Västerås, Sweden	(extension)	1000
Örebro, Sweden	(extension)	1500
Various places, Sweden	13 P.A.B.X.	1340
Various places, Sweden	15 P.A.B.X.	(extension) 445

During 1946 the following exchanges and switchboards with 100-, 25- and 12-line selectors have been delivered. Extensions to existing plants are not included in the figures.

	n u m b e r	number of lines
Exchanges with 100-line selectors	15	1550
Switchboards with 100-line selectors, system AHD	32	2789
Switchboards with 25- and 12-line selectors, system OL	341	6682

U.D.C. 621.395.341.2

JACOBÆUS, C: *Influence of the Size of Selectors on the Number of Selectors in Telephone Plants*. Ericsson Rev. 24 (1947) No 1 pp. 2—9.

Starting out from the general formula for number of devices with grading, it has been possible to arrive at approximate curves for selector requirements for various sizes of selectors. The curves have been drawn for an exchange 10000 lines in size, with a constant grade of service  $p = 0.002$ /selector step and with hunting capacity  $k$  as  $x$ -variable. By derivation of a formula for »closed groups» in an exchange, facilities have been created for making an exact computation of requirement of devices for various selector types. Comparison between selectors is also made for different sizes of exchanges and finally, if a constant total blocking is reckoned on, for the whole exchange instead of a given grade of service per selector step.

U.D.C. 621.395.66

BJUREL, B: *New Traffic Meter for Telephone Plants*. Ericsson Rev. 24 (1947) No. 1 pp. 10—16.

The Technical Division of the Board of Telegraphs in conjunction with Telefonaktiebolaget LM Ericsson has worked out for large telephone plants a new traffic meter, especially adapted to the new traffic unit Erlang. The construction and function of the traffic meter is described in the article.

U.D.C. 621.366.621

FREDIN, C: *New Svenskradio Receivers*. Ericsson Rev. 24 (1947) No. 1 pp. 17—23.

Svenska Radioaktiebolaget has during 1947 put on the market two improved models partially re-designed. The article describes a large radio-gramophone, Svenskradio 478, and a smaller table model, Svenskradio 474, both provided with localized short-wave.