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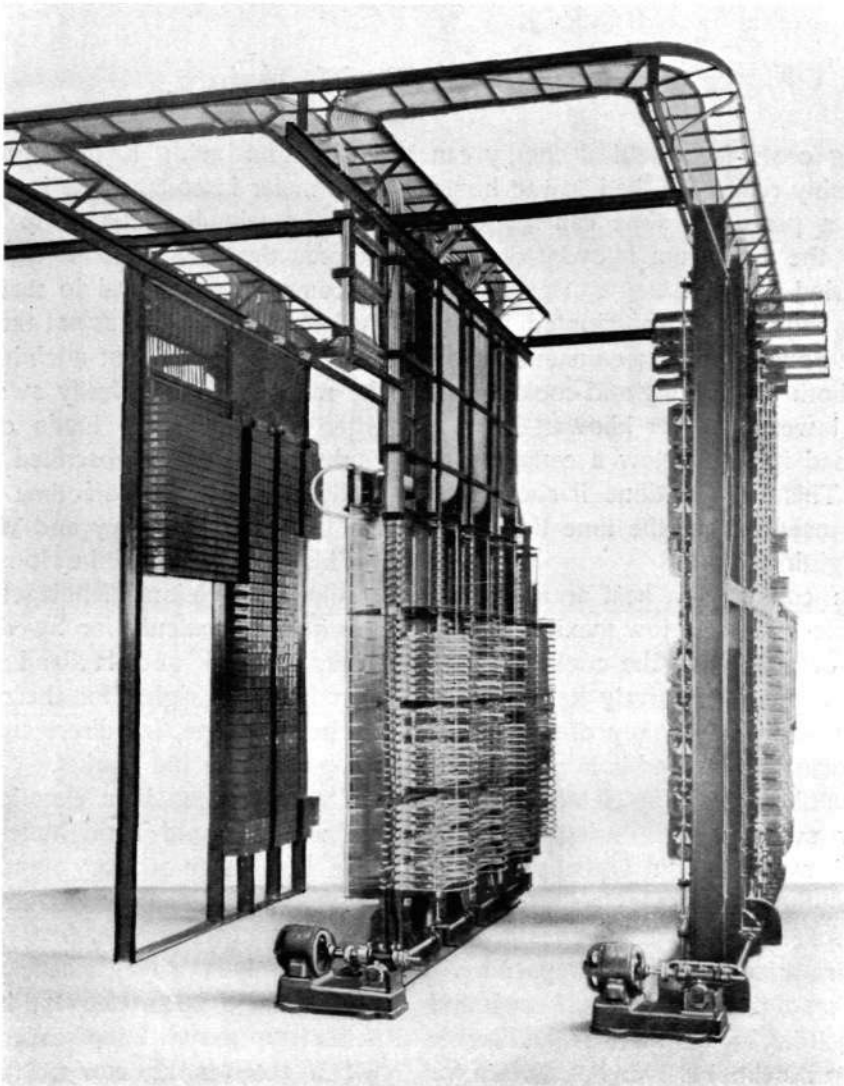

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ENGLISH EDITION

L. M. Ericsson

THE L. M. ERICSSON REVIEW

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Household Tariff Meters.

The generating costs for electrical energy can be considerably reduced if the kilowatt hours generated over a period of time can approach the product of the maximum kilowatt demand by the same period of time.

According to modern tariffs adopted by the Swedish Electric Power Works, a consumer using electric energy both for lighting and cooking can count upon a lower price per kilowatt hour, if the maximum load is held below a certain subscribed value. This can be done if energy for cooking is not used during the time this value is utilized for lighting.

If the electric cooker is a heat accumulating one, it is possible to hold a low maximum load, as the supply of current to the cooker can be intermittently cut off for relatively long periods without reducing the practicability of the cooker.

A means of balancing the load is to provide the cooker with a number of heating elements, which are successively switched off during increased lamp load, and switched on when the lamp load is reduced. Such an arrangement, however, necessitates a cooker of complicated construction, requiring constant attention by the subscriber.

Another solution of this problem has been found by Mr Axel Widström, an Engineer of the Electric Power Works in Stockholm. He has divised for this purpose an electricity meter for use in conjunction with a heat-accumulating cooker. This meter is constructed in such a manner, that when a simultaneous lamp and cooker load exceeds the subscribed value, the average effect is constant and equal to that value as long as the lamp load alone does not exceed the subscribed value. The manner of attaining this is to cause the meter to automatically switch off the cooker when the combined loads of the lamps and cooker exceed the subscribed effect, termed Bulk limit; the switched off time lengthening when the lamp load is heavy and vice versa.

This meter is termed the Household Tariff Meter.

Allmänna Telefonaktiebolaget L. M. Ericsson has acquired the patents for Sweden, Norway, Denmark, Finland and Holland and thus also the manufacturing rights for these countries.

The first type, for direct current, is now ready for putting on the market.

The following is a description of the meter.

The Household Tariff Meter for direct current, type *L2H*, is an ordinary ampere hour meter with kilowatt hour recording train, built as per the magnet-motor principle.

Figure 1 is a diagramatic view of the meter.

1, *2* and *3* is an electrical installation, where *1* is the lamp circuit, *2* the heat accumulating cooker, which receives its current through the sealed mercury switch *39*, and *3* the meter registering the total energy on its recording train *16* and the energy exceeding the subscribed value on its recording train *31*.

8 is the armature of the meter. This is an ordinary break disc provided with three flat fine wire coils. The three coils are placed between two aluminium discs and are attached to a three-segment commutator *6* made of gold-silver alloy. The armature is free to rotate between the shanks of two steel permanent magnets *7* each with the field Φ.

The brushes *5* are each provided with three extremely thin strips of gold-silver alloy. They are connected to an adjustable shunt resistance *4* made of manganin, therefore of a low temperature coefficient. Of the total current flowing, the main current I_s passes through the shunt *4*, the remainder I_a passing through the armature.

The co-operation between the field of the armature coils and the field of the permanent magnets causes a torque M_v, which is proportional to the armature current I_a and the field Φ.

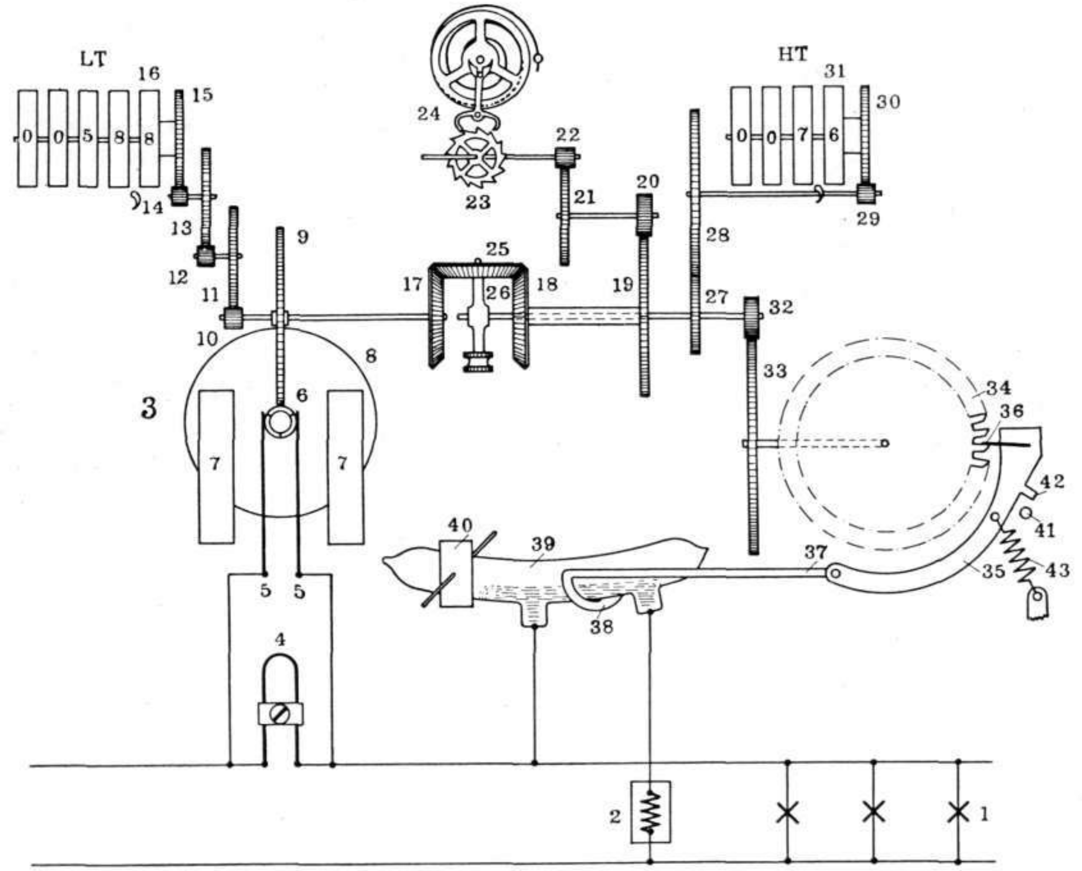
$$M_v = C_1 \times \Phi \times I_a.$$

C_1 is a constant, depending upon the construction of the meter. Under the influence of this torque the armature begins to rotate. Through the rotation of the aluminium discs in the field Φ eddy currents are produced in the same, which together with the field Φ act on the armature a breaking moment M_B proportional to the square on the field Φ and the armature speed n.

$$M_B = C_2 \times \Phi^2 \times n$$

C_2 is a constant, depending upon the construction of the armature, the thickness of the aluminium discs and their conductivity.

In stationary condition the rotating and breaking moments are equal, thus



R 107

Fig. 1.

$$M_V = M_B$$

or

$$C_1 \times \Phi \times I_a = C_2 \times \Phi^2 \times n$$

R 108 Fig. 2.

from which

$$n = \frac{C_1 \times I_a}{C_2 \times \Phi}$$

Now Φ is constant, thus

$$n = C_3 \times I_a.$$

Thus the speed n being propotional to the armature current I_a, and the armature current I_a proportional to the total current I, the armature speed n is proportional to the total current I

$$n = C_4 \times I.$$

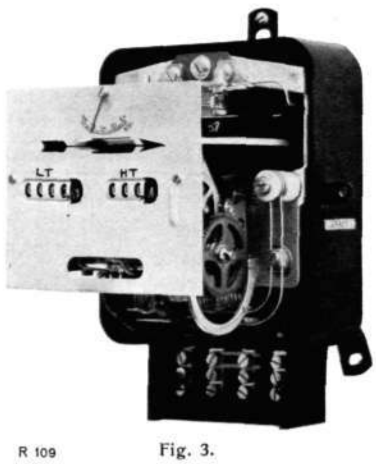
If the armature movement is transmitted to a recording train this will register the number of ampere hours. If the voltage of the system is constant, which usually is the case, the recording train can be provided with such a gearing that it registers the consumed amount of electric energy in kilowatt hours.

The movement of the armature is transmitted by a worm to a wheel *9* and further through the gears *10/11*, *12/13* and *14/15* to the recording train *16* of cyclometer pattern, which registers the total amount of the consumed electric energy in kilowatt hours. This train is provided with five digits of which one is a decimal thus registering a max. 9999.9 of kilowatt hours.

17, *25* and *18* is a differential gearing. The wheel *17* is combined with the wheel *9* thus getting its movement from the meter *3* itself. The bevel wheel *18* is driven with a constant speed from a clockwork *23/24* through the gears *21/22* and *19/20*. The planet wheel *25* transmits the movement necessary for manipulating the sealed mercury switch *39* through the shaft *26*, the gear *32/33* and the ratchet wheel *34*. This mercury switch is pivoted at the point *40* and by means of an arm *38* is normally held in such a position that the cooker circuit is closed. The arm *38* is solid with the control lever *35* through the shaft *37*. The ratchet tooth *36* on arm *38* engages with the teeth of the ratchet wheel *34* over a defined arc after which owing to their divergence they disengage.

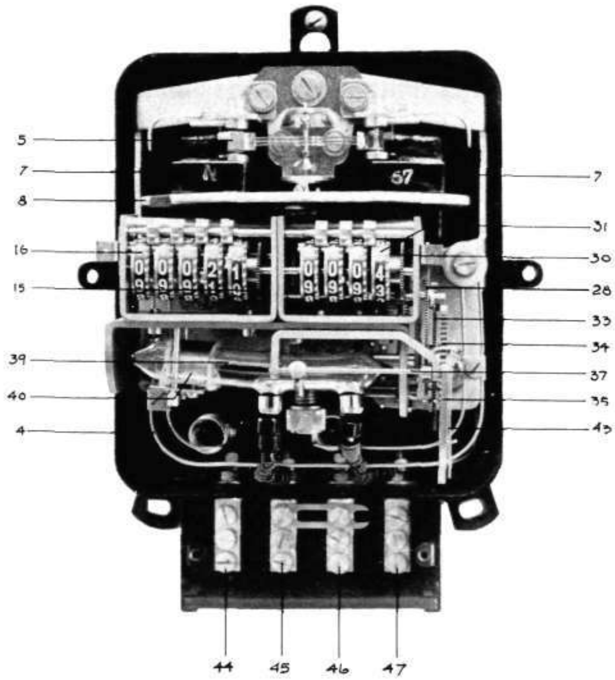
The speed of the planet wheel *25* is proportional to the difference between the speeds of the wheels *17* and *18*. If these wheels rotate with equal speed the planet wheel will remain stationary. If the load of the system is of such a value that the speed of the wheel *17* is greater than that of the wheel *18*, the ratchet wheel *34* moves counter-clockwise and lifts the ratchet tooth *36* thus tilting the sealed mercury switch *39*, which breaks the cooker circuit. Then the load of the system decreases. If the decrease is of such a value that the speed of the wheel *17* is less than that of the wheel *18*, the ratchet wheel *34* moves clockwise and thus the cooker circuit is switched on again.

The ratchet wheel *34* and the ratchet tooth *36* are so constructed that the wheel *34* is free to



R 109 Fig. 3.

continue its movement counter-clockwise, whereby the ratchet trips from tooth to tooth maintaining its extreme displacement. The movement of the



R 110 Fig. 4.

sealed mercury switch is determined by stops *41/42*. The clockwork driving force is the resultant of the driving force of the meter counteracted by the weight of the mercury switch aided by a spring *43* acting through the differential gearing. The clockwork is primarily at a standstill. As shown before, the ratchet tooth *36* and the mercury switch *39* are lifted when the armature begins to rotate. The counteracting force is transmitted through the gear *25/18* to the clockwork *23/24*. As soon as it has reached a sufficient value, the balance wheel *24* starts and the movement is released, i. e. the planet wheel reverses, the ratchet tooth falls and the clockwork comes to a standstill. The movement is then repeated until the total value of the lamp and cooker loads reaches the bulk limit, when the clockwork runs at a constant speed.

Through the gearings *27/28* and *29/30* the planet wheel *25* is combined with a recording train of cyclometer pattern registering the energy value exceeding the subscribed value in kilowatt hours. This train is provided with four digits of which one is a decimal, thus registering 999.9 kilowatt hours.

The complete mechanism works in the following manner.

The bulk limit is A watts. This limit may not be exceeded without extra charge for excess value.

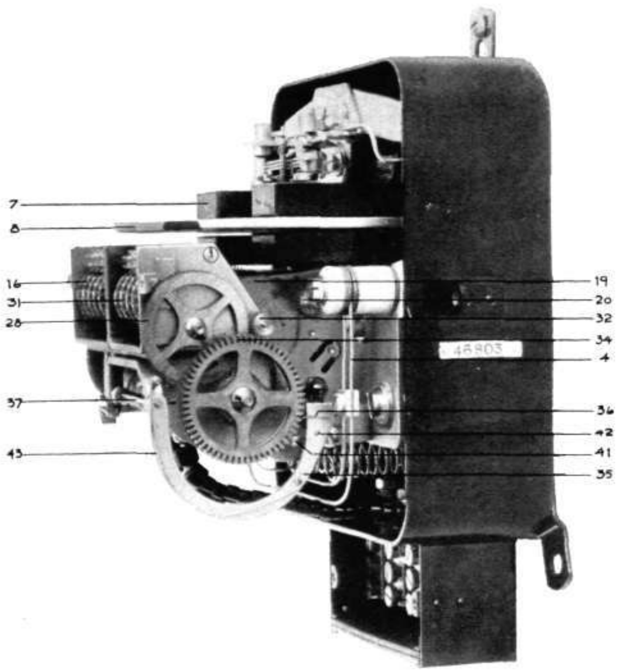
(As per the household tariff adopted by the Electric Power Works of Stockholm the consumer pays 220 Swedish Crowns per kilowatt year as the fixed cost and 0.06 Swedish Crowns per kilowatt hour for energy below the bulk limit added with 0.60 Sw. Cr. per kilowatt hour over this limit.)

The apparatus is therefore arranged in such a manner that at the bulk limit A watts the speeds of the bevel wheels *17* and *18* are equal. If the limit is exceeded by a certain value, for example M watts, the planet wheel *25* moves counter-clockwise with a speed proportional to M and breaks the cooker circuit after a certain time T_i. The load then decreases below the bulk limit with a certain value N watts. The planet wheel *25* then moves clockwise with a speed proportional to N and closes the cooker circuit after a certain time T_u.

Thus the average load is

$$\frac{(A + M)\,T_i + (A - N)\,T_u}{T_i + T_u}$$

As the range of the ratchet tooth for breaking and making is the same and the speed of the



R 111 Fig. 5.

planet wheel is proportional to M and N, so

$$T_i \times M = C$$

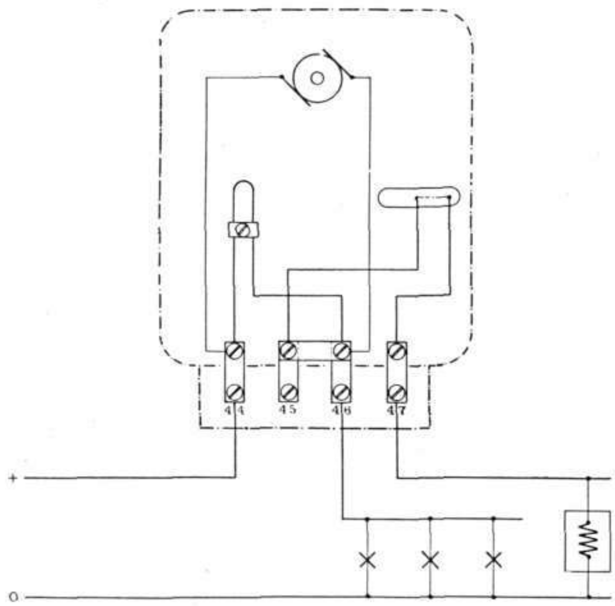
and

$$T_u \times N = C.$$

If these are put into the equation for the average load, the value of this will be

$$\frac{(A+M)\frac{C}{M} + (A-N)\frac{C}{N}}{\frac{C}{M} + \frac{C}{N}} = A$$

From this it will be seen that if the sum of the lamp and cooker loads exceeds the bulk limit



R 112 Fig. 6.

A watts, the average load of the system is equal to A watts as long as the lamp load alone does not exceed the bulk limit. If this is the case the planet wheel *25* and thus also the ratchet wheel moves with a speed proportional to the value with which the lamp load exceeds the subscribed value. This excess value is registered by the recording train *31*. The cooker remains switched off as long as the lamp load exceeds the bulk limit.

The household tariff meter is constructed for bulk limits of 200, 250, 300, 350, 400, 450, 500, 550 and 600 watts. The meter can be altered from one bulk limit to another by means of a simple re-adjustment. The position of the clock mechanism in the meter is adjustable to allow the proper intermeshing of the gears *20* and *19*, the gear *20* varying in the number of teeth for the different bulk limits. It is not necessary to alter the meter if the effect of the cooker is altered. A meter of a bulk limit of 500 watts holds an average effect of 500 watts whether the cooker is constructed for 250, 300 or 400 watts.

Fig. 2 is a photograph of the meter with cover. The cover is provided with the usual plate, stating type, serial number, main voltage, current and number of revolutions per kilowatt hour. The readings of the two recording trains can easily be read through a window in the cover, the one for Low Rate being marked *LT* and that for High Rate *HT*. The armature and the sealed mercury switch can be observed through slots in the dial. The dial is also provided with a pointer and a scale graduated from 0.2 to 0.6 kilowatts stating the bulk limit adjustment of that particular meter. Fig. 3 is a photograph of the meter without cover. Fig. 4 is a front view of the meter without cover and dial. Fig. 5 is a photographic side view of the meter without cover and dial. The before mentioned terms for the different details are used for these photograps.

Other details of the meter type *L2H*, such as jewel post, jewel screw, magnets etc. which have not been mentioned in this description, are of the standard pattern as used on meter type *L2*.

Fig. 6 shows the connecting diagram of the meter.

Figs 7 and 8 show curves characteristic to a meter of the type *L2H*. They refer to a meter of 220 volts, 3 amps, 10,000 revs per kilowatt hour regulated for a bulk limit of 300 watts, for use in conjunction with a cooker of 250 watts.

1) The switched on time T_i of the cooker in seconds as a function of the lamp load W_L in watts.

For values of W_L below 50 watts T_i is infinity, i. e. the cooker is constantly switched on.

For values of W_L between 50 and 300 watts

$$T_i \text{ (seconds)} = \frac{2700}{0.1\, W_L - 5}$$

When $W_L = 50$ watts, $T_i = \infty$ seconds. If W_L increases, T_i decreases. When $W_L = 300$ watts, $T_i = 108$ seconds. For values of W_L above 300 watts the cooker is constantly switched off.

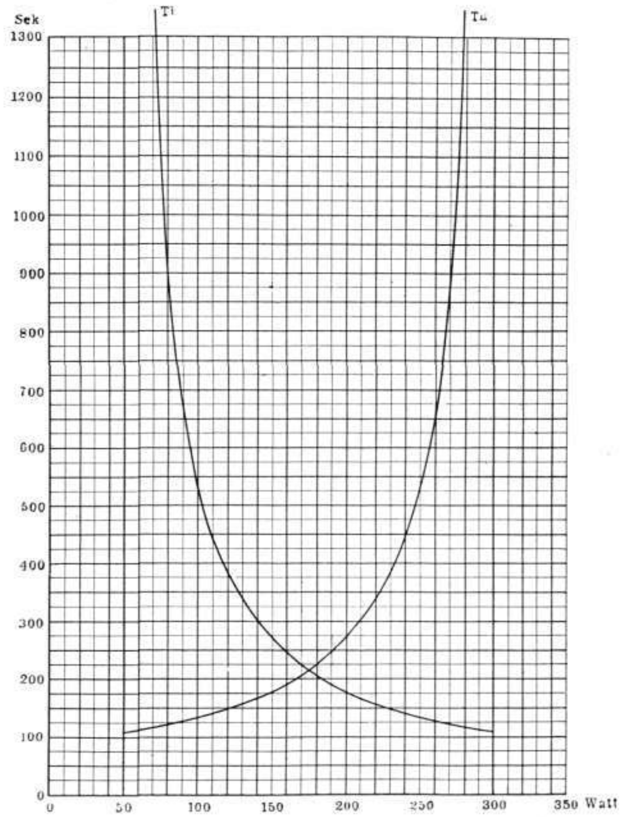
2) The switched off time T_u in seconds as a function of the lamp load W_L in watts.

For values of W_L below 50 watts the cooker is constantly switched on.

For values of W_L between 50 and 300 watts

$$T_u \text{ (seconds)} = \frac{2700}{30 - 0.1\,W_L}$$

When $W_L = 50$ watts, $T_u = 108$ seconds and when $W_L = 300$ watts, $T_u = \infty$ seconds, i. e. for values of W_L above 300 watts the cooker is constantly switched off.



R 113 Fig. 7. Lamp Load.

When $W_L = 0$, $T_u = 90$ seconds, i. e. if the lamp load is broken at the same time as the cooker is switched off, the cooker is switched on after a period of 90 seconds.

3) The average effect of the cooker, $W_{S\,\text{med}}$, in watts as a function of the lamp load W_L in watts.

For values of W_L below 50 watts, $W_{S\,\text{med}} = W_L = 250$ watts.

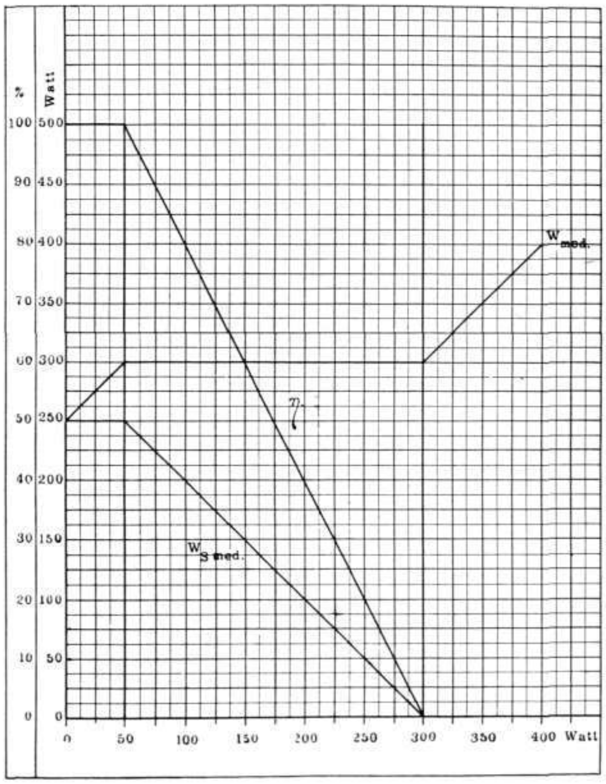
For values of W_L between 50 and 300 watts

$$W_{S\,\text{med}} \text{ (watts)} = \frac{250 \times T_i}{T_i + T_u} = 300 - W_L$$

When $W_L = 50$ watts $W_{S\,\text{med}} = 250$ watts
» $W_L = 300$ » $W_{S\,\text{med}} = 0$ »
» $W_L > 300$ » $W_{S\,\text{med}} = 0$ »

i. e. the cooker is constantly switched off.

4) The average effect of the cooker in per cent of the stationary effect of the cooker (η %) as a function of the lamp load W_L in watts.



R 114 Fig. 8. Lamp Load.

For values of W_L below 50 watts, $\eta = 100$ %.

For values of W_L between 50 och 300 watts

$$\eta\,(\%) = \frac{T_i}{T_i + T_u} \times 100 = 120 - 0.4\,W_L$$

When $W_L = 50$ watts, $\eta = 100$ %
» $W_L = 300$ » $\eta = 0$ %
» $W_L > 300$ » $\eta = 0$ %.

5) The average effect of the system, W_{med}, in watts as a function of the lamp load W_L in watts.

For values of W_L below 50 watts

$$W_{\text{med}} \text{ (watts)} = W_S + W_L = 250 + W_L.$$

For values of W_L between 50 and 300 watts $W_{\text{med}} = 300$ watts.

For values of W_L over 300 watts

$$W_{\text{med}} = W_L \text{ watts.}$$

Fig. 9 shows the accuracy in per cent of the meter at different loads in per cent of full load. From the curve it is seen that the error of the meter does not exced $\pm$ 3 per cent at full load down to $^1/_{10}$ load. This may be considered sufficient owing to the increased friction moment

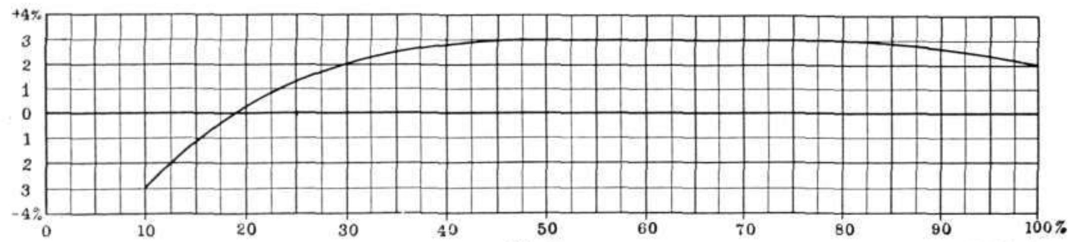


Fig 9.

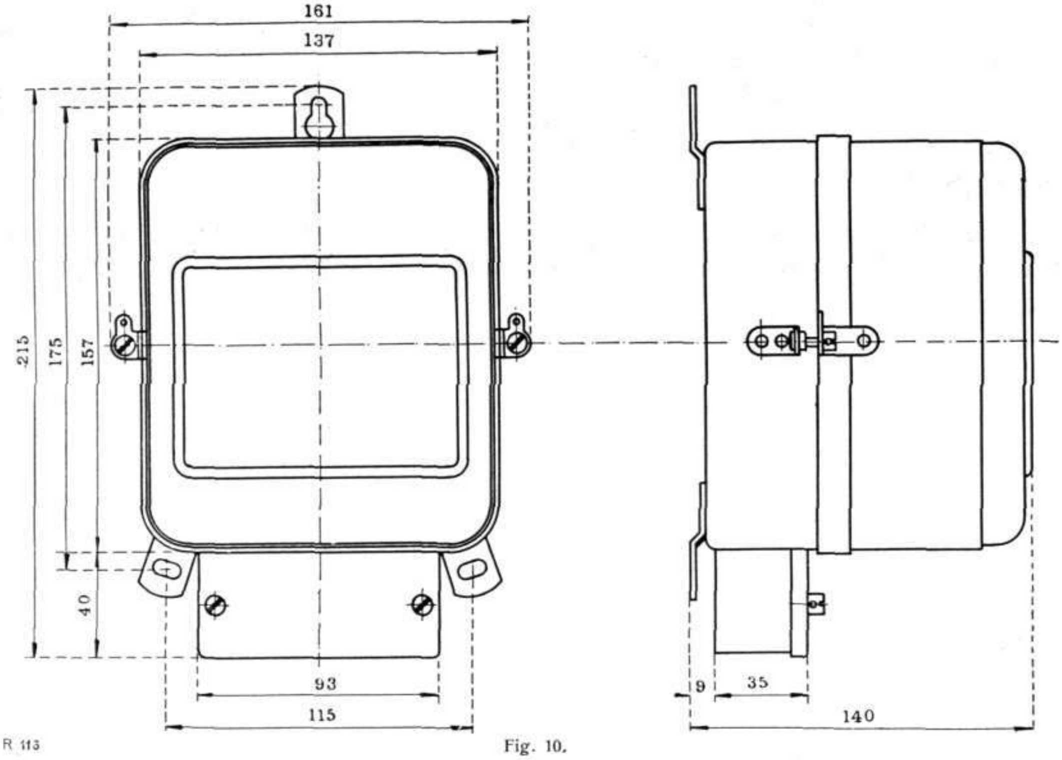


Fig. 10.

caused by the clock work and the mercury switch. This result has been reached by designing the meter to obtain the greatest possible torque (about 20 gcm.).

Fig. 10 shows the dimensions of the meter.

To meters of type *L2H* the following technical data may be applied:

Limits of error. The error of the meter does not exceed $\pm$ 3 per cent at full load down to $^1/_{10}$ load.

Minimum running current. When a current equal to one per cent of the marked current of the meter traverses its main circuit, the rotor starts and continues running steadily.

Speed of rotation. 110—120 revolutions per minute at full load.

Energy losses. The pressure drop in the meter circuit does not exceed 1.6 volts at full load.

Excess current. The meter will not be injured and its accuracy will not be permanently impaired by a current 50 per cent in excess of its marked current, the rotor being free to rotate.

Torque about 20 gcm. at full load.

Pressure of brushes about 0.5 gram.

Weight of armature about 70 grams.

Nett weight 3.5 Kg.

Mark.

Calculation of the Required Number of Switches for Automatic Telephone Exchanges.

It is not the intention, in this article, to deal with the theoretical investigations on which the plotting of the curves here shown is based, but to give the reader an idea of the practical application of these curves for the calculation of the number of switches and trunk lines required in an automatic plant, and more especially as regards the Ericsson automatic system.

A new problem has presented itself with the introduction of automatic telephone switching systems. The change from a manual to an automatic system is warranted only in cases where the automatic system is superior to the manual in operating conditions and economy. The two following items will be taken into consideration for judging the question of economy, namely, the purchase price and the yearly expenditures. The purchase price includes the first cost of outside plant and subscribers' stations, exchange equipment and, in some cases, the exchange building. As the purchase price for an automatic exchange is greater than for a manual exchange almost without exception, it must lie within the interest of the manufacturers to do all in their power to reduce this cost by developing to the utmost the mechanical possibilities existing within the automatic systems, thereby bettering their chances of succesfully competing with the manual systems. The gist of the problem is this: How calculate the number of switching units required so as to obtain the best possible results, and at the same time reach the highest possible degree of reliability in operation.

It is to the interest of the contractor to submit some authoritative basis to convince the purchaser that the equipment to be supplied is fully adequate to deal with the requirements laid down. Should the equipment subsequently prove inadequate, it can be readily found whether the purchaser has understated the requirements. It can therefore be of interest to here present the methods of computation applied by L. M. Ericsson.

We will first indicate the factors which are necessary for the computation. They are:

1. Size of plant, i. e. number of subscribers' lines at the initial capacity and at the assumed final capacity.
2. Number of exchanges at the initial capacity and at the final capacity. (Distance between exchanges is of no direct interest in this connection, as this article does not deal with cost of outside plant.)
3. Average number of calls per subscriber per day.
4. Average length of calls.
5. Concentration, which indicates how large a part of total number of calls occurs during the busy hour. It is self evident that calls are not equally distributed over a twenty four hour period, but that their frequency varies to no small extent. The distribution of calls can be graphically shown, as indicated in fig. 1.

The number of calls are marked off along the ordinate and the hours of the day along the abscissa. The hours between 5 a. m. and 9 p. m. only are included. The total number of calls during this period amounts to 60,000. The busy hour is evidently between 1 and 2 p. m., with a total of 7,500 calls. Concentration will in this case be $\frac{7,500}{60,000}$ or $\frac{1}{8}$. Traffic as a whole, as well as concentration, can vary to a large extent, and for this reason, one should obtain information as to the maximum values for traffic and concentration from statistics covering a period of one year. When doing this, one naturally must not let oneself be influenced by extreme fluctuations in traffic caused by exceptional conditions.

Concentration varies for different exchanges, depending on whether the telephones served by these exchanges are mainly business or private phones, and can vary from $\frac{1}{6}$ to $\frac{1}{12}$. $\frac{1}{8}$ can be taken as a mean value.

We will now introduce the following indication marks:

C = number of subscribers

s = number of calls per subscriber during busy hour.

m = average gross length of calls expressed in minutes. By gross length is understood length of conversation plus time required for making and breaking of connection, i. e. the length of time which expires from the moment a calling subscriber lifts the hand-microtelephone until all the switching devices which have been engaged in making the connection have been restored to normal after the conversation is finished.

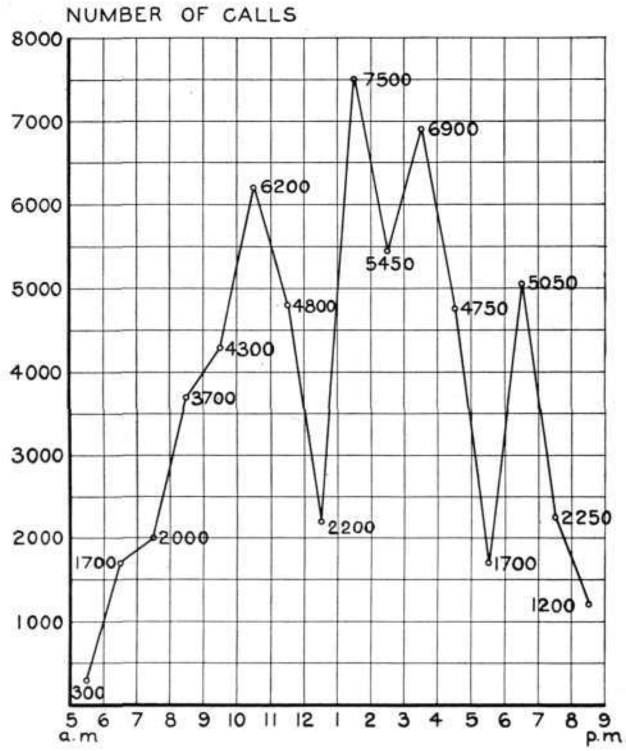
$S = Cs$ = number of calls during busy hour from C subscribers.

$A = Sm$ = number of speaking minutes during the busy hour in a group of C subscribers, each making s calls of a mean length of m minutes.

The number of trunks or switches required to handle the traffic in a group of C subscribers is dependent on A, i. e. the number of speaking minutes within that group, and in some cases also on the factors C, S and m separately. For the application of the calculations to the Ericsson automatic system, however, only the product A need be taken into consideration, as those cases where each separate factor by itself is of importance occur only in very small groups.

If A is known, one can now read off the required number of switches direct from the curves, shown in fig. 2.

The problem of plotting curves and computing formulae from which — with a knowledge of the factor A — it is possible to determine the number of necessary switches or connecting lines, has been taken up by several mathematicians. The curves here shown have been plotted by Mr. Erlang and are applied by the British Post Office, among others. These curves, as well as the methods propounded by other authors, are all founded on the theory of probability. The



R 62 Fig. 1. Example showing Distribution of Calls over the Consecutive Hours of the Day.

loss of a certain number of calls — say one pro mill —, on account of all the accessible selectors or connecting lines being busy, is allowed for. The problem to be solved will then be as follows:

How many selectors are required so that all calls — within a margin of p $^0/_{00}$ — occuring in a group having a load of A speaking minutes may, in all probability, be given service?

The curves shown in fig. 2 are computed for five different values of the permissible loss or grade of service i. e. 10 $^0/_{00}$, 5 $^0/_{00}$, 1 $^0/_{00}$, 0.5 $^0/_{00}$

and 0.1 ‰. The number of speaking minutes A are marked off along the abscissa and the required number of switches x along the ordinate.

Although, as has already been mentioned, many mathematicians have accupied themselves with this problem, most of them having applied different methods of computation, the results attained coincide to a marked degree. The table here below, for example, gives the necessary number of switches according to various authors. All values are valid under the assumption that the grade of service equals 1 in 1,000.

Computed by	Number of Selectors when	
	$A = 195$	$A = 4{,}500$
Erlang	11	100
Poisson	10	103
Spiecker	10	93
Christensen	11	105
Engset	10	104
Holm	9	94
Campbell	9	91
Lubberger	10	95
Pleijel	10	99
Mean value	10	98

As is evident from the above table, the values given by Erlang are amply proportioned, both that for a small load as well as that for a large load lying above the mean value.

The curves given in fig. 2 are applicable only in such cases where all calls occurring within the group can be reached by one and all of the switches which are connected to this group, as is the case in fig. 3.

Five hundred trunk lines are connected to the multiple in a selector rack. $A = 2{,}400$ speaking minutes. With a grade of service of 1 in 1,000, 58 selectors will be required, according to the curves. In such cases, where each call occuring within a group can only be connected to a limited number of trunks — an example of which is shown in fig. 5 —, the computations must be made with due regard to this fact.

The »hour service» that can be accomplished, or, in other words, the number of speaking minutes per hour that can be given service by each trunk in a trunk group, depends upon the size of this group. Obviously, one can not figure with so large an hour service per trunk in a group of ten trunks as in a group of one hundred, as the probability of all trunks being simultaneously engaged is greater when selection is limited to ten, than when it is limited to one hundred.

The permissible hour service per trunk in a group can be figured directly with the aid of the curves in fig. 2. A group of say, ten trunks can receive a load of 180 speaking minutes, with a grade of service of 1 in 1,000. The hour service per trunk amounts in this case to $\frac{180}{10} = 18$ speaking minutes. The corresponding value for a group of one hundred trunks is $\frac{4{,}500}{100} = 45$. One can also say, therefore, that the efficiency per trunk in a group of ten is $\frac{18}{60} = 30\,\%$, while for a trunk in a group of 100 it amounts to $\frac{45}{60} = 75\,\%$.

The load allowed per trunk in groups of various sizes and for various grades of service is obtained from the curves in fig. 4, the values of which are calculated from the curves shown in fig. 2. The number of trunks x are laid off along the abscissa and the assumed hour service per trunk u, along the ordinate.

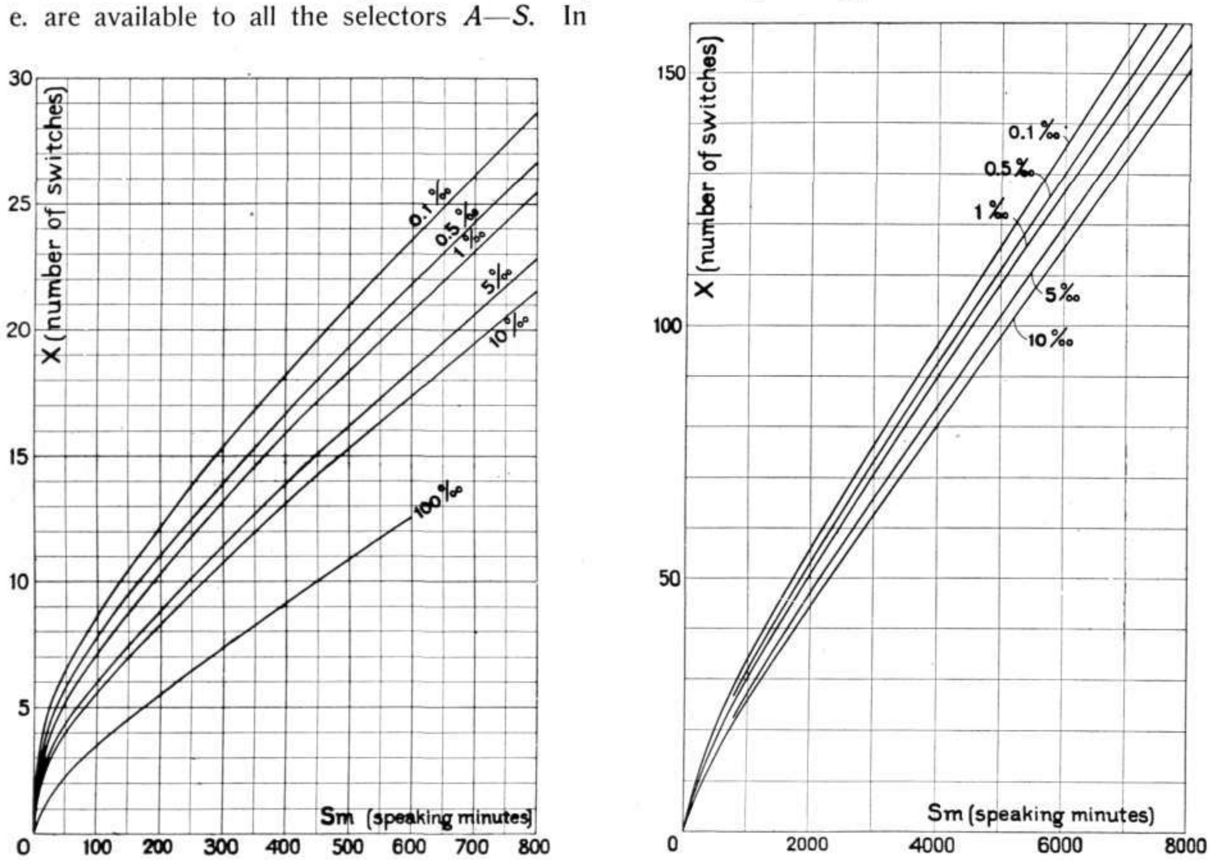
We will now consider the case illustrated in fig. 5.

The number of speaking minutes entering the 36 group selectors GS equals 1,324. This number of speaking minutes must also pass through the outgoing trunk group x_1. Each group selector may choose between 20 trunks. If we assume the grade of service to be 5 in 1,000, we get a value for u of 33.5 from the curve in fig. 4. The required number of outgoing trunks is therefore $\frac{1{,}324}{33.5} = 40$.

By introducing special arrangements indicated in figs. 5 and 7, one can — in certain cases — figure with a larger hour service per trunk. In fig. 5 one speaks of uniform selection, trunks x_1 to x_{20} being available to selectors 1 to 16, and trunks x_{21} to x_{40} being available to selectors 19 to 36. Furthermore, each selector begins by choosing over the trunk x_1 and x_{21} respectively, thereafter over x_2 and x_{22} resp., finishing up by choosing over the trunks x_{20} and x_{40} respectively.

The trunks 11 to 20 in fig. 6 are common, i. e. are available to all the selectors *A—S*. In addition, there are ten trunks 1 to 10, available to selectors *A—I* only, and ten trunks 21 to 30, available to selectors *K—S* only, the principle here applied being that those trunks which are selected first are common to a smaller number of selectors than those which come into use when the first trunks are already engaged.

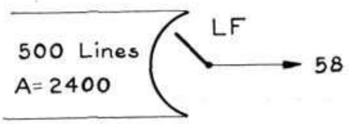
In fig. 7, the outgoing trunks are coupled in parallel, so that selector *A*, for example, chooses first over line 1, then over line 2, then over line 3, etc. Selector *B* begins by choosing over line 10, then over line 1, etc. The outgoing trunks are put to a uniform use by means of this arrangement, permitting a somewhat larger hour service per trunk. On account of the construction of the multiples (the 20 line multiple frames composed of bare wires, serving both as contact bank and multiple connections) in the Ericsson automatic system, the case illustrated in fig. 5 will mainly be applied. A distribution according to fig. 6 or a redistribution of the trunks in relation to each other, as shown in fig. 7, can only be accomplished when the corresponding multiple frames are coupled in parallel. This coupling is then taken care of in the intermediate distributing frame.



R 63/64

Fig. 2. Relation between *Sm* and *x* according to Erlang.

It is not customary — when making calculations — to take into consideration any increased hour service which might possibly result from a redistribution of the trunk lines, the values for *u* obtained from the curves in fig. 4 for selection over 20 being always used.



R 65 Fig. 3. Relation between Speaking Minutes and Switch within a Group.

We will now go on to a closer scrutiny of the meaning »grade of service». The good functioning and reliability of an automatic exchange is dependent — among other things — upon the interconnecting possibilities. The number of switches and trunk lines must not be too closely calculated, i e. one must not set out by assuming too high a value for the grade of service, or the interconnecting possibilities will naturally be diminished. This in turn, causes dissatisfaction on the part of the subscribers, and one is then forced to increase the number of switches and corresponding trunk lines so as to gratify the demands for satisactory service.

Diverging opinions and varying requirements make it very difficult to determine a definite, normal value for the grade of service. It may be stated, however, that the permissible grade of service may be somewhat larger for an exchange with very heavy traffic during the busy hour than for one with light traffic. If we consider the fact that, during heavy traffic, for example in business centres, as many as 20 % of the called numbers are busy, a grade of service of 1 % can not be considered too high, as this additional amount of 1 % will not be noticed by the subscribers.

The total loss of calls theoretically possible consists of the sum of the assumed losses for the various stages of selection and is therefore determined by the number of stages of selection and the value of the assumed loss at each stage, as shown in fig. 8.

A plant for 200,000 lines is here shown, built according to the different systems. Fig. 8 a shows a Strowger system. Here seven selectors are required to complete a connection between two subscribers, namely the first and second preselectors 1 *PS* and 2 *PS,* four group selectors 1 *GS* to 4 *GS* and the connector *C*.

In fig. 8 b the plant is assumed to be built according to a system with 200-line selectors. The number of selectors necessary for a complete connection will in this case be six, i. e. the first and second line finders 1 *LF* and 2 *LF*, three group selectors 1 *GS* to 3 *GS* and a connector *C*.

Fig. 8 c, lastly, shows a 200,000-line plant built according to the Ericsson system. The number of selectors is here four, i. e. line finder *LF*, two group selectors 1 *GS* and 2 *GS* and a connector *C*.

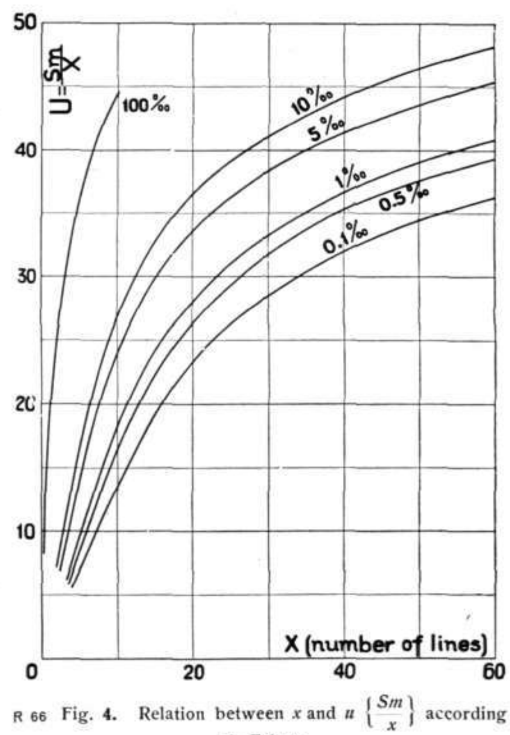
If we now in all three cases assume a grade of service of 2 in 1,000 for each stage of selection, the total loss will then be as follows:

The Strowger system with six stages of selection, total loss = 12 ‰.

System with 200-line selectors with five stages of selection, total loss = 10 ‰.

The Ericsson system with three stages of selection, total loss = 6 ‰.

When a prospective purchaser is comparing bids, based on different systems as concerns switch provision, it is the total loss which, in this connection, must be taken into consideration when judging the interconnecting possibilities of the systems under consideration. If one desires

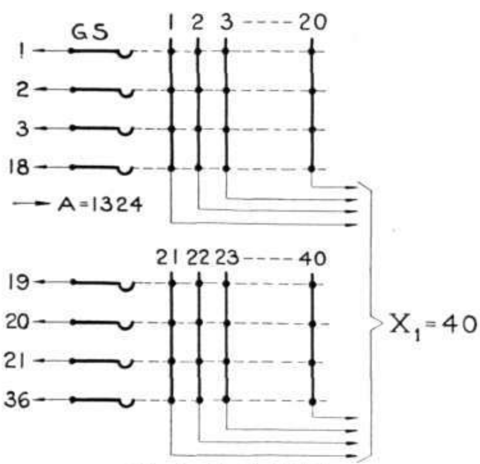


R 66 Fig. 4. Relation between x and u $\left\{\frac{Sm}{x}\right\}$ according to Erlang.

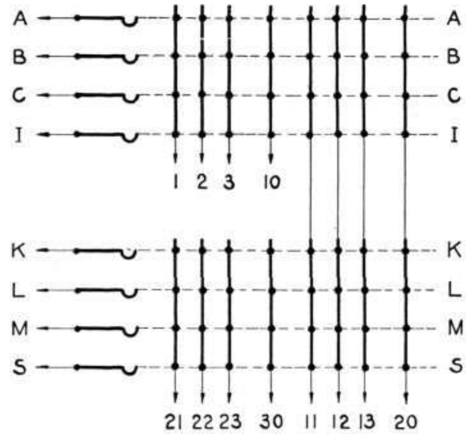
to determine the grade of cervice, when making a request for bids, one must state the total loss and not the loss per stage of selection without regard to the construction of the various systems, as is often the case. This will be clearly observed in fig. 8, where a grade of service of 2 in 1,000 has been determined for each stage of selection, with the result that the total loss in the Strowger system is twice as large as in the Ericsson system.

Still another point of view must be taken into consideration as concerns the term loss. In the Strowger system, the selection of a disengaged trunk line by the group selectors is accomplished by means of a rotating contact arm, which chooses over ten lines. Should all the trunks be engaged, the contact arm will come to rest in an eleventh position (a busy tone being sent back to the calling subscriber). In such a case, one can speak of an actual loss, since the connection to the desired number cannot be completed, the calling subscriber being forced to hang up the receiver and put in a new call, to get a connection.

In the Ericsson system, a disengaged trunk is chosen by the plunging of the contact arm of the selector into a multiple frame. Should all twenty lines connected to this frame be engaged, the movement of the contact arm is automatically reversed after passing the last line, and it selects anew over the twenty lines while moving back out of the frame or, in other words, the



R 67 Fig. 5. Simple Multiple.



R 68 Fig. 6. Mixed Multiple of Combined and Individual Groups.

choosing continues until a disengaged line is actually found. In this case, therefore, one need not figure with an actual loss. The loss is merely seeming, in reality consisting of a prolongation of the time required for making the connection. Furthermore, this prolongation is in most cases imperceptible to the subscriber, as the movements of the group selectors are going on while the subscriber is busy dialling the desired number. It is evident that a system with seeming losses gives more effecient cervice than one with actual losses. One is able, on this account, to further raise the grade of service in systems of the former type and still obtain the same efficiency of service as in systems of the latter type.

Calculating the number of junction lines between different exchanges.

If we assume a plant consisting of n exchanges, the number of outgoing calls from each exchange to all the other exchanges in the same net shall be figured according to the following formula:

1. Outgoing total from exchange No. 1

$$p \times \frac{(CS - s_1 \times c_1) \times s_1 \times c_1}{CS}$$

Outgoing total from exchange No. 2

$$p \times \frac{(CS - s_2 \times c_2) \times s_2 \times c_2}{CS} \text{ etc.}$$

For calculating the number of outgoing calls from a certain exchange to each one of the other exchanges, the following formula is used:

2. From exchange No. 1 to exchange No. 2

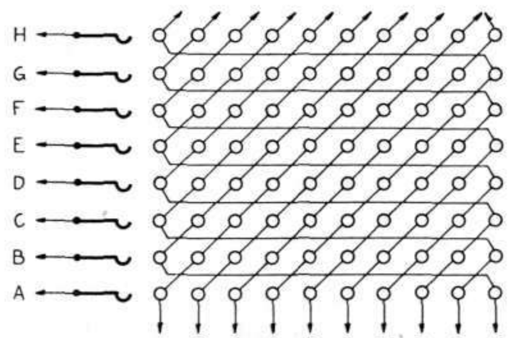
$$p \times \frac{s_1 \times c_1 \times s_2 \times c_2}{CS}$$

From exchange No. 1 to exchange No. n

$$p \times \frac{s_1 \times c_1 \times s_n \times c_n}{CS} \quad \text{where}$$

$c_1, c_2 \ldots c_n$ is the number of subscribers connected to the respective exchanges,

$s_1, s_2 \ldots s_n$ is the number of calls per subscricer occurring at the respective exchanges during the busy hour,



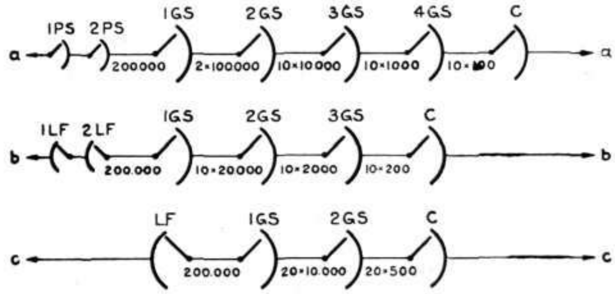
R 69 Fig. 7. Staggered Multiple.

CS is the total number of calls occurring at all the exchanges during the busy hour. CS, therefore, equals $s_1 \times c_1 + s_2 \times c_2 + \ldots + s_n \times c_n$.

p is a coefficient determined by experience. If one assumes traffic to be absolutely uniform, i. e. if the outgoing calls from a certain exchange are distributed among the other exchanges in direct proportion to the size of (number of calls originating at) these exchanges, the coefficient $p = 1$. Experience has proved, however, that traffic is seldom uniform, as sometimes a greater part and sometimes a lesser part of the traffic determined by the proportion between the exchanges is retained within the exchange where it originated. It is impossible to give any approximate values of p as, in each case, this value depends upon several factors, such as the different character of the exchanges with reference to the nature of their subscribers, regulations regarding the restriction of the number of free calls, zone tariffs, and so forth. As a rule, however, the coefficient p is largest for traffic from suburban exchanges with mostly house telephones to exchanges in central business districts, and smallest for traffic in the opposite direction. The value of p can vary between 0.5 and 1.5, and 0.75 may be taken as a mean value.

The number of outgoing speaking minutes from each exchange may now be determined by multiplying the values for the number of calls — calculated by means of the formulae herein — with the length of the calls.

When determining the number of trunk lines



R 70 Fig. 8. A 200,000-Line Plant According to Various Systems.

for the Ericsson system, we must consider the fact that selection takes place over twenty lines.

One must, therefore, use the values of u obtained from the curves in fig. 4, the value of x being 20.

Significance of the size of groups.

If an exchange of 10,000 lines, having 20,000 Sm during the busy hour — i. e. an average of 2 Sm per subscriber — be split into groups of 100 lines, it is not at all certain that the average traffic load per group will be $\frac{20{,}000}{100}$ or 200 Sm, as it is possible for the loads in different one hundreds groups to vary quite extensively, one group having 250 Sm, for example, while another group may not have more than 125 Sm. Should we choose still smaller groups, the variation between them will be still larger. It is therefore necessary to consider the size of the groups when calculating the number of switches required for systems designed with individual contact banks for the selectors and permanent connections. One is forced to make so called group additions, so as to be on the safe side. The Ericsson system makes use of as large groups as 500 lines — the variations being consequently relatively small — and racks and switches so constructed as to allow the easy removal of switches from one rack to another. For this reason there is no need of concidering these load variations, but the same average value may be used for the five hundreds groups as for the whole exchange. Racks, multiple frames and cables are always figured with a certain safe margin of, say, from 15 to 25 %. Later on, when the traffic loads within the various groups have been determined by experience, a transposition of switches from groups with light loads to heavily loaded groups can be very easily accomplished, should it prove necessary.

Example Illustrating the Calculation of number of Switches for an Automatic Telephone Plant.

For the purpose of making what has here been set forth more readily understood, we will illustrate the manner of calculating the number of switches in a plant by means of an example.

We will assume the following qualifications:

(a) The plant shall be designed for a final capacity of 50,000 lines, distributed among five automatic exchanges of 10,000 numbers each.

(b) There is at present a manual exchange of 8,000 lines, called *A*, which will be retained for the time being, and which, for this reason, will be completed for the purpose of working in conjuction with the new automatic exchanges.

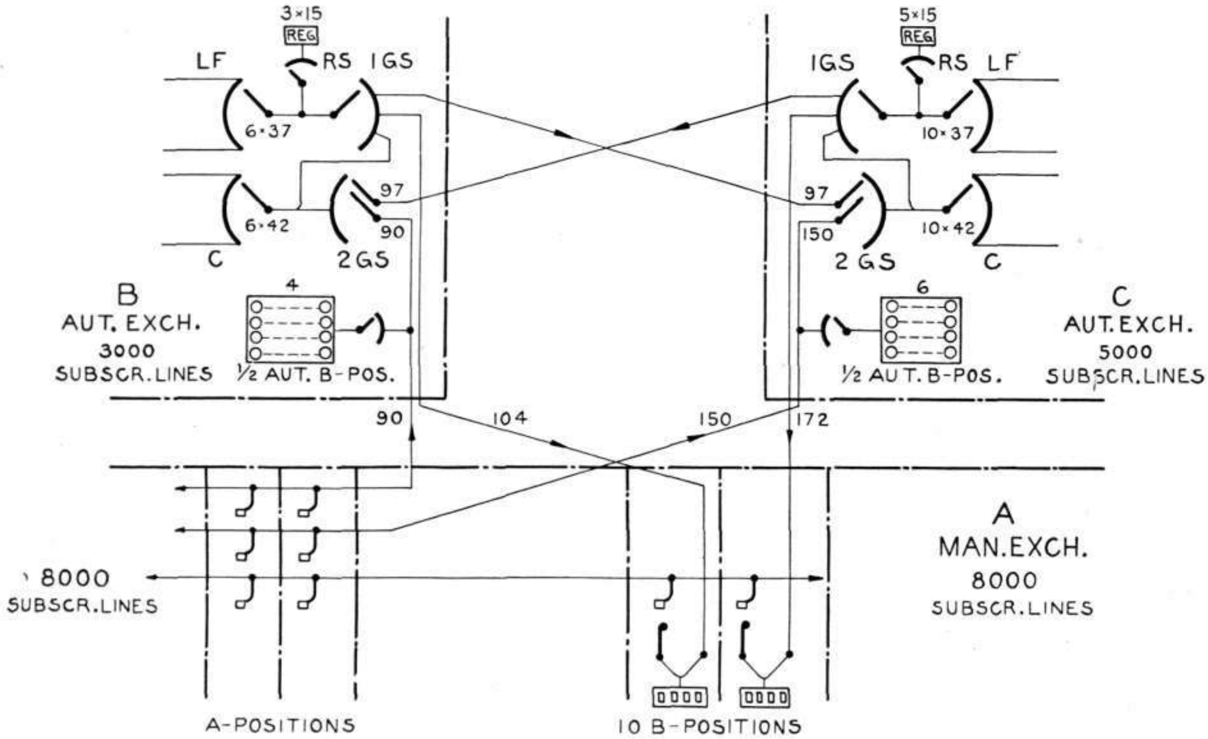
(c) The initial plant will consist of two automatic exchanges, i. e. exchange *B*, with an initial capacity of 3,000 lines, and exchange *C*, with an initial capacity of 5,000 lines.

(d) The number of calls per subscriber per day is
For the manual exchange *A* — 8 calls
For the automatic exchange *B* — 12 calls
» » » » *C* — 12 » .

(e) Concentration of traffic is the same for all three exchanges, amounting to $\frac{1}{8}$.

(f) Average length of calls = 1 min. 40 seconds net for all three exchanges.

(g) Traffic is assumed to be uniform, i. e. the coefficient p has a value of 1 in all cases.



R 71

Fig. 9. Schematic Diagram of an Automatic Plant.

A schematic diagram is now drawn up with the above qualifications as a basis, as shown in fig. 9. As the final capacity has been fixed at 50,000 lines, the automatic exchanges are arranged for a so called 60,000 system, the internal traffic being carried over two group selectors, 1 *GS* and 2 *GS*.

Service in conjunction with the manual exchange is arranged as follows:

The junction lines going from the automatic exchanges to the manual central exchange terminate at single-cord *B* positions, these positions being furnished with call indicators (carriage call).

The junction lines going to the automatic exchanges terminate in group selectors 2 *GS*. These lines are led in multiple through the *A* positions at the manual exchange, traffic being handled over semi-automatic *B* positions at the automatic exchanges.

In addition to the qualifications (a) to (g) set down by the purchaser, we will now establish the following values:

(h) Time required for connecting is twenty seconds for line finders and first group selectors, fifteen seconds for second group selectors, twelve seconds for connectors and fifteen seconds for registers.

The total connecting time required for each call may be made practically equal to that required by the line finders, i. e. twenty seconds. The functioning of the other switching devices will partly coincide with that of the line finders. We have assumed that the registers are engaged fifteen seconds during each call. About three seconds of this time are employed for the connecting and restoring of the registers and for the radial setting of the line finders. The remaining time of twelve seconds we have allotted to the subscriber for the dialling of a five-digit number. This time depends entirely upon the dexterity of the subscriber, and we count twelve seconds as being amply sufficient. Eight seconds may be taken as a good average, when the subscribers have become more accustomed to the use of the dial, thereby reducing the total time required for making a connection from twenty to sixteen seconds.

(i) The grade of service is established at a maximum of 16 in 1,000, distributed as follows:
   5 in 1,000 when calculating line finders and first group selectors,
   5 in 1,000 when calculating second group selectors and junction lines,
   5 in 1,000 when calculating connectors,
   1 in 1,000 when calculating registers.

The value of u derived from the curves in fig. 4 for selection over twenty with a grade of service of 5 in 1,000, will therefore be used when calculating second group selectors, outgoing junction lines and connectors. This value is 33.5.

When calculating the junction lines incoming to the automatic exchanges, we figure with $u = 38.4$, corresponding to selection over thirty with a grade of service of 5 in 1,000. The reason for counting with selection over thirty is the assumption that each *B* operator can handle thirty lines and, since traffic is carried over speaking lines, it is the register selectors *RS* — which are connected to these positions — that select disengaged lines.

Distribution of traffic.

The number of outgoing calls from exchange A during the busy hour $= \frac{8{,}000 \times 8}{8} = 8{,}000.$

The number of outgoing calls from exchange B during the busy hour $= \frac{3{,}000 \times 12}{8} = 4{,}500.$

The number of outgoing calls from exchange C during the busy hour $= \frac{5{,}000 \times 12}{8} = 7{,}500.$

The calls are distributed as follows:

Outgoing from exchange *A* to exchange

$A,\quad \frac{8{,}000}{20{,}000} \times 8{,}000 = 3{,}200$ calls

$B,\quad \frac{4{,}500}{20{,}000} \times 8{,}000 = 1{,}800$ »

$C,\quad \frac{7{,}500}{20{,}000} \times 8{,}000 = 3{,}000$ »

Total 8,000 calls

Outgoing from exchange B to exchange

A, $\frac{8,000}{20,000} \times 4,500 = 1,800$ calls

B, $\frac{4,500}{20,000} \times 4,500 = 1,013$ »

C, $\frac{7,500}{20,000} \times 4,500 = 1,687$ »

Total 4,500 calls

Outgoing from exchange C to exchange

A, $\frac{8,000}{20,000} \times 7,500 = 3,000$ calls

B, $\frac{4,500}{20,000} \times 7,500 = 1,687$ »

C, $\frac{7,500}{20,000} \times 7,500 = 2,813$ »

Total 7,500 calls.

The number of speaking minutes are distributed as follows: (Calls internal to the exchange go directly from the first group selectors to the connectors, so that the time employed for making a connection is, in this case, only twelve seconds. The gross length of these calls will therefore be 1 min. 52 sek. = 1.87 min. For calls to other exchanges, on the other hand, the gross length will be 1 min. 55 sek. = 1.92 min.)

Outgoing from exchange A to exchange B
$1,800 \times 1.92 = 3,456$ *Sm*

Outgoing from exchange A to exchange C
$3,000 \times 1.92 = 5,760$ *Sm.*

(Traffic $A \longrightarrow A$ is of no interest in this connection.)

Outgoing from exchange B to exchange A
$1,800 \times 1.92 = 3,456$ *Sm.*

Outgoing from exchange B to exchange B
$1,013 \times 1.87 = 1,894$ *Sm.*

Outgoing from exchange B to exchange C
$1,687 \times 1.92 = 3,239$ *Sm.*

Outgoing from exchange C to exchange A
$3,000 \times 1.92 = 5,760$ *Sm.*

Outgoing from exchange C to exchange B
$1,687 \times 1.92 = 3,239$ *Sm.*

Outgoing from exchange C to exchange C
$2,813 \times 1.87 = 5,260$ *Sm.*

Calculating the number of line finders and first group selectors.

The number of gross speaking minutes handled by the line finders in a group of five hundred subscribers' lines is $\frac{500 \times 12 \times 2}{8} = 1,500$, giving a value of $x = 37$, in accordance with the curves.

Thirty seven line finders and thirty seven group selectors are therefore required for five hundred lines.

Exchange B therefore requires:
$6 \times 37 = 222$ line finders and
$6 \times 37 = 222$ first group selectors.

Exchange C requires:
$10 \times 37 = 370$ line finders and
$10 \times 37 = 370$ first group selectors.

Calculating the number of connectors.

The number of speaking minutes handled by the group selectors in a 500-line group is $\frac{500 \times 12 \times 1.87}{8} = 1,403$, giving $\frac{1,403}{33.5} = 42$ connectors.

Exchange B therefore requires $6 \times 42 = 252$ connectors, and exchange C $10 \times 42 = 420$ connectors.

Calculating the number of second group selectors.

1. *At exchange B.*

(a) Traffic from exchange C.

According to the above we have incoming from C to B 3,239 *Sm.*, giving

$$x = \frac{3,239}{33.5} = 97.$$

Traffic $C \longrightarrow B$ therefore requires 97 trunk lines and second group selectors.

(b) Traffic from the manual exchange A.

Incoming number of speaking minutes from A to B is 3,456, giving

$$x = \frac{3,456}{38.4} = 90.$$

Traffic $A \longrightarrow B$ therefore requires 90 trunk lines and second group selectors. Assuming an operator can connect 500 calls per hour, the number of B po-

sitions required at exchange B will be
$\frac{1,800}{500} = 4.$

2. *At exchange C.*
   (a) Traffic from exchange B.
   Number of trunk lines and group selectors as according to 1. (a), i. e. 97.
   (b) Traffic from the manual exchange A.
   Incoming number of speaking minutes from A to C is 5,760, giving
   $x = \frac{5,760}{38.4} = 150.$
   Traffic $A \longrightarrow C$ therefore requires 150 trunk lines and second group selectors.
   Number of B positions will be
   $\frac{3,000}{500} = 6.$

Calculating the number of outgoing junction lines from the automatic exchange to the manual exchange.

1. *From exchange B.*
   3,456 *Sm.* go from B to A, requiring
   $\frac{3,456}{33.5} = 104$ junction lines.
2. *From exchance C.*
   The traffic $C \longrightarrow A$ amounts to 5,760 *Sm.* during the busy hour, requiring $\frac{5,760}{33.5} = 172$ junction lines.
   The number of incoming calls to A from B and C during the busy hour is $1,800 + 3,000 = 4,800$.
   Assuming an operator can connect 500 calls per hour, the number of B positions required at exchange A for handling the traffic from the automatic exchange will be
   $\frac{4,800}{500} = 10.$

Calculating the number of registers.

The connections between the registers and the line finders are made over the register selectors. Each line finder is equipped with a register selector with twenty contact positions.

The number of calls in a 500 line group during the busy hour is $\frac{500 \times 12}{8} = 750.$

Since the time required by a register for making a connection has been established at fifteen seconds, the total time required by the registers in a group of 500 subscribers will be
$\frac{750 \times 15}{60} = 187.5$ min.

The register selectors have twenty contact positions, an hour load of $28.5 \times 20 = 570$ *Sm.* being permissible in a group of twenty lines (the value for u of 28.5 is obtained from the curve in fig. 4, for selection over 20 and a grade of service of 1 %). For this reason, one might let a group of twenty registers be common to 1,500 lines, as the total time required by these twenty registers for making connections would in that case be $3 \times 187.5 = 562.5$ min. This, however, is not practical, as only 7.5 min. would then remain in reserve. For this reason we allow each register group to be common to only 1,000 lines. The total time for connecting will then be $2 \times 187.5 = 375$ min., therefore requiring 15 registers. We now have the possibility of adding five registers per group, corresponding to an increase in traffic of about 55 % (an increase in traffic from 375 to 570).

A total of $3 \times 15 = 45$ registers is thus required for exchange B, and $5 \times 15 = 75$ for exchange C.

The figures in fig. 9 denote the number of the different switching devices arrived at by means of the above calculations. This schematic drawing now forms the basis from which the project is to be developed, at the same time giving a clear conception of how the plant has been planned and facilitating a criticism of the calculations.

After the plant has been put in operation, and by the introduction of special traffic-control devices, it is possible to check the calculated values against existing conditions. A description of such control devices will be given in a subsequent article.

G. G.

The Compañía Entrerriana de Teléfonos in the Argentine.

The Argentine is — next to Brazil — the largest country in South America as regards both area and population, a country that within the near future is bound to command the world's attention to no small degree, partly on account of its wealth of articles of export, and partly on account of its need of all manner of industrial products.

The area of the Argentine is approximately 2,800,000 sq. kilometres, or about equal to the combined area of the following European countries: Sweden, Norway, Denmark, Finland, the British Isles, Holland, Belgium, France, Switzerland, Germany and Austria.

The country extends from 22° to 55° South Lat. and offers — on account of its great range — the most varying climatic conditions; from tropical heat in the North to rigorous winter in the South, from mountain climate along the mighty range of the Andes in the West to temperate lowland climate along the shores of the Atlantic in the East.

Lying between the great Paraná and Uruguay rivers — both emptying into the so called La Plata river, which in reality more resembles a large bay — is a fertile tract of land which, on account of its location, is often called »the Mesopotamia of the Argentine» or the land between the rivers.

R 51 The Province of Entre Rios in the Argentine.

This tract of land is composed of the self-governed provinces Entre Rios in the South, next Corrientes, and in the North the province of Missiones, administered by a governor appointed by the Federal Government.

In the province of Entre Rios — whose Spanish name also means »between the rivers» — is located the telephone concern Compañía Entrerriana de Teléfonos, in which Allmänna Telefonaktiebolaget L. M. Ericsson has acquired an interest through the purchase of stock, and which, for this reason, will here be taken into closer consideration.

Entre Rios is a fertile plain, gradually changing into a marshy lowland in the South which is subject to frequent inundations and which constitutes a part of the delta of the Paraná river.

The province has an area of about 76,000 square kilometres, corresponding approximately to »Götaland» in Sweden. Its population has been subject to a considerable increase during the last years, and consists at present of about

600,000 inhabitants, which, for the most part, belong to the strong, white race, the so called creols, descendants of the latin peoples which migrated to the South American countries at an earlier period. Among these, the Basques are esqecially noted for their intelligence, diligence and law-abiding qualities.

The two main occupations in Entre Rios are cattle raising and farming, together with wonderfully developed fruit-growing in some districts (mandarins).

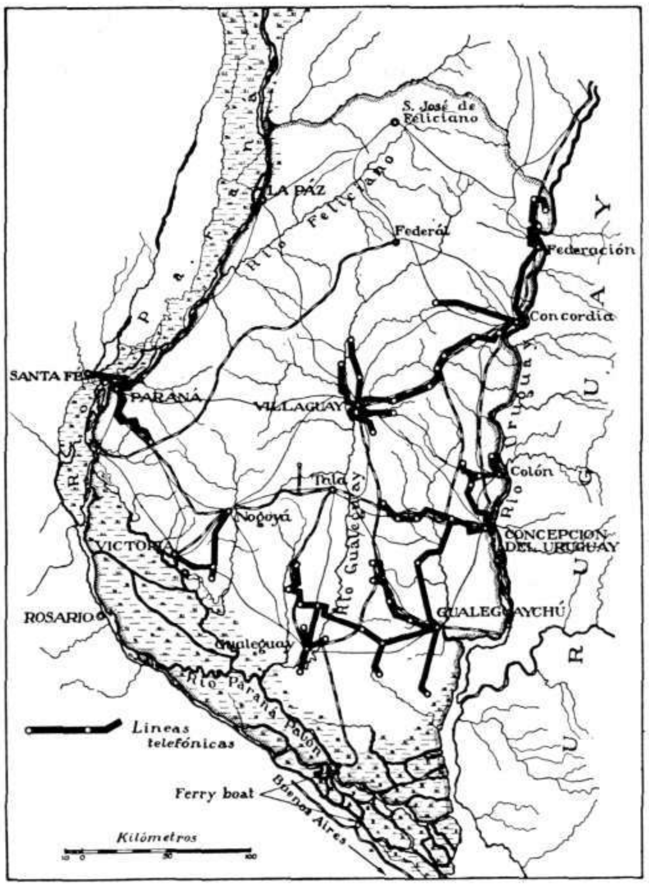
Some idea of the importance which cattle raising and farming has attained within the province, can be gained from the following figures.

The number of domestic animals in Entre Rios was — according to official statistics — in 1921:

Cattle ...	2,714,007	head
Horses ...	509,174	»
Sheep ...	2,710,355	»
Hogs ...	79,025	»
Goats ...	14,744	»
Mules ...	17,441	»

Farming products during the same year amounted to:

Wheat ...	252,113	tons
Flax	254,133	»
Corn	156,385	»



R 52 Pregent Expansion of the Interurban Telephone Net in Entre Rios.

Cattle raising — which not only produces hides and wool, but also furnishes such large packing houses as Armour, Liebig, etc. with meat — together with farming has caused business within the province to grow and flourish to a marked degree during the latter decades. The excellent shipping facilities afforded by the large rivers have also been a contributing cause to this end. Their enormous breadth and great depth permit ocean going steamers to touch at those cities and towns of the province which are located along the rivers. As a natural result excellent harbours, such as one otherwise finds only in coast ports, have been built far inland.

A good system of railways, comunicating with railways on the other side of the river by means of ferrys accomodating from ten to twelve coaches, has made complete the requisites necessary for the development of a flourishing trade.

Paraná, the capital of Entre Rios, is situated on the river of the same name and at a distance from Buenos Aires of about 400 km., measured along the course of the river, its population now being about fifty thousand. Next after Paraná we have the city of Concordia on the river Uruguay, with a population of about thirty thousand, and after that the important cities Gualeguaychú, located near the effluence of the river Uruguay into the La Plata (22.000 inh.), Gualeguay in the southern part of the province (16,000 inh.) and Victoria, also with 16,000 inhabitants.

As previously mentioned, the succesful development of trade within the province is to a large degree due to the exellent means of communication afforded by the rivers and railways, at the same time creating a demand for the further development of these same means of communication.

A few farsighted business men from among the leading men of the province, Domingo Isthilart, Joaquín Goldaracena, Benito Legerén and others, realized this fact with the result that the

R 47 Street With Pole Line in Conceptión del Uruguay.

Compañía Entrerriana de Teléfonos was formed in Concordia on the first of April 1916 for the main purpose of providing telephone comunictions for the different counties of the province.

This company started its activities by purchasing some telephone plants already in existence with a total of 937 subscribers, and, in june 1923, had reached a total of 4,200 subscribers, partly through the development of the original plant and partly through the purchase of additional nets.

When taking into consideration the adverse conditions existing during the great war with the accompanying difficulties of obtaining telephone equipment, the development of the Company during these years must be considered very satisfactory.

From the very beginning, the leading forces within the Company have planned its activities with a view towards the successive interconnecting of the various comunities within the province by means of telephone lines, and towards the popularization of the telephone by offering the public satisfactory service.

Also, no means have been spared for the attainement of this purpose and, at the present moment, the Company can boast of widespread telephone nets surrounding the various commercial centres of the province.

In 1920 the stockholders of the Company, realizing the need of support in their work and seeking at the same time to associate themselves with reliable experience in the field of telephony, proffered an invitation to Allmänna Telefonaktiebolaget L. M. Ericsson to become shareholders in the Company and take part in its management.

Carlos Rogberg, Swedish Consul General in Montevideo, and Gerhard Victorin, principal of the Concordia Business College, where he is also teacher of Spanish, have become members of the board of directors as representatives of the Swedish company.

Intense building activities have prevailed within the Company during the years 1920 to 1923, resulting, among other things, in the complete rebuilding of the old telephone plant in Paraná, which city can now boast of a modern C. B. exchange and a modern underground cable system of Ericsson's manufacture.

The building of the cable line connecting Paraná with the city of Santa Fé on the other side

R 46 »The Smallest Telephone Exchange».

R 49 One of the Docks in Santa Fé.

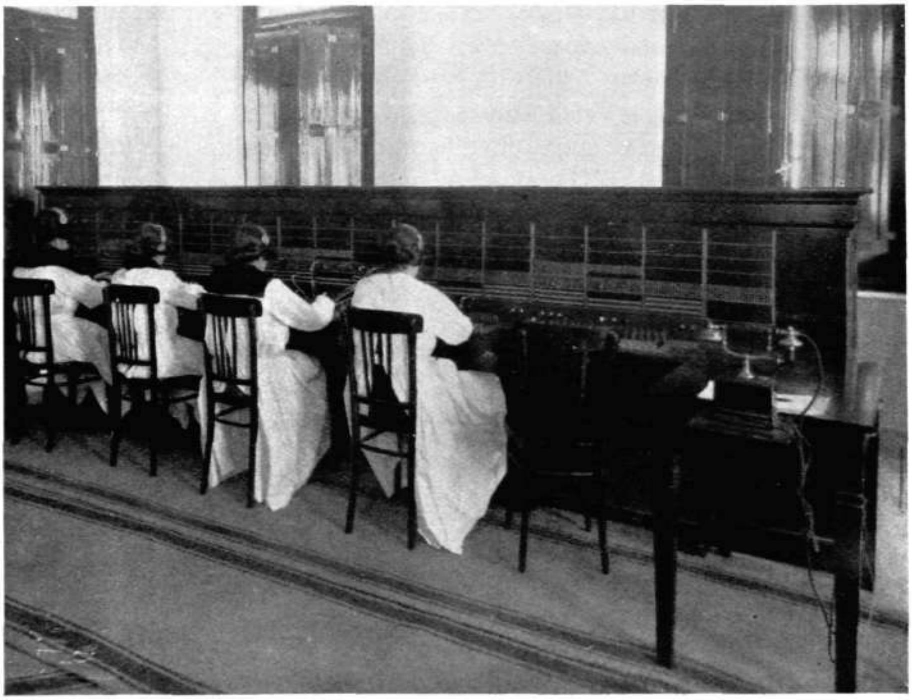
R 48 View from a »Rancho» in the Rural District of Entre Rios.

of the Paraná river, a troublesome and tedious piece of work, has been completed during the past year.

The building of this new plant has been accomplished by the Ericsson daughter company in the Argentine, Compañía Sudamericana de Teléfonos L. M. Ericsson in Buenos Aires.

The abovementioned cable line — which, together with the Paraná exchange, will be made the subject of a more detailed description in a future issue of this journal — has been the means of providing intertraffic, not only between the provinces of Entre Rios and Santa Fé, but also with the large Argentine cities of Rosario (260,000 inh.) and the federal capital, Buenos Aires (1,750,000 inh.) by means of an interurban line owned by the Argentine telephone company Telegráfico-Telefónica Nacionál.

The developments which will first command



R 45 Interior of the New Telephone Exchange in Paraná.

the attention of the Entrerriana company will consist of necessary extensions and new exchanges, first consideration being given to the installation of modern equipment, eventually for full automatic switching where conditions make it practicable.

The interconnecting of isolated parts of the telephone net by means of interurban lines, and also a second means of communication with Buenos Aires, will be given special attention. This last will eventually be accomplished by means of wireless telephone stations, providing communication without the extra work which the laying of submarine cables across the vast and marshy delta of the Paraná river would entail.

It can be stated with no small degree of satisfaction that collaboration has been established between L. M. E. and many prominent men in the Argentine. It is our sincere hope that this collaboration will result in providing the province of Entre Rios with a well developed and well operated telephone system.

It this matter, L. M. E. will naturally do all within their power to vindicate, in the Argentine, the good reputation they have earned in the field of telephony; a reputation of which plants in Stockholm, Moscow, Warsaw, Rotterdam, Mexico City and all parts of the world — ranking amongst the foremost as regards both construction and administration — give ample testimony.

R. L.

Automatic Telephone Exchange in San Sebastian.

The City Council of San Sebastian passed a decision in the latter part of May to sign a contract with L. M. Ericsson for the delivery to the city of an automatic telephone exchange.

The plant is designed for a total capacity of 20,000 lines, the initial capacity being 5,000. A number of smaller rural exchanges, also automatic, will be connected to this exchange, forming so called satelite exchanges. Therefore, these exchanges will be equipped only with line finders, connectors and their associated devices, each call to and from such an exchange being carried over the main exchange. As this plant is of exceptional interest from a technical point of view, it will be made the subject of a more exhaustive article in a subsequent issue of The L. M. E. R.

San Sebastian has a population of about 60,000, and is regarded by the Spaniards as the second capital of Spain, the Royal family as well as both the government departments and the foreign diplomatic corps making it their place of residence during the hot summer months.

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