The L. M. Ericsson Review

TELEFONAKTIEBOLAGET L. M. ERICSSON

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We have the painful duty of communicating that the Head of our Sales Department

Director

Erik Oskar Sandberg

died on the 19th August.

By the decease of Director Sandberg our firm has lost not only one of its seniors in length of service but also one of its most capable collaborators, who has efficiently held important pioneer positions and executed numerous responsible commissions over a period of about forty years.

Telefonaktiebolaget L. M. Ericsson

ENGLISH EDITION

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R 792

Carl Johan Andersson.

In memoriam.

Carl Johan Andersson, former shop superintendent of the Ericsson company, died at his home in Upsala on August eleventh at the age of 77.

Mr. Andersson had devoted his energies to this company from the time it was founded in 1876 until 1908, when he retired and made his home in the above-mentioned city. In the capacity of partner and collaborator, Mr. Andersson joined Mr. Ericsson in organizing this company and had the satisfaction of witnessing its growth from a very insignificant beginning to its present world encompassing proportions.

Mr. Andersson's quiet and considerate personality won for him a large number of warm friends. He performed his duties with care, judgement and energy, qualities with which he was highly gifted. His death means the passing of still another of the "old guard", remembered and mourned by former comrades and friends.

R 791

Erik O. Sandberg.

In memoriam.

Another veteran of the Ericsson organization has passed away, one of the pioneers who took part in the early struggles for recognition which resulted in establishing the company in the acknowledged first-rank position it has long occupied, and to which the inherent worth of its inventions and products entitled it. The ranks are thinning fast. It was only last December that we lost our Grand Old Man, the founder, and for a long time the director of the company, Lars Magnus Ericsson, and in August of this year he was followed by his first partner, Carl Johan Andersson. And now, only a few days after the last-named had been laid to rest in the quiet cemetary at Upsala, we have to report the death of Erik Oskar Sandberg.

Suddenly and without warning came the news of his death. Both of the men who had preceded him were well on in age having retired from the company many years ago, but Sandberg attended to his multifarious duties and responsibilities in the company's service with unbroken energy and seemingly unimpaired health up to the time of his death. Heart failure ended his life on the nineteenth of August, only a few hours after he had left the office.

He was not a veteran in point of age but in years of service. Although not yet 56 at the time of his death, he had been with the Ericsson company for no less than 39 years. Sandberg was born at Glanshammar, in the Province of Närke, Sweden, on the 3rd September 1871, being only 17 years old when — in 1888 — he obtained employment with the Ericsson firm. The assiduous attention of the young man to his duties and his keen interest in the work soon gained for him the goodwill of his employer. The concern at that time was of comparatively small proportions, and he was given opportunities to acquaint himself with all departments of the business, opportunities of which he conscientiously availed himself. The ease with which he acquired a knowledge of languages, furthermore, made it natural that he should be the choice of Ericsson and the latter's commercial manager, Axel Boström, for important missions in connection with the energetic efforts made at that time to introduce the Ericsson products abroad.

England was one of the earliest and most important markets of the company. The expansion of the business in that country making it desirable to establish a branch office there, the London office was opened in 1898, and the responsible and difficult task of starting and organizing the English branch was entrusted to young Sandberg. He aquitted himself with great credit of this commission, and having brought the undertaking to a successful conclusion left the management in other hands and returned to Sweden.

His sejourn there, however, was of short duration. The branch in Russia, where manufacturing had been started on a comparatively small scale already in 1897, was expanding rapidly. A factory of considerable size had been put up, and the growing business demanded the services of a man who not only was familiar with the manufacturing methods at the parent factory and the business principles of the concern, but who also possessed the personal qualities required for managing an enterprise of this kind under the peculiar conditions prevailing in Russia. Sandberg was chosen for this responsible position and entered in his new duties in 1901. Indomitable energy, unfailing patience and wide experience, together with the support of able collaborators, enabled him to overcome the difficulties with which the company had to contend during the years that followed, and which at times were so great as to suggest the advisability of shutting down the factory. In 1905, this concern was reorganized into a Russian joint-stock company, having up to that time been conducted as a branch of the Swedish parent company. From this time onward the developement of this company was both rapid and unbroken under Sandberg's leadership. In proof of this statement may be mentioned that the number of workers when Sandberg was placed in charge of the branch was about 500, while during the war, up to the Revolution in March 1917, the factory employed 3500 workers. The industrial and economic upheaval in Russia which ensued upon the successive revolutions was the cause of Sandberg's return to Sweden. He has since been employed at home, during later years holding the position of sales manager at the Stockholm factory. In this capacity his intimate knowledge of all the branches of business covered by the Ericsson organization and of the company's business connections in all parts of the world made his services extremely valuable to the firm.

The company has suffered a serious loss through the death of Sandberg, not the least because his passing away means the severing of a strong link between the present and the past.

Through his high character and fine intellectual attainments, Sandberg made himself liked and valued not only by his superiors, but by all who had opportunities to know him intimately. His unassuming and kindly disposition, his never-failing readiness to give advice and assistance, his optimistic views of life in adverse as well as prosperous situations gained him the staunch friendship of fellow-workers of all degrees. Especially characteristic for the man was the quiet strength with which he faced the many trying situations with which his life was richly interspersed, and a patience which could be subjected to the severest tests without giving way. It was Sandberg's good fortune to serve his apprenticeship in telephony under the guidance of such competent and exacting men as L. M. Ericsson and Axel Boström. He made good and faithful use of his own attainments and the knowledge he had acquired in the course of his career, and during his advancement to increasingly responsible positions he remained true to the ideals inculcated in his youth.

Erik Oscar Sandberg had colleagues and friends of older or younger generations scattered over the whole world, who received the news of his death with feelings of sorrow and loss. A strong and able man has been stricken down while he was still coping energetically and successfully with the many problems belonging to his office. An irreplaceable link in the chain of comradeship and friendship has snapped. It will be long ere his memory fades!

Hemming Johansson

R 563

R 785

The Burial of Erik O. Sandberg.

The funeral service over Erik Oskar Sandberg was held on August 25th in the Solna church, which had been tastefully decorated with palms and the many floral offerings from both near and far. The service was opened with a solo sung by B. Arrhenius, followed by a moving sermon by rector A. Hagardt, who also performed the funeral service. This was followed by another solo, after which the burial took place in the nearby Norra Kyrkogården (North cemetery). In addition to relatives and friends the board of directors and personnel of the Ericsson company were present to pay a last tribute to the deceased. His life work in the service of the company was made the subject of a short speech held at the grave side by Director K. F. Wincrantz, who also made mention — in words full of warmth and tinged with deep regret — of the serious loss suffered by the company through the death of E. O. Sandberg. Director H. Johansson brought the deceased a sincere and heartfelt thanks on the part of former comrades and friends. His unforgettable personality was held forth in a simple and touching manner by Alexander Johansson, one of the company's oldest employees, who finished by reciting some farewell verses written by himself, the last of which is here given in the language of origin:

"Höstliga löven nu falla
Lätt på din fridsälla grav
Tag nu en hälsning från alla
Tack för det goda du gav."

ANDERS LIGNELL,
Superintendent of telephones,
Stockholm

R 660

Member of the International Consultative Committee for Long Distance Telephone Communications

THE L. M. ERICSSON
AUTOMATIC TELEPHONE SYSTEM

Experiences from the Stockholm telephone net concerning the efficiency and maintenance of the system.

By A. Lignell, Superintendent of telephones, Stockholm.

The first automatic telephone exchange in Stockholm built according to the Ericsson system was put in operation in the middle of January 1924.

This exchange — Norra Vasa — was then built for a capacity of 5 000 subscribers' lines, but the installation of additional equipment — for the maximum capacity of 10,000 lines — was begun already at the end of the same year, this extension being completed during the latter part of the year 1925.

It may be of interest in this connection to mention that a trial exchange with inter-traffic with the entire telephone net of Stockholm had been in operation for a considerable length of time before the placing of the order for Norra Vasa, and that the various tests with this exchange were successfully carried out to the full satisfaction of the Swedish Telegraph Administration. At the present time there are about 6 000 automatic subscribers' lines in service. Since Stockholm has about 100,000 subscribers, the system is planned for a capacity of over 100,000 lines and with six-digit numbers for the automatic lines.

Inter-traffic between Norra Vasa and the other exchanges in the Stockholm net is handled as follows:

to the eight manual exchanges within Stockholm — with a total of about 90 000 subscribers' lines — over junction positions with call indicators (carriage call),

to subscribers with so-called »name call» (250 subscribers) and for suburban traffic (no-charge traffic to 178 exchanges with about 1 000 outgoing junction lines and 25 000 subscribers) by dialling one figure (0 and 8 resp.) thus automatically connecting up the calling subscriber with a disengaged B-operator,

for placing orders for toll calls, by dialling the figure 9, thus automatically connecting up the calling subscriber to a disengaged record distribution operator. In Stockholm, orders for toll calls are recorded by the toll operator for the wanted route or, in event of large toll routes, by special record operators, who generally also handle the incoming toll traffic over one line. Arrangements for co-operation between the record operators have been made.

The traffic to the automatic exchange is handled at Norra Vasa partly over semi-automatic key boards and partly over manual junction boards, the toll traffic being also directed over similar toll junction boards on account of the many advantages which accompany the manual handling of this service.

Now that this exchange has been in service for so long a time that the experience gained as to the traffic efficiency and maintenance cost of the system can be considered fully reliable, it may be of interest to place this information before the general public.

Traffic efficiency.

We may as well state once for all that our experience of the Ericsson system has been most satisfactory. The efficiency of the traffic has been supervised during the whole time the exchange has been in service by means of a special traffic control desk.

This desk puts the supervisor in a position to reach any of the registers and, by means of a control register, to follow the dailling of a number by the calling subscriber and thereafter to ascertain whether the subscriber obtains the desired connection or whether he has dialled the wrong number; also, during the subsequent conversation, she can observe any existing disturbances or irregularities in the connection. The registers can be blocked by means of a special key, thus locking a call connection for the purpose of establishing the nature and locality of a fault.

For the supervision of conversations, the supervisor switches in on a connection at the outset of a call, notes the dialled number, ascertaines that an answer is received, that the calling subscriber is connected to the desired number and, finally, that the conversation proceeds without any interruption. If a faulty connection occurrs, the supervisor locks the same and an investigation is made to discover the cause of the fault. The supervisory control period which ended in November 1926 included 31,507 fully supervised calls comprising 28,461 calls from automatic subscribers directed over call indicator junction positions at manual exchanges and 3,046 calls between automatic subscribers, whereby all the registers were systematically tested.

The results of this supervisory control are given in the following.

Table I.

Full automatic traffic.

(between two automatic subscribers' stations)

Number of supervised calls	3 046			
of which	2 772	or	91.01 %	faultless
and	274	»	8.99 %	faulty
Total	3 046	or	100.00 %	

In the faulty calls, the faults were assigned to the following categories:

a. Action on part of subscriber	234	or		7.68 %
b. Automatic system:				
localized	29	or	0.95 %	1.15 %
not localized	6	»	0.20 %	
c. Causes not referrable to automatic system, but localized to outside line of calling subscriber	5	»		0.16 %
Total	274	or		8.99 %

Table II.

Traffic from automatic subscriber's station directed over call indicator junction position at manual exchange.

Number of supervised calls	28 461			
of which	26 384	or	92.70 %	faultless
and	2 077	»	7.30 %	faulty
Total	28 461	or	100.00 %	

In the faulty calls, the faults were assigned to the following categories:

a. Action on part of subscriber	1636	or		5.75 %
b. Automatic system and call indicator positions:				
localized	196	»	0.69 %	0.96 %
not localized	78	»	0.27 %	
c. Technical arrangements independent of automatic system and localized to outside line	44	»		0.16 %
d. Action on part of operator	112	»		0.39 %
e. Causes of a temporary nature (installation work, etc.)	11	»		0.04 %
Total	2077	or		7.30 %

The above figures show that the total number of faults which occurred in the traffic between automatic subscribers amounted to 8.99 % of the total number of calls while for traffic over call indicator junction positions the corresponding figure was 7.30 %.

A closer scrutiny of the distribution of the faults among the various above-mentioned causes shows that 7.68 of the 8.99 % and 5.75 of the 7.30 % were caused by the subscribers themselves. This large percentage of faults caused by the subscribers — a very large figure, according to our standards — has its natural explanation, however. It is clear that the correct use of the calling dial as well as the memorizing of 6-digit numbers has not yet become second nature with the subscribers. Furthermore, those of the subscribers who do not themselves have automatic telephones but who occasionally use them when visiting the sections of the city where such instruments have already been installed are naturally still less trained in the manipulation of the dial; also, one must bear in mind that in Stockholm children start using the telephone at a very early age. However, this fault percentage is experiencing a steady decline. For instance, in May 1925, when about 300 subscribers' lines were cut over, it amounted to about 15 % compared with 7.68 % in November 1926.

It may seem surprising that the fault percentage on the part of the subscribers is about 2 % higher for full automatic calls than for calls over call indicator junction positions. It has been found, however, that for traffic within the Norra Vasa area, the subscribers often dial the digit 1 instead of the 3 of the Norra Vasa exchange as the first digit in the 6-digit telephone number. This, again, can be traced to the fact that most of the present manual subscribers with numbers that are not preceded by the name of an exchange have numbers beginning with the figure 1. Faults of this kind may also be classified as infantile diseases of telephone culture.

If we pass over to those faults that may be attributed to automatic apparatus and devices we find that for traffic between automatic subscribers the number is 1.15 % and for traffic over call indicator junction positions 0.96 % of the total number of calls.

The faults which constitute the former figure number thirty-five, of which twenty-nine were localized while in six instances it was not possible to lock the call in time or else the locality of the fault was not found in time.

The twenty-nine localized faults are distributed as follows:

Table III.

	Number of faults	Percentage of 3046 calls	Percentage of number of faults (29)
Contact faults in registers and relays appurtenant thereto	23	0.76	79.31
1st group selectors	1	0.03	3.45
Sequence switches and relays appurtenant thereto	1	0.03	3.45
Lines within the automatic exchange	1	0.03	3.45
Calling dials on subscibers' instruments	3	0.10	10.34
Total	29	0.95	110.00

For traffic over call indicator junction positions, 196 of the 274 calls whose faults were attributed to the automatic system and which constituted 0.96 % of the total number of supervised calls, were locked in time. The localized faults are distributed as follows:

Table IV.

	Number of faults	Percentage of 28, 461 calls	Percentage of number of faults (196)
Contact faults in registers and relays appurtenant thereto	109	0.38	55.61
Mechanical faults in selectors	7	0.02	3.57
1st Group Selectors	33	0.12	16.84
Sequence switches and relays appurtenant thereto	5	0.02	2.55
Line within autom.exchange	3	0.01	1.53
Buzzer	1	0.00	0.51
Call indicator junction positions and devices appurtenant thereto	16	0.06	8.16
Calling dials on subscribers' instruments	22	0.08	11.23
Total	196	0.69	100.00

A comparison between these figures and corresponding figures for the manual system in Stockholm with about 70 % junction calls may be of special interest.

The supervisory control periods in May and November 1926 for the manual traffic show the following results:

Table V.

	May			Nov.		
Number of supervised calls	8650			7862		
of which faultless	8361	or	96.66 %	7571	or	96.30 %
faulty	289	»	3.34 %	291	»	3.70 %
Total	8650	or	100.00 %	7862	»	100.00 %

In the faulty calls, the faults were assigned to the following categories:

	May			Nov.		
a. Action on part of subscriber	107	or	1.24 %	98	or	1.25 %
b. Action on part of operator	114	»	1.32 %	143	»	1.82 %
c. Joint action on part of subscriber and operator	48	»	0.55 %	34	»	0.43 %
d. Technical arrangements	20	»	0.23 %	16	»	0.20 %
Total	289	or	3.34 %	291	or	3.70 %

A comparison with the full automatic service (Table I) shows the faulty calls with manual service to be from 3.34 to 3.70 % against the 8.99 % with automatic service. However, if we deduct the faults caused by the subscribers themselves, in both cases, we obtain a remainder of 1.31 % for the automatic service against 2.10 to 2.45 % for the manual service.

An increased familiarity with the automatic system on the part of the public will doubtlessly considerably reduce the mean total percentage of faults occurring in automatic traffic. Also, when judging the advantages of automatic service in a large telephone net with considerable junction traffic, one must not neglect to take into consideration the important gain as regards the disconnecting times which an automatic system offers.

Test calls.

During the time between April 19th and May 31st 1927, 6817 full automatic test calls were made by a chief operator at Norra Vasa. This testing was so arranged that from each five-hundred group about five hundred calls were made, distributed among the five-hundred groups occupied by subscribers' lines (14 groups).

The results of this testing are given in the following.

Table VI.

Number of calls	6817		
of which	6758	or	99.13 % fautless
and	59	»	0.87 % faulty
Total	6817	or	100.00 %

Specification of faults.

Faulty connection	27	or	0.40 %
Incomplete »	13	»	0.19 %
No register tone	1	»	0.02 %
The register tone does not cease	1	»	0.02 %
No calling signal tone	4	»	0.06 %
False busy signal	11	»	0.16 %
Signal not heard by subscriber	1	»	0.01 %
Contact with other subscriber's line	1	»	0.01 %
Total	59	or	0.87 %

Of these 59 faults, 57 were localized and distributed among the following categories:

Automatic system:				
localized	51	or	0.75 %	0.78 %
not localized	2	»	0.03 %	
Causes not attributed to autom. system, localized to outside line of calling subscriber	4	»		0.06 %
Faults of a more temporary nature	2	»		0.03 %
Total	59	or		0.87 %

Distribution of the 51 faults localized to the automatic system:

	Number of faults	Percentage of 6817 calls	Percentage of number of faults (51)
Contact faults in registers and relays appurtenant thereto	32	0.47	62.75
Mechanical faults in registers	3	0.05	5.88
2nd Group Selectors	1	0.01	1.96
Sequence switches and relays appurtenant thereto	14	0.21	27.45
Lines within automatic exchange	1	0.01	1.96
Total	51	0.75	100.00

From the above we find that the percentage of faults which can be attributed to the automatic system does not amount to more than 0.78, truly a very good result.

In Stockholm, the week day traffic at present amounts to about 850,000 calls.

Monthly reports of complaints lodged by subscribers, specified as to the various causes of these complaints, are made out, the complaints against each separate local exchange being given in the number per thousand subscribers during the month and also per 10,000 calls.

Thus, it was found that the average figures for the time March 1926 to February 1927 were as follows:

Complaints per thousand subscribers during one month:

At the manual exchanges	5.90
At the automatic exchange	2.00
Complaints per ten thousand calls:	
At the manual exchanges	0.18
At the automatic exchange	0.11

Maintenance.

The Norra Vasa exchange, with 6 000 subscribers' lines in service, does not require a maintenance force of more than seven men, this number having been found more than sufficient. The following men are employed:

1 foreman,
2 head repairmen,
3 assistant repairmen,
1 handy man, for sweeping, dusting, etc.

The total maintenance force for a 10,000-line exchange with an intensity of traffic equal to that of Norra Vasa with seven calls per line and day should not amount to more than eight men. For exchanges with still larger capacities, certain cost items, such as maintenance of the power plant, night watchman's salary and — with the Ericsson system — also for keeping the premises clean, are considerably lower. The new Stockholm exchanges now under construction — Central and Kungsholmen — which will be completed during 1928 will have initial capacities of 20,000 and 15,000 lines respectively, the four remaining automatic exchanges being projected for an initial capacity of 20,000 to 30,000 lines each. A force of nine men for 10,000 lines will undoubtedly be ample.

With 2 400 working hours per man and year, this will mean

$$\frac{9 \times 2400 \times 1000}{365 \times 9000} = 6.58 \text{ maintenance}$$

hours per 1 000 subscribers and day, or 2.40 hours per subscriber and year, assuming that only 9 000 lines are connected up for service, which is the case in actual practice.

At the present time, the capacity of the Norra Vasa exchange is 10,000 lines, switching devices for 8 000 subscribers being installed. Their number is as follows:

Line finders	496	
First group selectors	496	
Second » »	140	(for full autom. traffic)
» » »	60	(for incoming semi-autom. traffic. A part of the incoming traffic is directed over B-positions)
Connectors	412	
Total number of selectors	1604	
Registers	114	

The total number of calls during January 1927 amounted to	1,073,891
Number of calls during busy hour	4,225
» » » per busy hour and subscriber	0.7

The traffic is exceptionally evenly distributed throughout the day. The faults occurring during January were as follows:

in the selectors	25.0
in the registers	11.0
per 100 subscribers and month	0.6
» 100 selectors » »	1.6

Unwarranted disconnecting of calls has not occurred during the entire control period, neither has there been any trouble in the contacts between the contact arms of the selectors and the multiple wires during the entire three years of operation. The continuous control of the efficiency of the traffic has given satisfactory evidence of the efficiency of the maintenance.

The February 1926 number of 'Zeitschrift für Fernmeldetechnik, Werk- und Gerätebau' contains an article in which the author, Dr. Lubberger of Berlin, makes a purely theoretical comparison between step-by-step selectors and machine driven selectors.

After some argumentation which, however, is not supported by any adduced proofs founded on actual experience, the author arrives at the conclusion that a step-by-step selector is superior to a machine driven selector. Mr. G. Deakin of Antwerp has profited by this occasion to take up the defense of the machine-driven systems, for which purpose he has produced some interesting figures bearing on the efficiency of traffic and on the maintenance of automatic telephone exchanges. Mr. Deakin makes the statement that "reliable statistics gathered from systems in actual operation are the only decisive factor when judging the advantages of one system as compared with those of another system, and no such proofs have been produced by Dr. Lubberger". Further, Mr. Deakin states that "efficiency in operation is the watchword of automatic telephony. No other arguments are of any value if this important requirement is not filled. If no reliable figures are obtainable as to operation it is impossible to know how a system will function in actual practice and where faults are liable to occur".

Mr. Deakin must be seconded in his above cited views. When comparing various systems, it is quite natural that cost of maintenance and efficiency in operation should be considered as decisive factors, and all the more so with the ever increasing demand for service with the highest possible degree of efficiency. During the present year, Siemens and Halske have published an exerpt from 'Zeitschrift für Fernmeldetechnik, Werk- und Gerätebau' Nos. 5 & 6, 1926, entitled 'Betriebserfahrungen bei der Instandhaltung der Automatischen Fernsprechämter in Amsterdam' by engineer-in-chief Dr. Ir. K. C. E. Maitland and containing quite a bit of statistical information as to the operation of the Strowger plant in Amsterdam installed by the above-mentioned company.

It is of decided interest to compare Deakin's and Maitland's figures with our own experiences from the Ericsson automatic system, a comparison — both as to maintenance and efficiency of operation — which we are sure will prove of equal value to all those who are interested in automatic telephony. Figures on the supervisory control of the subscribers' calls, in similarity with those here given for Norra Vasa in tables I to IV, are regrettably missing in Maitland's report, but even though the available figures be studied with all possible circumspection it will be impossible to make a decision in favour of the step-by-step type of selector.

The above statements give sufficient evidence that the Ericsson system has met very high expectations both as to efficiency and low cost of maintenance. As far as I know, the results obtained in Stockholm are the best official ones hitherto published with regard to any automatic system.

Stockholm den 28 juni 1927

C. Lignell

R 735

The Skövde and Herrljunga Interlocking Plants.

By Captain T. H:son Almqvist, signal engineer district II of the Swedish Gov't Ry. service.

When planning the interlocking plants for Herrljunga and Skövde in District No. II of the Swedish Gov't Railways, the fundamental idea was to have an interlocking machine which need be manoeuvered only for the movements of trains and only by the train dispatcher himself.

Both of these interlocking plants have been delivered and erected by Signalbolaget, Stockholm, sales company for railway signal and safety devices manufactured by L. M. Ericsson and by the Avos company of Örebro. The greater part of the electric devices in these plants are of Ericsson manufacture.

The Skövde plant.

The Skövde station serves its purpose mainly as a through station, as all the trains on the main line Stockholm—Gothenburg pass through it. The trains from Karlsborg, however, do not run further than Skövde.

The area covered by this plant is shown on the track plan in fig. 1. Special mention should be made of the fact that the starting signals for the side tracks can be used for all the sidings in the station yard, so that — when the traffic is heavy — a certain train (freight train) may leave the station on a given signal no matter whether it is standing on a locked track or not.

R 776 Fig. 2. The Interlocking Machine at Skövde.

As already mentioned, the interlocking machine is not manned except during the passage of a train. For shunting purposes, the points provided with central control are set locally: consequently, there is no necessity to manoeuver the interlocking machine on such occasions.

The plant is provided with an electric interlocking machine of standard type (see fig. 2), placed in the signal cabin (fig. 3) on the north side of the station building. The interlocking machine is provided with nine point and skotch block levers, five point locking levers, two levers for manoeuvering the crossing gates, and thirteen signal levers. A switchboard for power distribution, an illuminated track plan and the necessary relays are also mounted in the signal cabin. The track plan is placed at eye-level on the wall in back of the interlocking machine, and is a true reproduction of the entire track system. The various track sections (track circuits) are shown on this plan. A small electric lamp — one for each section — denotes whether a section is clear or not, a glowing lamp indicating a clear section. By observing this track plan, the train dispatcher can follow the various train movements and switching operations out in the station yard. The relays are mounted in a special cabinet with glass doors, under the track plan. Cabinets with signal indicators, whose lamps are on the same circuits as the regular signal lamps, are also placed under the track plan. These signal indicators show the positions of the signals.

All the signals are electric day signals. Since the main line through Skövde is electrified, the light signals have — as far as possible — been mounted on the posts and gantries which support the wires for the traction current (see figs. 4 & 5). Where this was not feasible, concrete posts have been erected for this purpose.

The signals are controlled by means of signal relays (D. C. relays) mounted in the signal cabin, these relays, in turn, being actuated by the aid of the signal

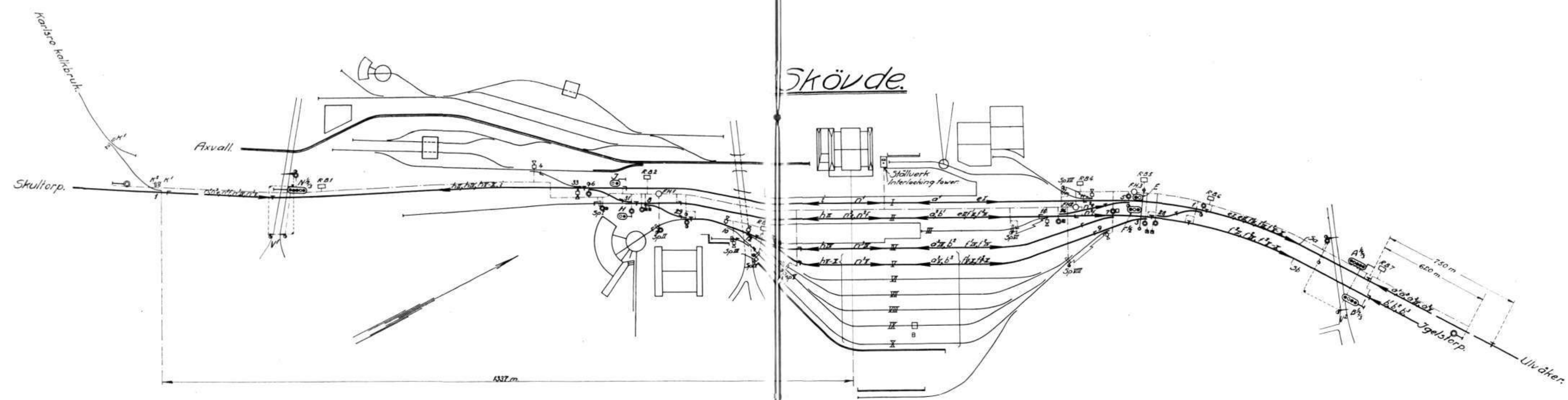


Fig. 1.

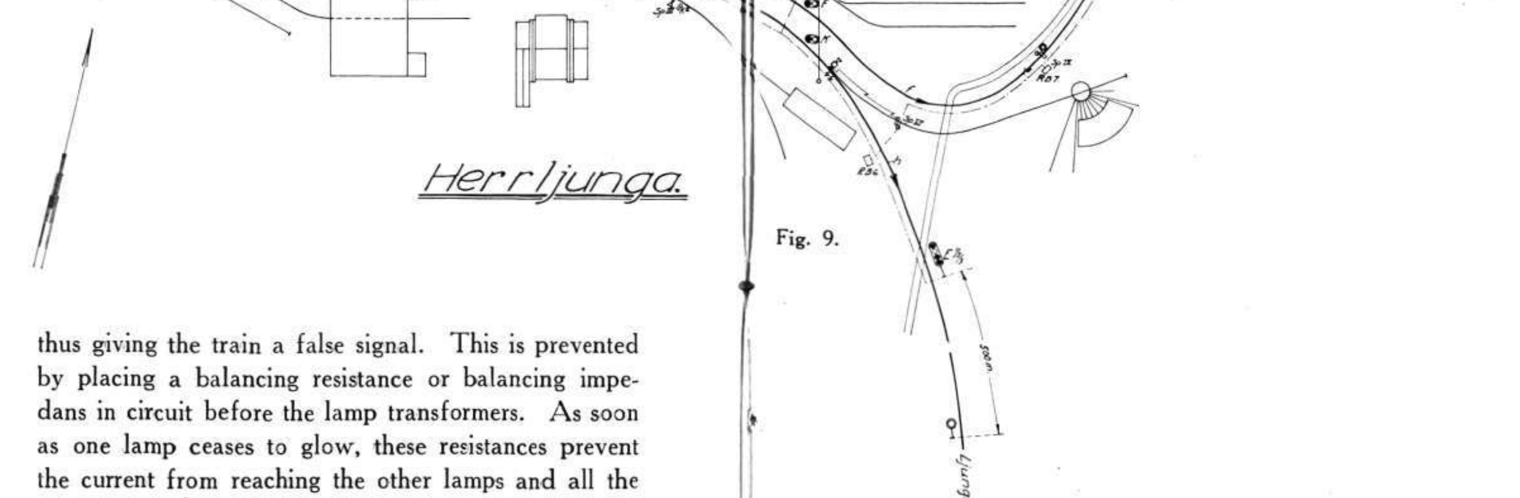



Fig. 9.

levers in the interlocking machine. The signal relays are also influenced by one or more of the abovementioned track circuits, so that a signal cannot be set to "clear" as long as a track section forming a part of the track in question is occupied by any form of rolling stock.

The lights of the signals conform to the formation of the night signal of a semaphore, i. e. a red light means "stop", and one, two or three steady green lights means a clear incoming main or side track respectively.

When a signal consists of two or three green lights, it is possible that one of the lights does not burn, thus giving the train a false signal. This is prevented by placing a balancing resistance or balancing impedans in circuit before the lamp transformers. As soon as one lamp ceases to glow, these resistances prevent the current from reaching the other lamps and all the green lights are extinguished.

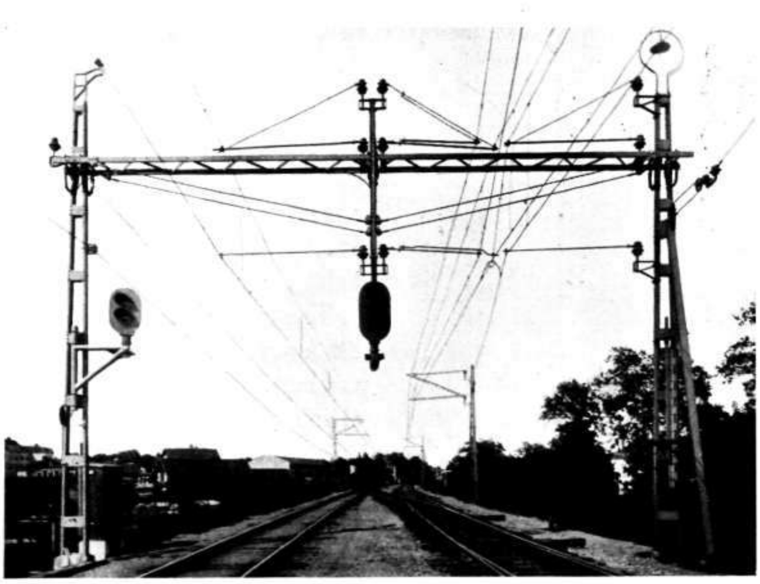
In addition to the normal, front lamp, all red signals are provided with an extra rear lamp, the current for this lamp passing through a resistance to reduce its voltage. If the front lamp should not burn, the rear lamp will show a weak but still quite discernible red light.

The light signals receive their current (110 volts, 50 cycles) over a feed line from the interlocking machine. Transformers, mounted in cabinets in the vicinity of the respective signals, reduce the tension of this current to about 12 volts. A good luminosity is obtained with this low voltage, since the glowing substance, which is relatively small, can be concentrated in the theoretical focus of the lens system.

The advance signals used by the Swedish Gov't Railways have both green and white intermittent flash-lights. Green indicates that the co-operating main signal is set to "stop"; the white one, that it is set to clear. Since certain trains pass through Skövde over the main track without stopping, it was found desirable to provide the main starting signals with advance signals, so as to advise the locomotive engineer as soon as possible of the position of the starting signal. This has been arranged by using one of the green lights of the home signal — the third one — for a green flash-light, and by placing a white flash-light in the unoccupied space between the second and third green lights (the right hand signal in fig. 4). These two flash-lights serve as advance signals for the starting signals of the main tracks so that at the same time as a steady green light at the head of the signal mast indicates a clear incoming track, a green flash-light at the foot of the mast indicates that the corresponding starting signal in the direction of the incoming train is set to stop. If this starting signal should be set to clear, this is indicated by means of a white flash-light instead of the green. Should the incoming or home signal be set to stop, or — by means of one or two green lights — indicate that the incoming train is being directed to a side-track, the position of the starting signal is not indicated on the home signal.

R 777 Fig. 3. The Skövde Signal Cabin.

R 778 Fig. 4. Home Signals at Skövde for Trains from Stockholm (Ulvåker) and Karlsborg (Igelstorp).



R 779 Fig. 5. Starting Signals at Skövde for Trains to Stockholm (Ulvåker) and Karlsborg (Igelstorp).

The current for the advance signal of the starting signal is obtained over the signal relays of the starting signals and home signals in question.

All the local point setting arrangements are constructed according to the principle adopted by the Swedish Gov't Railways, comprising an electric switch located near the point and which energizes a relay mounted in the signal cabin. When the relay energizes, the control circuit for the corresponding point lever in the interlocking machine is broken, a circuit which furnishes current to the switch motor being simultaneously closed. If the control magnet contacts do not break the circuit when the point is set locally, a special relay is provided which then energizes and closes an alarm circuit, simultaneously cutting the supply of control current for the entire interlocking machine and causing all the signals to be set to stop.

Those points and skotch blocks which are not controlled by the interlocking machine but nevertheless must be included in the installation, are provided with a locking device (see fig. 6). Contacts actuated by the point itself close a current over a locking magnet on the locking lever, naturally on condition that the point is in a position permitting of its being locked. If this is not the case, the locking lever cannot be set.

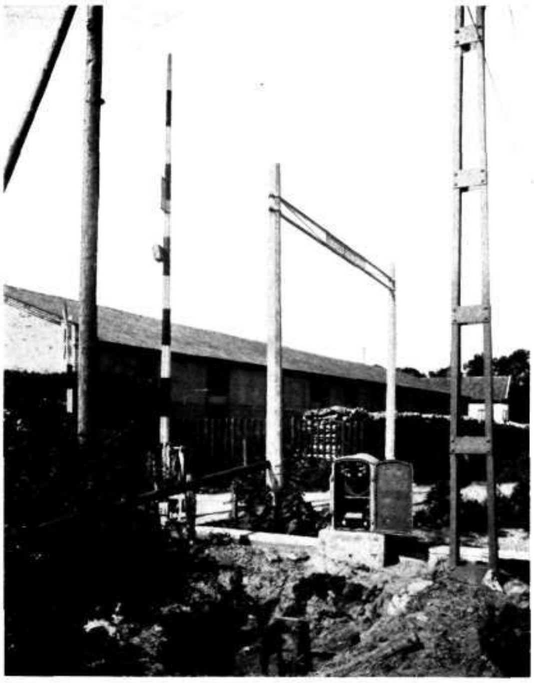
The *crossing gates* at both ends of the station yard are also power driven and controlled by means of levers in the interlocking machine. The signal relay

R 780 Fig. 6. Locking device.

current is influenced by the position of these gates. When a train for which the gates have been lowered enters a certain track section, the crossing gate lever in the interlocking machine can be restored to normal, but the gates will not be raised until the train has passed the crossing. The motors which raise and lower the gates, as well as the switch machines, are for d. c. One of the bars of the crossing gates at the north end of the station yard is shown in fig. 7. The electric driving mechanism is free-standing and connected to the mechanical actuating devices between the gates.

As already mentioned, the illuminated track plan in the signal cabin (see fig. 2) shows the tracks and points at both ends of the station yard. Since the middle portion is under the direct supervision of the train dispatcher, a saving has been effected by excluding it from the track plan.

The various tracks are divided up into fifteen insulated track sections. The track relay for each section is placed in a wooden cabinet beside its respective section. The positions of the track relays are repeated by special d. c. relays mounted in the signal cabin, which close circuits to the different lamps mounted behind the track plan. Further, the circuits providing current for the various signals are closed over these relays in various contact combinations, and the relays

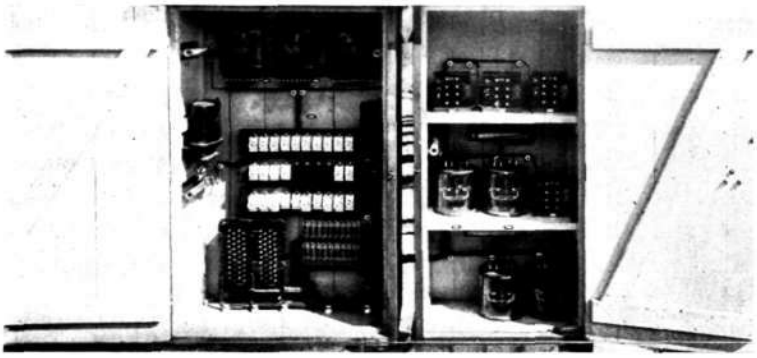


R 781 Fig. 7. Crossing Gates at the North Grade Crossing, Skövde.

are used for various other purposes, such as track releasing, point locking etcetera.

The track circuits are fed by a 220-volt 50-cycle alternating current with the exception of the one farthest to the South, which is fed by battery current. The alternating current is transformed down to a suitable voltage by the track transformers.

The electric traction prevents the use of more than one rail as a conductor for the signal current. The other rail must continue uninterruptedly so as to serve as a return conductor for the $16^2/_3$-cycle traction current. This return current is responsible for a certain drop in tension in the return rail, this drop, in turn, creating a current over the track relay and the track transformer. In order to prevent the energizing of the track relays by means of this current, frequency relays are used. The track relays used in Skövde are so-called double vane relays, built so that if the strength of the $16^2/_3$-cycle current should depass that

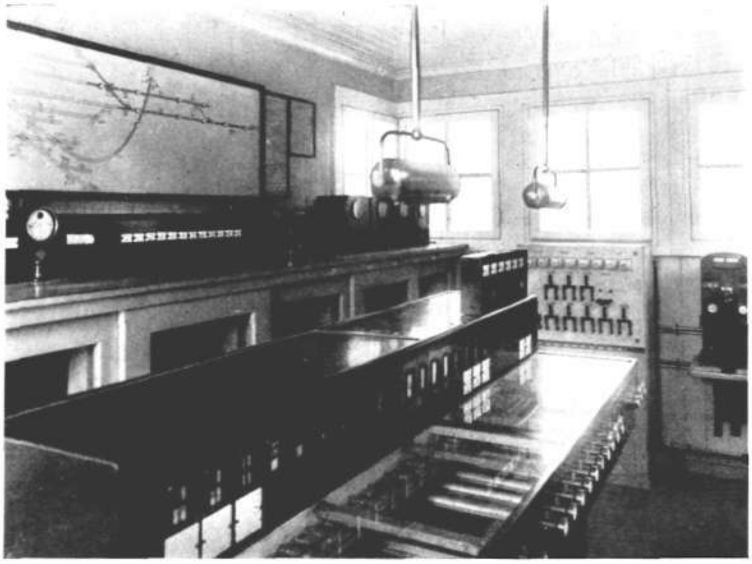


R 782 Fig. 8. Cabinet No. 2 at Skövde.

of the 50-cycle current by a certain margin, the relay is de-energized and the front contacts are broken. A resistance of about 0.7 ohms is connected in series with the relays for the purpose of limiting the traction current to a certain value in the relays.

The a. c. relays are energized by a normal pole tension of two to three volts, the current in the track circuits having a tension of about six to eleven volts. The current over the relay maintains a strength of about 8.5 amperes.

The d. c. track circuit is fed with current from a battery of Edison soda cells. In order to provide protection against the determinal influence of the traction current, a suitably proportioned choke coil and a resistance are connected — the first in series and the latter in parallel — with the relay.



R 783 Fig. 10. The Interlocking Machine at Herrljunga.

The a. c. relays are de-energized when a shunt of about 0.75 ohms is established between the rails, the d. c. relay doing likewise for a shunt of about 0.5 ohms. During the passage of a train, this shunt is not more than $^{1}/_{1000}$ of an ohm.

The road is almost entirely ballasted with gravel, macadam or crushed stone being used at the points only.

As previously mentioned, the transformers for the light signals as well as the track relays and track transformers are mounted in small wooden cabinets placed beside the track sections out in the station yard. The cabinets are placed so that the fall in tension in the lines on the secondary side shall be as small as possible. They accomodate transformers and resistances, as well as the cable terminal boxes, which are mounted furthest down in the cabinets. In fig. 8 (cabinet RB/2 in Skövde), the cabinet to the left contains six track transformers, fuses, resistances, porcelain terminal blocks and two cable terminal boxes, while in the right hand cabinet are mounted four signal transformers, four track relays and transformers.

All the cables are made according to the specifications of the Royal Swedish Railway Administration, each conductor having a cross section of 2 sq.mm.

The necessary current for the interlocking plant is furnished by two storage batteries, the one — a 130 volt Tudor battery — for the switch machines and locking devices, the other — a smaller 30 volt battery — being for the control current, signal lights and repeating relays. These storage batteries are mounted in a special addition to the signal cabin, shown in

R 784 Fig. 11. The Herrljunga Signal Cabin.

fig. 11 (signal cabin in Herrljunga). The necessary feed current is obtained from the railway's own power line, which furnishes a single phase, 10,000-volt 50-cycle current. This is transformed down to 2×110 volts at which tension it enters the previously mentioned distribution board. The current for charging the storage batteries is rectified by means of a mercury vapour rectifier, which is visible to the right above the relay cabinet in fig. 2.

The Skövde plant was put in operation on June 30th, 1927.

The Herrljunga plant.

The interlocking plant at Herrljunga is built in accordance with the plan shown in fig. 9 and on the same principle as the Skövde plant.

The interlocking machine (fig. 10) is mounted in the signal cabin (fig. 11) and is equipped with six point and skotch block levers, six locking levers and eight signal levers.

This plant differs from the one in Skövde in the following respects:

For economical reasons, the points and skotch blocks in the tracks leading to and from Vedum and Ljung are not provided with locking devices, but are only under control. The control current passes over point contacts and control magnets, these latter being mounted in a separate cabinet above the interlocking machine. The control magnets indicate which track has been cleared and this can be observed through the small indicator windows, the signal combination for the cleared track being formed when the signal lever is set. The switching current for the signals controls the position of the points so that the laying over of a switch in a track that has already been cleared will cause the clear signal to be reset to stop.

These points and skotch blocks which are under control only are so near the interlocking machine as to be under the direct supervision of the train dispatcher.

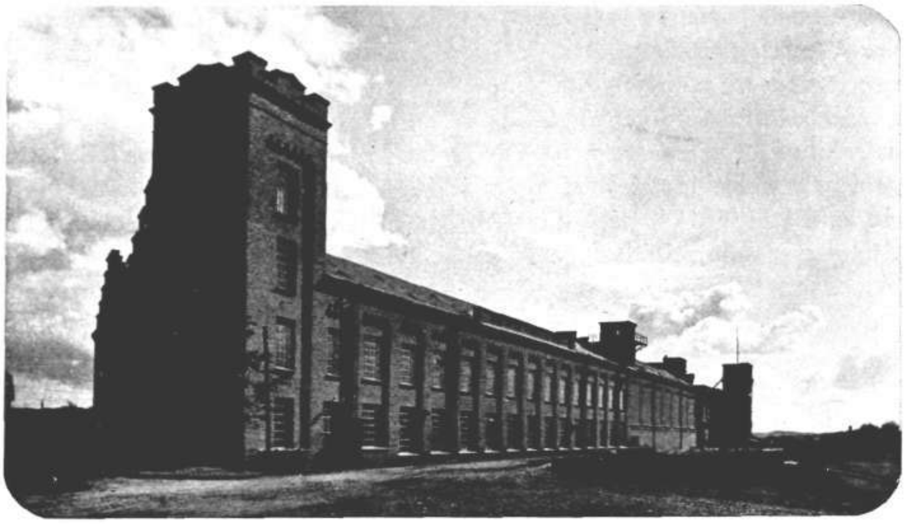
A special distance signal has been placed at the west end of the station yard, as it often happens — on account of the form of the station yard — that the locomotive of an extra long freight train stands beyond its own starting signal, in which case the train is given a starting signal by means of the above-mentioned distance signal.

Skotch blocks on all the main tracks have been provided at the grade crossing at the east end of the station yard. A clear signal cannot be given for a train until the skotch blocks have been placed over all the tracks which cross the main tracks in question.

The plant is also equipped with two alarm bell aggregates for road crossings, one at each end of the station yard. These alarm systems work automatically, a continuous signal being given by the alarm bell while a train is passing over a certain track section, depending on which signal has been set to clear. The alarm system at the west crossing, on the other hand, always rings for incoming trains, no matter whether the home signal is set to clear or not.

Lastly, we will find that at Herrljunga 2-phase relays of the latest Westinghouse type have been used for certain track sections — "two element, two position, frequency selective vane relay, style 'L'." These are the first relays of this type delivered by the company. They are frequency selective even though a $16^{2}/_{3}$-cycle current should enter both the local and track phase at the same time. The local phase has a tension of 110 volts, the track phase having a normal tension of 2 to 2.6 volts. The pole tension of the relay is then about 1.9 to 2.4 volts. The normal strength of the current through the relay is 1.03 to 1.21 amperes.

The Herrljunga plant was put in operation on June 22nd 1927.

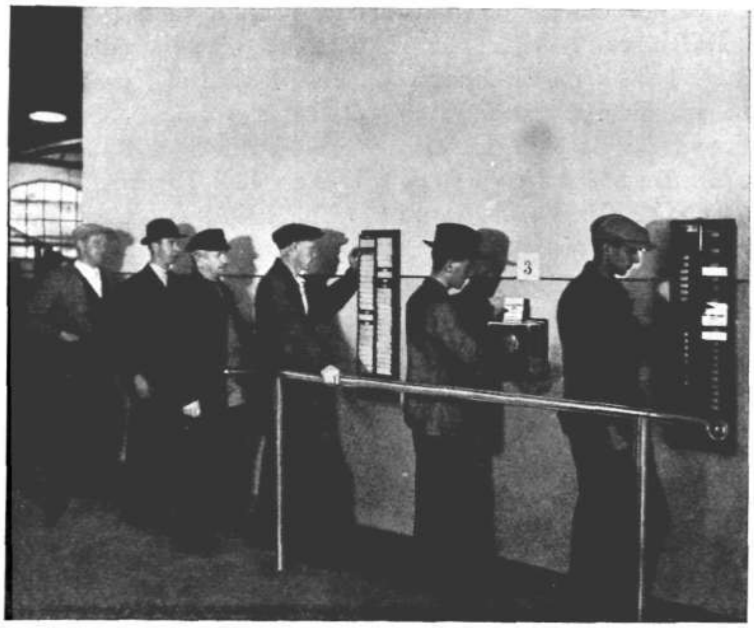


R 769 Borås Weaving Mills, Kungsfors Works.

Time Control and Efficiency.

By Alexander Engblom, chief engineer, Borås Weaving Mills, Sweden.

Increasing competition in all branches of industry make it imperative that the working hours be used to the best possible advantage. Constantly recurring losses of time, even though they do not amount to more than but a few minutes per man and day will, by the end of the year, add up to a surprisingly large figure. For instance, if each man in a force of one thousand men wastes three minutes every day, the total time loss by the end of one year will amount to 15,000 hours.



R 768

The serious disadvantages which accompany such losses cannot be but evident, even in cases where the timework system is not applied. Also with piecework the decrease in production occasioned by the time loss means a corresponding increase in overhead and poorer results for the company from a financial point of view.

For these reasons, attempts have been made to devise some form of time control or time keeping system that will eliminate the abovementioned disadvantages. One well known system which has been extensively used is the one with brass checks in which the worker, on entering the premises, receives a check on which his number is stamped and hands it in again when leaving. In some cases, the closing of the gates at a certain time is practiced in connection with this system. The checks are counted and the gates closed and opened by a timekeeper, who thus is in a position to keep track of the presence or absence of the workers.

This system, however, has quite a number of disadvantages, one of the greatest being that the worker is dependent on the sympathy or antipathy of the

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BORÅS WÄFVERI AKTIEBOLAG

Avd. Wiskaholm

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Kortet skall stämplas egenhändigt

R 785 a

timekeeper. Also, it does not — generally speaking — make it possible to check up the actual working time, but merely indicates whether the worker is present or absent.

For this reason the use of time clocks, which — in some way or other, either by means of cards or paper bands — register the actual time of arrival and of departure for each worker, have come into general use.

This system has the advantage of registering all times impartially, thus, in a way, making every worker his own timekeeper. Also, the timekeeping is placed more under the direct supervision of a superintendent instead of in the hands of some subordinate employee. The importance of this fact from a disciplinarian point of view need hardly be accentuated.

The various points of view which have here been

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set forth should make it apparent that a rational time control system is of invaluable aid to every manufacturer in his efforts to get the best possible results with the means at his disposal. It is necessary, however, to arrange the time control in the manner most suited to the existing conditions.

Aside from purely local points of view, the time clocks should be placed with due consideration for the desirability of letting the workers attend to their various preparations for work — such as change of clothing etc. — before punching the time clock. If possible they should be set up in the immediate neighbourhood of the place of work, thereby affording the advantage — from a psychological point of view — of making the time punching operation an integral part of the work itself. Also, in this manner, the registered time will correspond more accurately with the net working time.

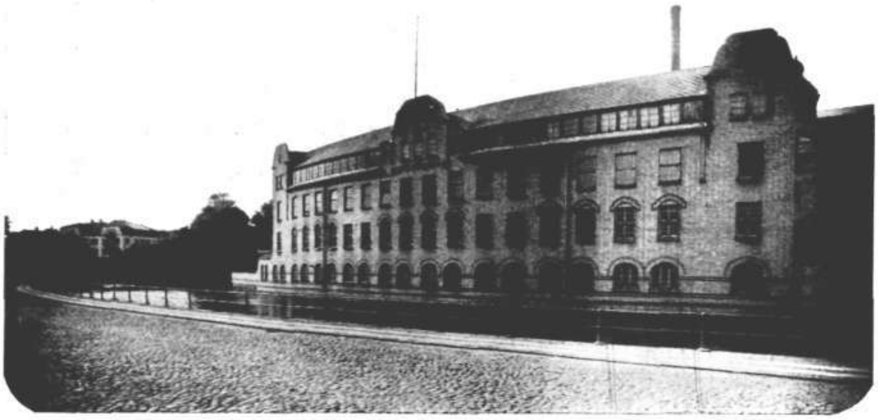
The number of time clocks should be determined so as to provide one time clock for every fifty (max. seventy-five) workers; also, a bar of some kind should be erected in front of the time clock so as to provide "one-way traffic" and avoid crowding. By providing suitable arrangements of this kind the time required by each man for punching his card can be reduced to two or three seconds.

As regards the most suitable type of time clock, we have — generally speaking — the choice of two systems. The one consists of clocks which function altogether independently of each other, while the other is the so-called central system, in which the various time clocks are connected to and regulated by a main clock.

Of these two, the central system possesses unquestionable advantages. Exactly the same time is indicated by all the clocks, thus eliminating many controversies. Various auxiliary apparatus, such as signal devices, secondary clocks to show the time, etc. can be made to function simultaneously at the same time as they are simply and accurately controlled by means of a program clock which can be set as desired.

At the works with which the author is connected — The Borås Weaving Mills — time control plants according to the central system have been installed and in operation since 1923. These plants comprise a total of thirty-one time clocks and have given excellent service and perfect satisfaction in every respect.

These plants are delivered and erected by the Ericsson telephone company of Stockholm and are consequently of Swedish make. In the capacity of technical manager of a large industrial concern it is gratifying to be able to authenticate that also in this branch Swedish products are fully equal, if not superior, to those of foreign make.



R 793 Borås Weaving Mills, Borås.

Field Telephone Switchboard for Buzzer and Magneto Signals.

A field telephone switchboard should fill certain special requirements, the following being among the more important:

lightness of weight, to facilitate transportation,
readiness for immediate use,
reliability,
easy and simple replacement of parts and units,
simplicity of operation.

A cordless switchboard for buzzer and magneto signals and with removable line units is shown in fig. 1, while fig. 2 gives a view of the same board open. This switchboard is for four double lines, the terminals,

R 745 Fig. 1.

carbon protectors, fuses, indicators and keys for the different lines being mounted on separate black lacquered metal strips (line units) which are easily removed by loosening the two screws in the ends of the strips.

The capacity of the switchboard is easily increased by connecting another similar board to the first one by means of the terminal screws located on the top cover, no changes whatever in the wiring of the boards being necessary. Naturally, the capacity is restricted by the three switching possibilities of the boards. Besides the above-mentioned terminals, there are two more for connecting a standard telephone instrument for exchange service purposes. There is also an alarm device for incoming calling signals.

Since the switchboard is intended for use with both buzzer and magneto instruments, it is evident that the indicator must be suited for both kinds of current. A sufficiently sensitive and reliable indicator has been obtained by providing the electromagnet with a

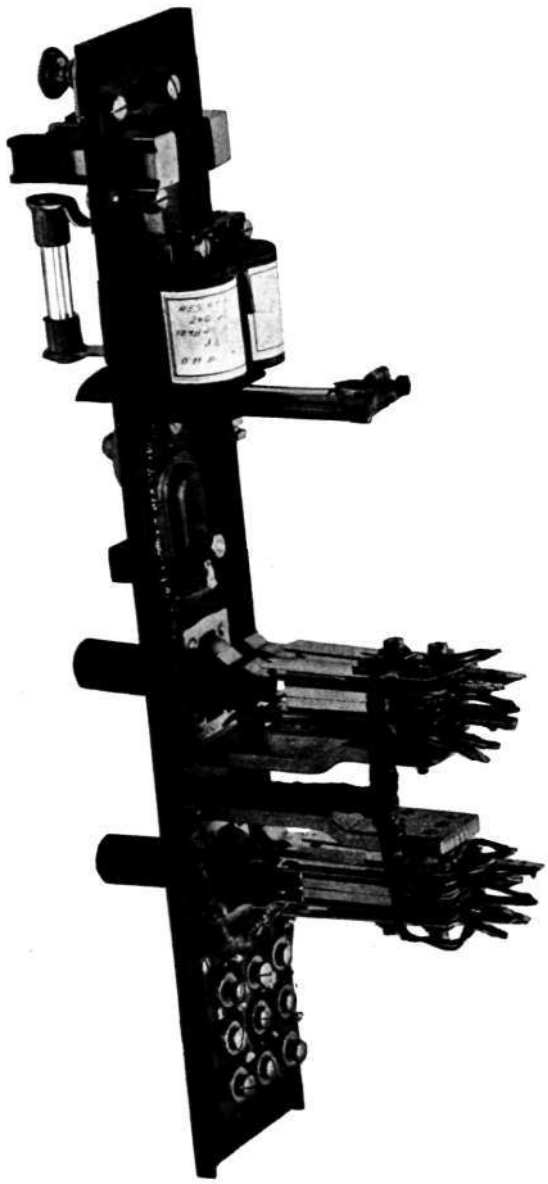
R 743 Fig. 2.

laminated core and two coils, the armature being of a very light construction and attached to a spring. This spring is formed so that one end serves as a locking device for the shutter, the other end being bent out near its point of support. A set-screw presses against the bent portion of the spring and permits the regulating of the air gap between the armature and the core of the electro-magnet. Thus, a correct adjustment will make the indicator sufficiently sensitive to the buzzer current as well as to the generator current.

The locking device of the shutter is protected from harm by means of a projection. During transportation the tension of the locking device is released, this latter being held in place by means of a spring lever.

The above-described switchboard has three switching possibilities, i. e. three simultaneous calls are possible. The bus-bars are connected in parallel by means of terminals or — in order to avoid all screw contacts — by means of a device resembling a knife-switch.

P. Otto Walter.



R 744 Fig. 3.

The previous issue (Nos. 4 to 6) of this journal contained an article entitled "Field Telephone Switches and Switchboards" by Captain W. Gyllencreutz of the Royal Swedish Signal Corps, in which also this type of switchboard was described. This description was accompained by a circuit diagram. The above short article completes this description by setting forth the principles of design which enable the indicator to be actuated by both generator and buzzer currents. Interested readers who wish to obtain information as to the functioning of this switchboard are referred to the above-mentioned article, more detailed information being gladly furnished by this company or by any of our subsidiaries or agencies (see pages 1 and 2 of the Ericsson News, No. 4 of the current year). We wish to draw our readers' attention to the statement of such an eminent expert as Captain Gyllencreutz, in which he says that this type of switchboard — on account of the indicator design — fills a gap in the collection of existing military switching devices, that it has the advantage — from a military point of view — of functioning with weak generator currents and transformed currents with strong damping of the signal current and that these advantages have been obtained without in any way lessening its other good qualities. In addition, this present article describes those features which make possible a simple and quick replacement, repairing and adjustment of parts.

The Editor.

Local Telephone Installations with Push Button Intercommunication Telephone Instruments

and

Series-Connected Exchange Instruments.

Intercommunication telephone instruments of the type here described are intended for use in private installations, with or without central exchange connections. In the former case the telephones are connected in series to one or more city lines besides being connected in parallel to the local lines. Also, the city lines may be extended to only a certain number of the telephone instruments, in which case the remainder are restricted to intercommunication service only.

In both cases the switching devices consist of push buttons which are released mutually as well as by depressing the cradle rest for the handmicrotelephone or by replacing this latter, thus breaking an existing connection. Contrary to certain earlier types of intercommunication instruments with a selective arm or with plugs, the type in question precludes the possibility of a connection remaining unbroken even after the handset has been replaced, or because the selective arm has not been restored to its normal position or the plug removed.

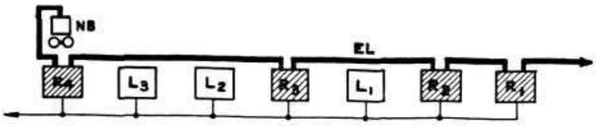
R 741 Fig. 1.

The connecting in series of the telephones to the central lines offers the advantage of preventing all listening-in from another telephone instrument in the system, since the attempt of a third party — either wilful or otherwise — to connect himself up to a busy central line results in the breaking of the existing connection or in a failure on his part to obtain the desired connection. Consequently, in a local plant with central exchange lines connected in this manner, it is of advatage that they are led first to those instruments which are primarily intended for city calls.

This method of connecting the central exchange lines, means that an incoming call from the city net is received by the last instrument to which this line is connected. Polarized bells, drop indicators, visual indicators or lamps (eventually combined with galvanic extension bells) may be used to indicate an incoming call. These devices are mounted in a separate wall box together with the special arrangements for the central line connection. In case of several city lines with bells for incoming signals, these should have different tones or be provided with some other device to distinguish them one from the other.

In the circuit diagram, shown in fig. 2, the exchange line *EL* is led through the telephone instruments *R1* to *R4* but passes by the instruments *L1*, *L2* and *L3*. The internal lines *IL* pass through all the telephone instruments in the system.

An incoming exchange call rings the bell of the last telephone *R4* connected in series to this exchange line. (In the following description this instrument is called the *service telephone*, all other series connected instruments in the installation being called



R 762 Fig. 2.

exchange line telephones, while those instruments which are not provided with central exchange possibilities are termed *local telephones.)* The person answering the call removes the handset from the cradle rest and depresses the exchange line key, thus connecting his telephone instrument to the calling exchange line. All the visual indicators connected to this line are simultaneously energized and indicate that it is busy. If the incoming call is to be directed to *R2*, this latter is called from *R4* by the depression of the corresponding local key without, however, breaking the central connection, in the manner described further on. The subscriber at *R2* removes his handset and receives the information that he is wanted on line number so-and-so, after which he depresses the corresponding exchange line key on his instrument. The subscriber at *R4* then replaces his microtelephone on the cradle rest.

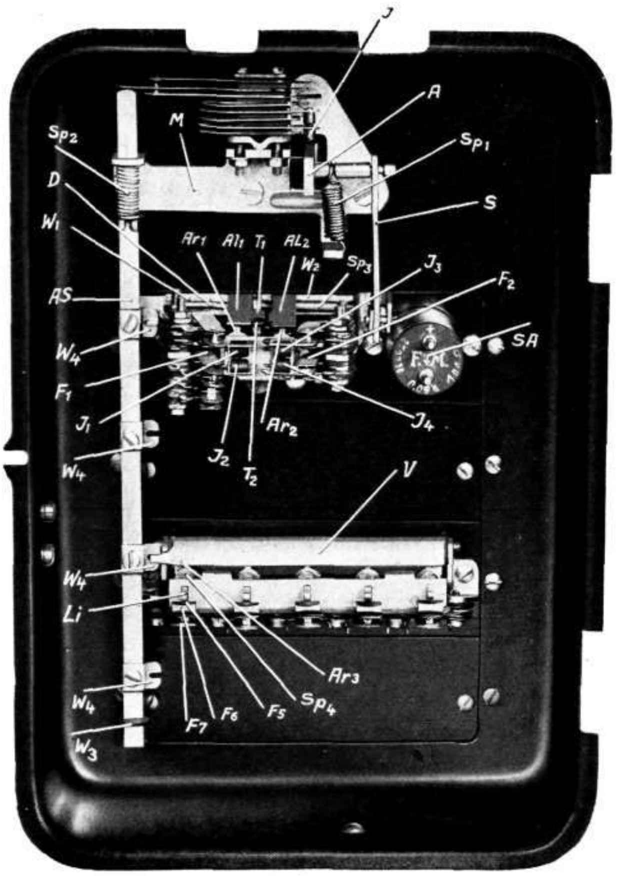
If, during a conversation over an exchange line, the speaking subscriber desires information of some sort from the subscriber at *L2* or *R3*, for instance, he makes the local connection by depressing the local key which corresponds to the desired instrument. The exchange line key then automatically returns to its normal position, thus preventing listening-in on the local conversation by the city subscriber without, however, breaking the exchange line connection. When this local conversation is finished the exchange line key is again depressed, thus breaking the local connection and permitting a resumption of the conversation over the exchange line.

When the conversation is finished, the handset is replaced on the cradle rest, thus releasing the exchange line key and breaking the connection over the central exchange. All the visual indicators are simultaneously restored to normal after which they indicate that the exchange line is disengaged.

The central exchange may be called from any of the exchange telephones by merely depressing the exchange line key after having lifted the handset off the cradle. If the central exchange is built on the *CB* system, no additional manipulations are necessary, but if it is an *LB* exchange, an additional ringing key is provided for closing an alternating current ringing circuit over a transformer or a pole changer. If the central exchange is automatic, the ringing key is replaced by a calling dial.

A local telephone instrument is called by depressing as far as possible the key for the desired line, thus closing a d. c. ringing circuit over the telephone instrument in question. The local line keys have two positions, and when the depressed key is released it automatically takes the middle or speaking position. The called subscriber need only remove the handset from the cradle rest to complete the connection. At the end of the conversation both parties replace their handsets and the depressed line key of the calling party automatically returns to its normal position, thereby breaking the connection.

The switching mechanism of an exchange telephone instrument is shown in fig. 3; above is the cradle switch, in the centre the exchange line key set with the visual indicator, while the lower part of the illustration shows a set of intercommunication keys for five lines.



R 743 Fig. 3.

A is the cradle lever arm which gives the two insulations *J* and the attached springs an upward movement when the handset is placed on the cradle rest. The lever arm *A* is provided with a pin, on the free end of which the releasing arm *S* for the exchange line key is pivoted. The function of the spiral spring *Sp1* is to pull down the end of the lever arm *A* when the handset is removed from the cradle rest.

The exchange line switching device consists of two spring groups *F1* and *F2* and a push button key — not visible in the illustration. The depressing of this key forces the two plungers down between the insulations *J1*, *J2* and *J3*, *J4* respectively, thus influencing the two spring groups *F1* and *F2*.

Further, the switching device consists of two angles *W1* and *W2*, movable arround the common axle *D*. A tooth on the angle *W1* engages a notch on the angles *W4* which are attached to the releasing bar *AS*. This angle is provided with a locking projection *AL1* on which is a tooth *T1*. The other end of the releasing arm *S* is pivoted on the angle *W2*. Also this angle has a locking projection *AL2*, on which is a tooth *T2*, lying under the tooth *T1* of the projection *AL1*. The angle *W1* with its projection *AL1* is pressed against the locking pawl *Ar1* by means of the spiral *Sp2* on the releasing bar *AS*, and the projection *AL2* of the angle *W2* is pressed against the locking pawl *Ar2* by means of the spiral spring *Sp3*. The depressing of the push button causes the locking projections to be pressed under *Ar1* and *Ar2*, thus preventing the return of the key to normal when the button is released.

The top of the releasing bar *AS* is pivoted on the angle *M* which supports the cradle lever arm, and the bottom is pivoted on an angle *W3* fixed to the casing of the instrument.

The locking bar *V* for the local keys engages a notch on one of the angles *W4* on the releasing bar *AS*. The pressure of the spiral spring *Sp2* forces the locking bar *V* against the locking pawl *Ar3* on the five local line keys *Li*.

Whe one of these local keys *Li* is depressed, the locking bar *V* is slowly pushed back, raising the relaising bar *AS* and acting on the three springs of the upper spring group. This causes negative to be connected to the case of the instrument and to the contact springs *F5*, *F6* and *F7* respectively, and a ringing signal is sent out to the desired instrument. In this case, the push button is depressed as far as it will go, thus pushing the locking bar *V* as far over as possible. When the push button is released, it is raised by means of its own spiral spring *Sp4*. The locking bar simultaneously moves back again under the shoulder of the push button, thus locking the latter in speaking position.

When — at the end of the conversation — the cradle rest is actuated by the replacing of the hand-microtelephone the releasing arm *S* is raised and the angle *W2* with the locking projection *Al2* is turned upwards. By the aid of the tooth *T2* the locking projection *Al2* is able to lift the angle *W1* as well as the projection *Al1*. As previously mentioned, the angle *W1* engages a notch in the angle *W4* on the releasing bar *AS*. This bar is also raised, causing the locking bar *V* to release the push button, the pressure of its own spiral spring causing this latter to return to normal.

If, after having established an exchange call and the exchange key, therefore, is in its depressed position, it is desired for some reason or other to get in touch with a local telephone instrument without breaking the exchange connection and without permitting the central exchange subscriber to listen in on the local conversation, the key of the desired local line is depressed. This manipulation causes the raising of the releasing bar *AS* and, consequently, the angle *W1* is turned upwards. The locking projection *Al1* is released from the locking pawl *Ar1* and the key is restored to normal. The right hand locking projection *Al2* remains under the locking pawl *Ar2*. This is explained by the fact that the spring group *F2* is actuated — on the depression of the exchange key — by means of a plunger which is not rigidly attached to the button, the other plunger — which actuates spring group *F1* —, on the other hand, being withdrawn from this group when the key returns to normal, resulting in the release of *F1* while *F2* remains in its working position. When the local conversation is ended, the exchange key is again depressed, causing the renewed moving of the locking projection *Al1* under the pawl *Ar1*. The angle *W1* raises the releasing bar, causing the locking bar *V* to resume its position under the pawl *Ar3* of the local line key.

When the conversation over the exchange line is terminated, the handset is replaced on the cradle rest, causing the angle *W2* to turn upwards. The locking projection *Al2* with its tooth *T2* takes with it the projection *Al1* on the angle *W1*, so that this latter is also turned upwards. This results in the withdrawal of the projections *Al2* and *Al1* from the pawls *Ar2* and *Ar1*, its own spring pressure causing the exchange line key to return to normal.

The exchange line key is provided with a small, red indicator, which becomes visible in a celluloid covered opening beside the key as soon as the key is depressed. This indicator has its own, special purpose to fill when several exchange lines enter the same telephone instrument, since it is possible that all of these are marked "busy". When a local conversation takes place during the course of an exchange call from the same telephone instrument, the exchange line that is connected up is market "busy", besides which the corresponding exchange line key — as already described — has returned to its rest position. When the subscriber wants to resume the conversation over the exchange line, it is very probable that he has forgotten which one it was. The red indicator — which is still visible in spite of the fact that the exchange line key has returned to normal — then indicates the line used. This indicator does not return to its rest position and disappear from view until the handset is replaced on the cradle rest.

Taking into consideration the number of lines to its rest position and disappear from view until the following types can be furnished:

Intercommunication telephones for 5, 10, 15 or 20 double or single lines,

Exchange telephones for 5 local and 1 to 3 exchange lines,

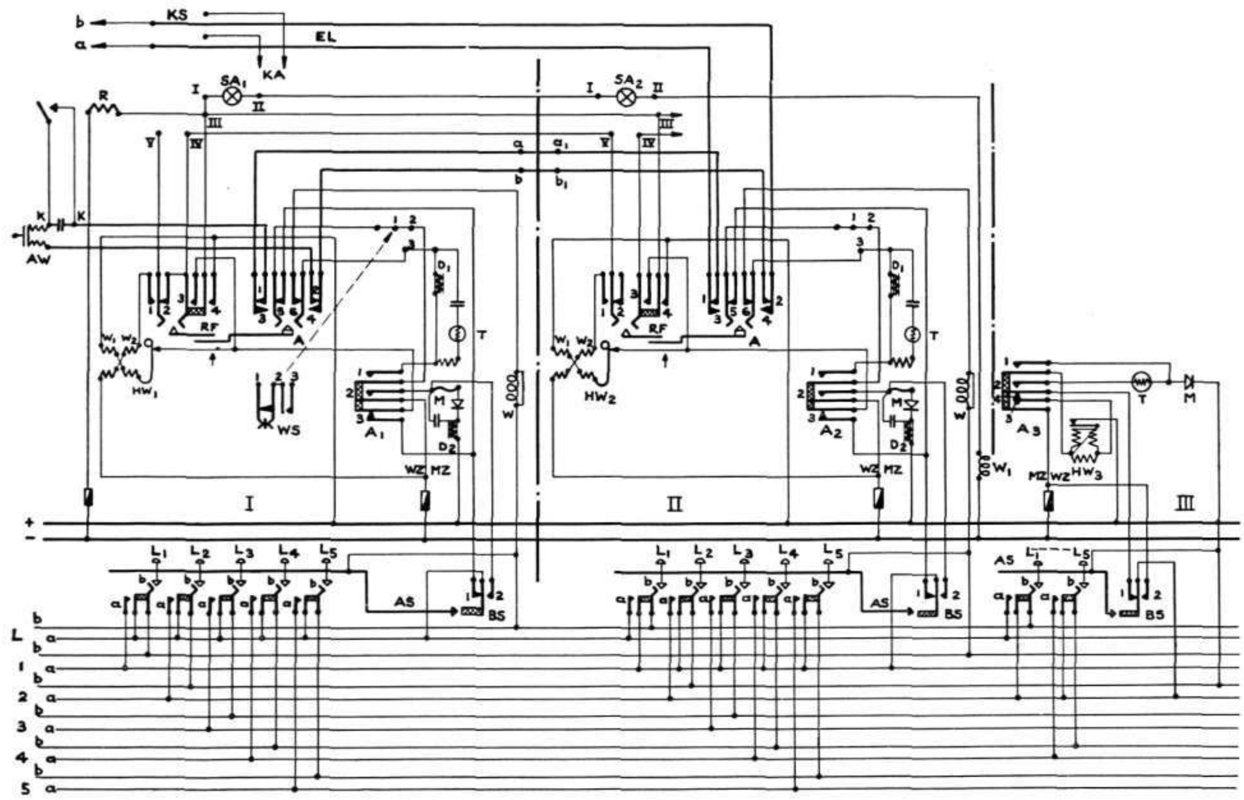
Exchange telephones for 10 local and 1 to 2 exchange lines,

Exchange telephones for 15 local and 1 exchange line. (See further Ericsson News No. 6, 1927, page 4.)

It would be uneconomical — on account of the high cost of the lines — as well as unpractical from the point of view of design (depending on the lightness in weight of the handset, which would cause uncertainty in the functioning of the releasing mechanism) to increase the above-mentioned capacities.

All inside connections are soldered, terminal screws being provided for the connections between the telephone instrument and the wall terminal box as well as from this last to the outside lines, this same method being applied to the connecting cabinets for the exchange lines. These cabinets as well as the wall terminal boxes are made of black lacquered pressed sheet steel, due consideration having been given the importance of leading exchange lines and local lines through separate cables.

The accompanying diagram (fig. 4) shows the inside



R 763

Fig. 4.

and outside circuits for two exchange telephones and one intercommunication telephone. The local lines are double and the central exchange is assumed to be on the *CB* principle.

The two branches *a* and *b* of the exchange line first pass over a testing key *KS*, by means of which this line can be switched over from the local net to a testing device *KA*. From the testing key the line is carried over all the exchange telephones and to the service telephone instrument I and its connecting cabinet.

Call from central exchange.

A call from the central exchange causes the bell *AW* — in the connecting cabinet of the service telephone — to ring. The answering party removes the handmicrotelephone from the cradle rest, closing contacts *1* and *2* and breaking contact *3* in the cradle spring group *A1*. The exchange line key *RF-A* is then depressed, the bell being disconnected from the main circuit over the contacts *A1* and *2*, the inductive resistance *D1* and the handmicrotelephone of the service telephone being brought in circuit over contacts *3* and *4* of the key *A* and contact *1* in the cradle switch *A1*. The transmitter circuit is closed over contact *2* in *A1* and the visual indicators *SA1* and *SA2* and the relay *R* are simultaneously energized over contact *RF4* in the spring group of the exchange line key. The relay closes a contact which short-circuits the condensor *KK* of the exchange line. The visual indicators are connected in series mutually as well as with a resistance *W1*, permitting the use of a common battery for the local d. c. signal, the transmitter circuit and the visual indicators. The resistance *W1* is adjusted to suit the voltage of the main *CB* (24 volts) and the number of visual indicators in series, and is thus dependent on the number of exchange telephone instruments.

Calling an exchange telephone instrument.

After having received information as to the desired exchange instrument, the party answering the service telephone depresses the corresponding local line key, for instance *L1*. This moves the releasing bar out of its rest position and releases the key *A*, its contacts *1*, *2*, *5* and *6* being closed while *3* and *4* are broken. The connection of the handset to the exchange line is broken over contacts *3* and *4*, while instead of inductive resistance *D1* the signal bell *AW* is connected up over contacts *1* and *2* so as to form a bridge between the two branches of the exchange line, thus preventing a clearing signal at the central exchange. In order to prevent a momentary break in the exchange line connection, contacts *3* and *4* are not broken until contacts *1* and *2* are closed. The *RF* side of the exchange line key is not actuated by the return of the key to normal, whereby the visual indicators remain energized and the condensor *KK* in the exchange circuit remains short circuited.

By depressing the key *L1* as far as possible contacts *a* and *b* are closed and the releasing bar *AS* is pushed over far enough to influence contacts *1* and *2* of the battery switch *BS* on the service telephone. Contact *2* closes the signal circuit to exchange telephone II while contact *1* breaks the receiver circuit so as to eliminate the unpleasant noises in the receiver while giving the signal. The signal circuit is then as follows: negative, contact *2* of cradle switch *A1*, contact *2* of battery switch *BS*, line *La*, contact *a* in *L1*, line *1a*, contact *1* of the battery switch *BS* in exchange telephone II, contact *3* of *A2*, winding *w1* of the bell *HW2*, to positive. The signal bell of the exchange telephone II rings, the handset is removed from the cradle rest and the ringing circuit is broken at contact *3* of *A2*.

When the party at the service telephone releases the key *L1*, it returns — as already mentioned — to an intermediate speaking position, its contacts *a* and *b* remaining closed. Simultaneously with the releasing of the key *L1*, the releasing bar *AS* is brought back to normal by its spiral spring, so that contact *1* in *BS* is closed and contact *2* broken. This connects the handmicrotelephone to the local circuit and disconnects negative of the calling circuit from the service telephone, forming the following circuit:

contact *1* in *A1*, secondary winding of induction coil, receiver *T*, condensor, terminal *3*, contact *A6*, the short-circuited resistance *W*, releasing bar *AS*, contact *b* in *L1*, line *1b*, the short-circuited resistance *W* in the exchange telephone II, contact *6* in exchange key *A* of the same telephone instrument, terminal *3*, condensor, receiver *T*, secondary winding of induction coil, contact *1* in *A2*, contact *5* in key *A*, contact *1* in key *BS* of exchange telephone II, line *1a*, contact *a* in key *L1* of service telephone, line*La*, contact *1* in key *BS* of service telephone, contact *5* in key *A*, and back to contact *1* in cradle switch *A1*.

The called exchange telephone instrument is connected to central exchange line.

The person at the service telephone now requests the called local subscriber to connect his telephone to the exchange line. This last subscriber depresses the key *RF-A*.

As previously described, the depressing of this key connects the handset of the exchange telephone to the exchange line, the service telephone being simultaneously disconnected from the same. At the same time, both the visual indicator and the relay *R* remain energized over contact *RF4* in the exchange telephone I. The following signal circuit to the service telephone is simultaneously closed, indicating that the subscriber at the exchange telephone I has completed the connection:

negative, fuse, winding *w2* of *HW2*, contact *RF1* in exchange telephone, terminal *V*, terminal *IV*, contact $RF3$ in service telephone, winding $w1$ of $HW1$ to positive.

The signal bells $HW1$ and $HW2$ ring. The person at the service telephone replaces his handmicrotelephone, causing the exchange and local keys in his telephone instrument to return to normal. Contacts $RF3$ and $RF4$ in the service telephone are broken and the bells $HW1$ and $HW2$ cease to ring. The subscriber at the exchange telephone I is thus informed of the fact that the handmicrotelephone of the service telephone has been replaced. The visual indicator and the relay R are now energized only over contact $RF4$ in the exchange telephone I. The speaking circuit from the exchange telephone is now the same as previously for the service telephone.

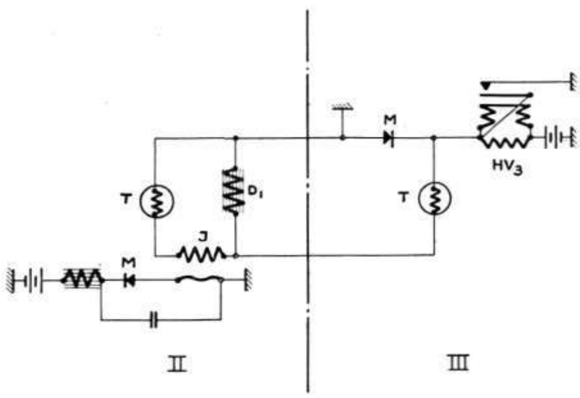
In case the subscriber at the exchange telephone I — which is now connected to the central exchange — should desire information of some sort from a subscriber at a local telephone instrument with intercommunication possibilities only, the local key $L2$, for instance, is depressed, causing the contact springs of the exchange and local line keys to be actuated in the same manner as previously during a call from the service telephone to an exchange telephone instrument. The exchange line circuit is closed over contacts $A1$ and $A2$, the microtelephone being disconnected from the same at contacts $A3$ and $A4$. In this way there is no possibility of listening-in on the local conversation from the exchange line. The signal circuit to the local telephone instrument III is as follows:

positive, over bell $HW3$, contact $A3$—5, contact 1 in key BS of local telephone, line $2a$, contact a of local line key $L2$ in exchange telephone II, line La, contact 2 of key BS, contact 2 in $A2$ to negative.

The bell of the local telephone instrument III rings, and the subscriber removes the microtelephone, thereby breaking the signal current at contact $A3$—4 while the speaking circuit is closed over contact $A3$—2. The following transmitter circuit is closed:

positive, transmitter, contact $A3$—1, in parallel through both windings of $HW3$, contact $A3$—3 and negative. The speaking circuit is as follows:

contact $A2$—1, secondary winding of induction coil, receiver T, condensor, contact $A6$ in exchange instrument II, the short-circuited resistance W, releasing bar AS, contact b of local line key $L2$ in exchange instrument, line $2b$, transmitter and receiver of local instrument, contact $A3$—2, contact $BS1$, line $2a$, contact a of key $L2$ in exchange telephone instrument II, line $1a$, contact $BS1$, and contact $A5$ back to contact 1 in $A2$. This speaking connection is shown in principle on the diagram in fig. 5.



764 Fig. 5.

An answer is received from the local telephone instrument.

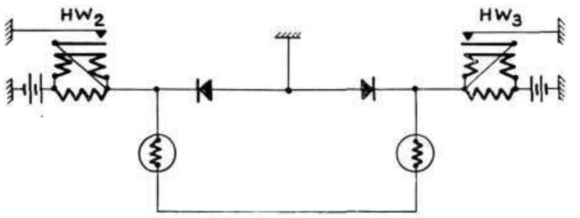
When the handmicrotelephone of the local telephone is removed from the cradle rest, the armature of the bell $HW3$ is attracted and held by the transmitter current. This breaks the armature contacts, making it impossible for the transmitter to be short-circuited over the same.

Termination of local conversation.

As soon as the subscriber at the exchange telephone instrument II has finished the local conversation, the exchange line key is depressed, causing the spring group at A to be again actuated and the local line key $L2$ returns to normal. Contacts $A5$ and $A6$ are broken while contacts $A3$ and $A4$ are closed. The handmicrotelephone is switched over from the local line to the exchange line, the inductive resistance $D1$ being connected so as to form a bridge over the two branches of the exchange line. Contacts $A1$ and $A2$ are broken and disconnect the bell AW from the exchange line only after the closing of contacts $A3$ and $A4$, this bell having been connected between the branches of the local line during the local call instead of $D1$. This arrangement permits the renewed depressing of the exchange line key without giving the central exchange a clearing signal.

Termination of central exchange call.

When the conversation over the exchange line is terminated, the handmicrotelephone of the exchange telephone instrument is replaced, causing the exchange line key to return to normal and the exchange line is again connected straight through to the bell AW. The breaking of contact $RF4$ then causes the visual



R 765 Fig. 6.

indicator *SA* and the relay *R* to de-energize and the condensor *RR* of the exchange line is again connected up in series in one of the line branches.

Calling the central exchange.

Central is called by merely depressing the exchange line key, thereby energizing relay *R*, short-circuiting the condensor *KK* and connecting the resistance *D1* across the two branches of the exchange line. The calling lamp at the central exchange glows.

In telephone instruments of the above described type, the switching devices for exchange connections are designed so as to be adapted — easily and at small cost — to different telephone systems. For co-operation with an automatic system the terminals *1*, *2* and *3* are used, the calling dial *WS* being connected to the same after having broken the connection between *1* and *2*. For magneto exchanges with or without automatic clearing signal, — the connection to the telephone is broken at *1* and *3*, and in its stead is connected a calling key which — during the giving of a calling signal — disconnects the receiver and closes an a. c. circuit over a transformer or a pole changer. For plants with automatic clearing signal at central, the resistance *D1* is eliminated and the relay *R* is re-connected as may be found necessary in the various cases.

Signalling and conversations between local intercommunication telephone instruments takes place in exactly the same way as between exchange and local telephones. The only difference is in the speaking circuit, a diagram of which is shown in fig. 6, and from which it is evident that there is no induction coil in this circuit. The transmitters receive current over the bell coils.

If these telephone instruments are to be made for single lines, all the terminals of the local *b*-lines are connected to a common return. In this case the resistances *W* are not short-circuited, their function being to damp the speech current in order that the cross-talk which is inevitable with single lines be reduced to a minimum.

K. P.

Projecting City Telephone Nets.

According to the Ericsson System of Cable Distribution.

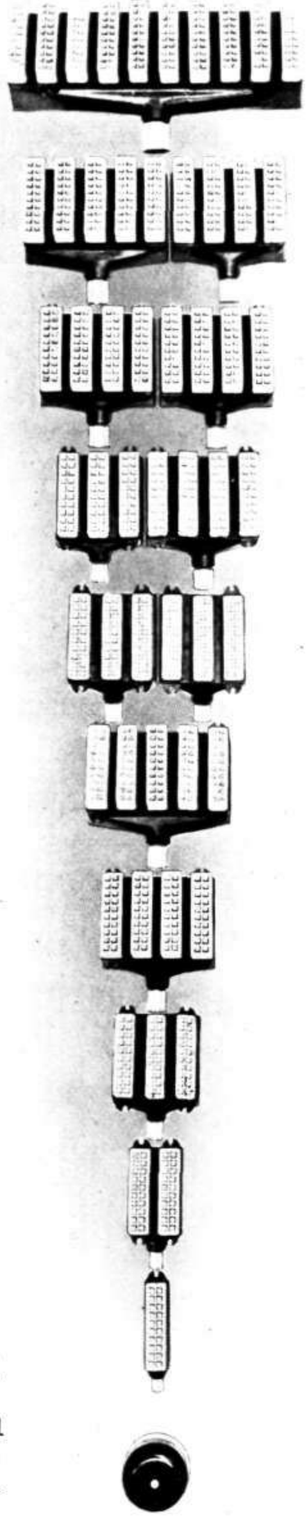
R 239 Ericsson Cable Works at Älvsjö, near Stockholm, Sweden.

When preparing the project for a city telephone net, the only basis from which to work consists of information as to the number of inhabitants and the yearly increase in population based on the statistics of the previous year. Furthermore, the assumed number of inhabitants to each telephone instrument is based on local conditions and on statistical data from other cities. In small or average sized cities, where the telephone net is operating satisfactorily and the rates are normal, this figure can be taken at about twenty. Instances with both higher and lower figures are not lacking, but for a normal project the figure mentioned should be very close to the actual one, or at least close enough for preparing the first rough draft. If there

L. M. Ericsson

Ericsson

Line Material



Thanks to more than 40 years experience in the building and operating of telephone nets we are able to offer to our customers first class modern line material which covers all the details and tools necessary for a telephone installation.

Our construction department executes on contract all kinds of work connected with telephone lines as well as complete installations. — Complete plans, estimates and catalogues supplied on request to be addressed direct to us or to our agencies in various parts of the world

TELEFONAKTIEBOLAGET L. M. ERICSSON
STOCKHOLM, SWEDEN

is an old net in the city, too much importance must not be attached to the existing number of subscribers, as the service most likely has been poor and the capacity of the plant insufficient, thus restricting its natural growth and development.

Since the project, as already mentioned, is based chiefly on the increase in population, it is clear that a certain period of time must be established during which the initial capacity of the net shall suffice for the current needs of the city. This holds good for the distributing cables and open wire distribution, the main cable lines, on the other hand, being successively added to as the necessity arises. Such a time period is usually fixed at from five to ten years, eventually to a still longer time period, for the underground canalisation and naturally depends upon the available capital as well as on a number of local conditions which may influence the normal expansion of the plant. However, it is well to keep in mind that an initial capacity designed to meet the requirements for a comparatively long period generally means a lower first cost.

After having assumed the maximum number of inhabitants — including a certain increase — during a certain period of time, which number we will designate by the letter *a*, and the number of inhabitants *b* per telephone instrument has also been assumed, the following necessary data for preparing the project are obtained by the aid of these figures.

1. Number of subscribers $c = \frac{a}{b}$

2. Number of lines *d* in outgoing main cables.

This figure is generally taken 30 % higher than the calculated number of subscribers, as a result of the wide experience gained from the operation of underground telephone nets. Thus we have

$$d = 1.3\,c = 1.3\,\frac{a}{b}$$

3. Number of distribution lines *e*.

Based on the same experience, the rational operation of a telephone net requires that this figure be $1\frac{1}{3}$ times the calculated number of main lines. This gives us

$$e = 1\frac{1}{3}\,d = ab't\;1.75\,c = 1.75\,\frac{a}{b}$$

4. Number of distribution cabinets *f* and their capacity *k*.

With due consideration for local conditions, a distribution cabinet with a suitable capacity *k* is chosen from among the standard catalogue types. In these cabinets the necessary number of line terminals are reserved for the main lines and the distribution lines in the above-mentioned ratio of 3 to 4. Thus, the necessary number of distribution cabinets

$$f = \frac{e + d}{k} = 3\,\frac{c}{k} = 3\,\frac{a}{bk}$$

5. Number of ducts *g* in the outgoing conduit lines from the central exchange.

This number depends on the chosen capacity *k* of the main cables, from which we obtain

$$g = \frac{e}{k} = 1.75\,\frac{c}{k} = 1.75\,\frac{a}{bk}$$

Thus, the resulting number of ducts is sufficient for the required distribution cables as well.

In order to illustrate this method by means of a concrete example, we will assume $a = 100.000$ inhabitants within 10 years and $b = 20$ inhabitants per telephone instrument, the following figures within 10 years then being obtained according to the above formulas:

number of *subscribers*

$$c = \frac{a}{b} = \frac{100{,}000}{20} = 5000$$

» » *main lines*

$$d = 1.3\,c = 1.3 \times 5000 = 6500$$

» » *distribution lines*

$$e = 1.75\,c = 1.75 \times 5000 = 8750$$

» » *distribution cabinets*

$$f = 3.00\,\frac{c}{K} = 3.00 \times \frac{5000}{700} = 22$$

on condition that the capacity of the cabinets has been taken at 700 lines, i. e. in the ratio of 3 to 4 — 300 main lines and 400 distribution lines.

» » *ducts* in the outgoing conduits from the central exchange, on condition that the capacity of the main cables has been fixed at 300

$$g = 1.75\,\frac{c}{K} = 1.75 \times \frac{5000}{300} = 30$$

1. *Cabinet areas.*

When the foregoing data for the net have been calculated, the city is divided up into *cabinet areas*

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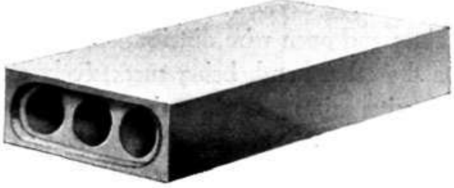
NJ 1/2



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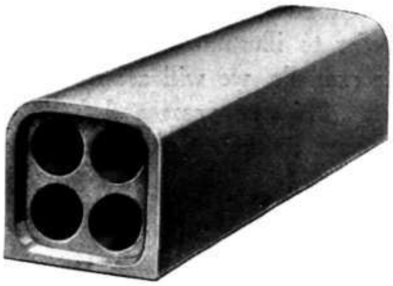

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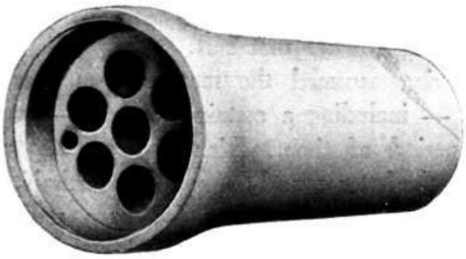

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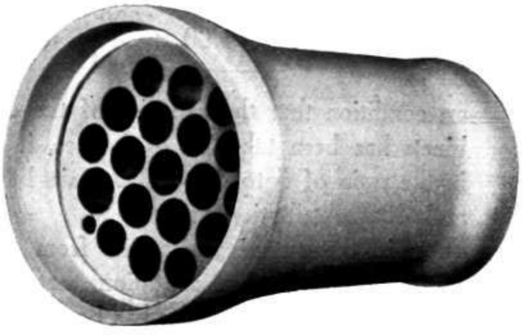

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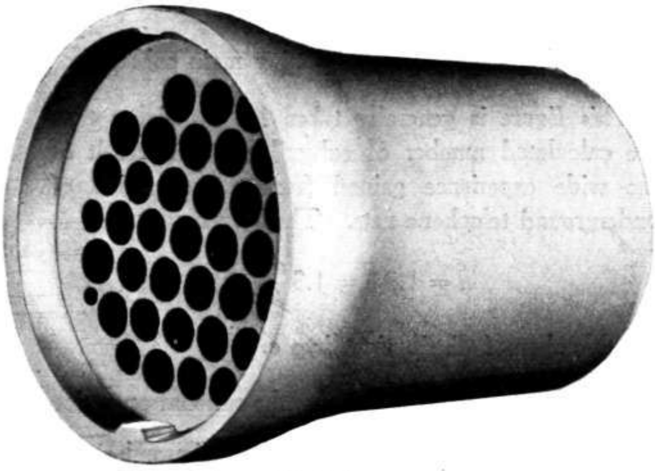

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Cement Conduits

according to the number of distribution cabinets. The number of subscribers c_s in each cabinet area will then be

$$c_s = \frac{c}{f} = \frac{k}{3}$$

or about 200 to 250 subscribers, if the capacity of the cabinet has been set at 700 lines, which is usually the case.

The distribution cabinets are the fixed points about which the whole net is built. For this reason their number should be sufficient to insure efficient distribution without future sub-dividing or replanning of the areas, this last expedient being both difficult and costly. The above method of calculation insures the filling of this requirement on condition that the sizes of the areas are determined with due consideration for the increase in population during the period for which the net has been projected. Consequently, the making of the project should be preceded by a thorough investigation of the existing local conditions.

In order to determine the size of the cabinet area with due consideration for future subscribers, it is customary to make a so-called block estimate, i. e. the requirements for each house in a city block are estimated, this estimate being based on the present number of apartments, stores, offices etc. as well as on the assumed future development. A number of suitably located buildings which, according to the estimate, will have $\frac{k}{3}$ subscribers during the predetermined period, are then grouped together so as to form a cabinet area.

2. *Telephone exchange.*

The choice of location for the telephone exchange is intimately connected with the grouping of the subscribers — especially since most large, modern nets are planned for automatic switching —, economical as well as efficient service being decisive points of view in this case. Consequently, the discussion of this question does not lie within the scope of the present article. The author only wishes to state that, if only one or several exchanges are being considered, the system with cabinet areas gives reliable guidance in determining their location, other factors which may influence the decision, however, being the possibility of acquiring a suitable site for the exchange building and the direction in which the city is expected to expand.

3. *The underground net.*

The conduit lines are now planned in accordance with the projected division of the city into cabinet areas.

The calculated number of ducts in the outgoing conduit lines is distributed among these latter as conditions may require, conduits with suitable numbers of ducts being chosen from among the standard types. The number of ducts in the respective conduit lines are successively diminished while passing through the cabinet areas, due consideration being given the probable future development of the net as well as the standard sizes of conduits.

The underground lines follow the shortest possible route through the most thickly populated parts of the city in order to make the cable lines as short as possible. Streets already occupied by tramways should be avoided in order to minimize the serious effects of electrolysis.

Wherever possible, the distribution cabinets should be placed along the main conduit lines, either against a building or in a niche cut into the wall, or in an open place. Pits, for admitting the cables to the cabinets, are built under the cabinets, communication with the conduits being obtained by means of suitable pipe lines.

4. *Main cables.*

A general rule which should be kept in mind when planning cable nets is that the main cables should be laid with a capacity per cabinet area approximately corresponding to the actual number of main lines calculated to fill the demand for one or two years in advance and to the standard cable types. This system gives the main cables a capacity which exceeds that of the cables which lead to the corresponding cabinets, although always with a surplus equal to a cable of standard size with respect to the number of pairs. These surplus lines terminate at suitable points, so as to be easily acessible when needed for the increase of the number of main lines in the cabinets. The main cables are increased from year to year in proportion to the actual yearly increase in the number of subscribers so that d always will be equal to $1.3\ c$.

5. *Distribution cables.*

These cables should always be laid with a capacity fully equal to what has been calculated for the future needs of the plant during the entire time period for which it is projected. These cables are laid to the greatest possible extent in the main conduit lines, although it may be found necessary to branch off conduit lines of small capacity (with one or two ducts) or even to use aerial cables, in order to make the cable lines as short as possible. The distribution cables for a cabinet area are carried to a point of distribution centrally located with respect to the homes of the subscribers. These distribution points should not be for more than ten or twenty lines, so that the lines from here to the subscribers' stations shall be as short as possible.

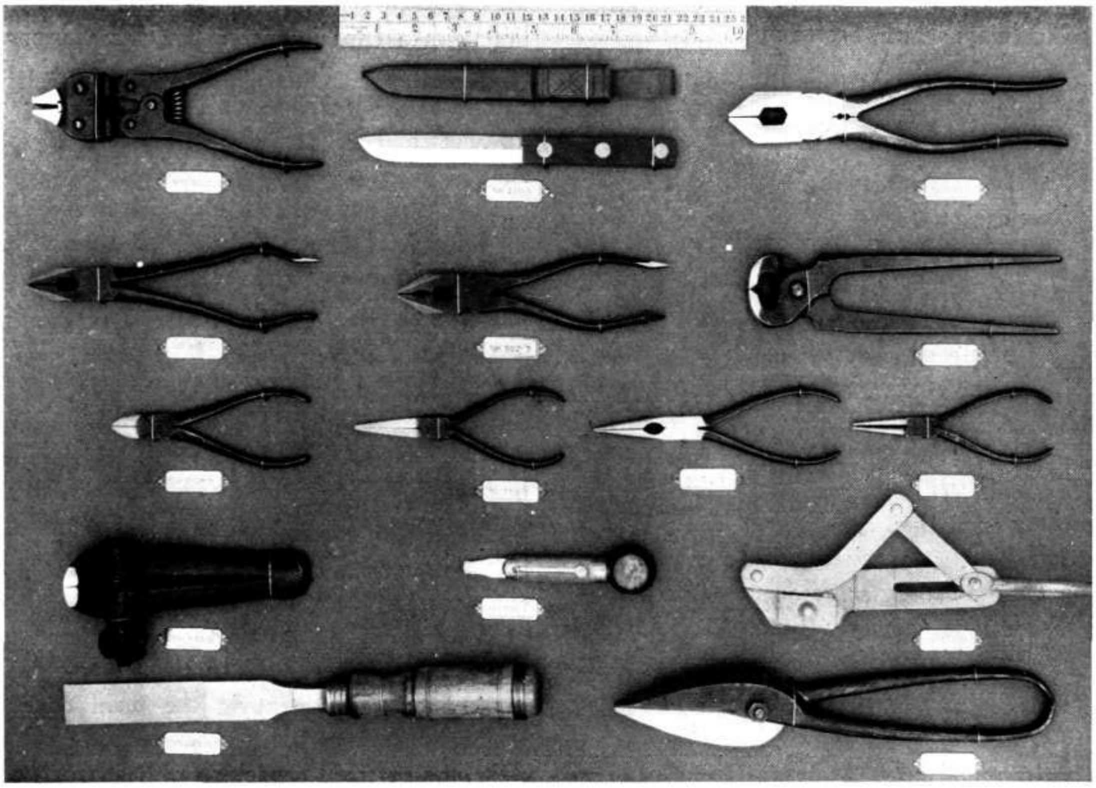
If lack of capital should prevent the completion of the net along the above lines, certain restrictions will naturally have to be made. These restrictions must on no condition influence the number of distribution cabinets, however, but these shall be erected to the full number estimated. It should be kept in mind that the erection of the full number of cabinets will give shorter distribution cables, thus affording considerable reductions in the first cost. On the other hand, the capacity of the projected conduit lines can be diminished, in which case the conduits should be laid deep enough to permit the laying of future lines above them. No reduction of the estimated capacity of the main cables (see point 4) can be effectuated and a reduction in the distribution cables should be resorted to only in case of absolute necessity, as the saving effected is only apparent, the cost for laying additional cables at a future date being much higher.

6. *Subscribers' lines from point of distribution to subscribers' stations.*

These lines can be carried in direct aerial cables or by means of combined cable and open wire lines, depending on the concentration of the subscribers' stations. In the more central parts of a city and with large buildings, the firstnamed method is generally used; the latter system — on the other hand — is more suitable towards the outskirts or where subscribers are more sparsely located. From the point of view of operation, the first-mentioned system is preferable. Subscribers' lines are mounted only as the necessity for the same arises, i. e. only in accordance with an actual increase in subscribers.

Such, in short, are the basic principles which must receive first consideration when preparing an estimate for an outdoor telephone plant. A considerable saving can be effected by preparing the project with the utmost care from the very beginning. The plant can then develop smoothly without the necessity for expensive re-construction work, and there will be no difficulty in maintaining the high standard of the net, a condition which is of the utmost importance for the operating company as well as for the subscribers.

E. A. E.



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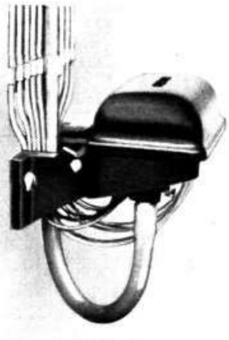

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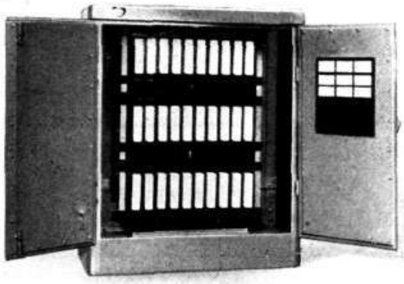
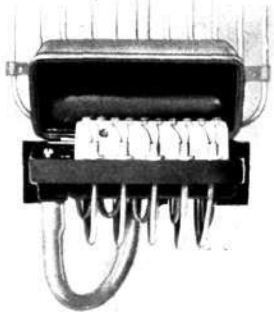


NA 25



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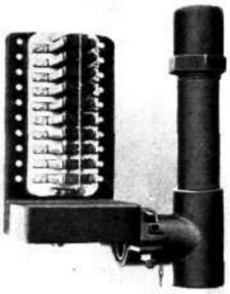

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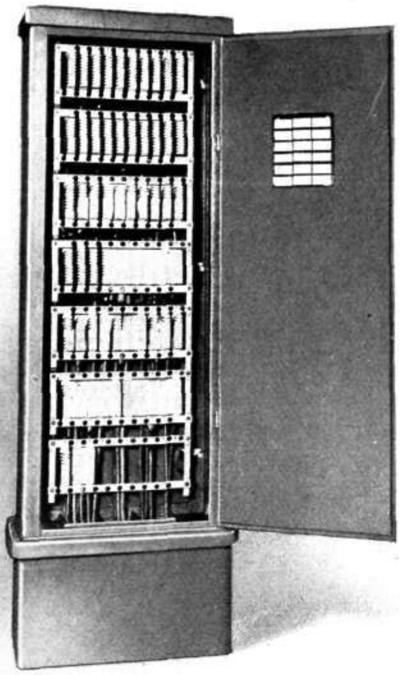

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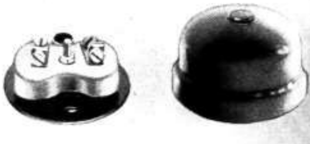

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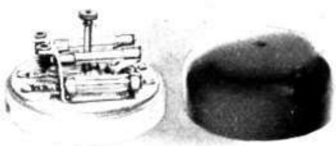

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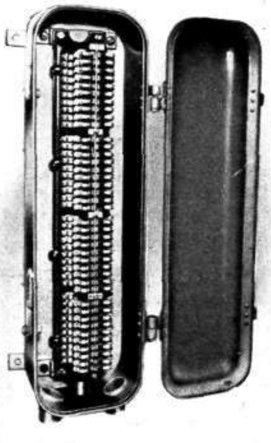

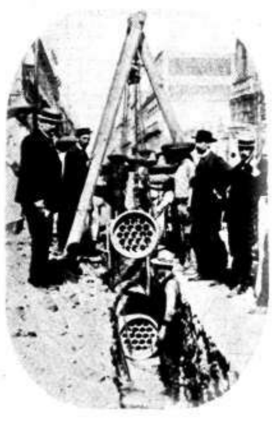

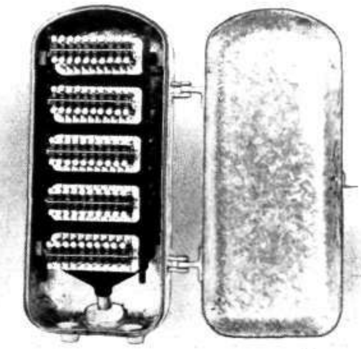

NA 115

NA 100

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Stockholm 1927. Kurt Lindberg, Boktryckeriaktiebolag.