Ericsson News

1930 | *English edition* | Managing Editor: Woldemar Brummer | No. 4–6.

Herman Rydin †.

The late Director General of the Swedish Telegraph Office, Herman Rydin, died in Stockholm on March 27th.

Rydin was the chief executive of the Swedish Telegraph Office for more than 20 years. His life-work coincides with the enormous technical development of the telephone, telegraph, and wireless services during the last decades. Rydin was a strong leader, and the right man to guide this progress into channels profitable to our country. The present undeniably excellent position occupied by the Swedish Telegraph, Telephone and Wireless Services is due to his efforts. On his retirement from his post as Director General at the end of 1927 the Ericsson Concern hastened to secure his services, by electing him Chairman of the Board of the Sievert Cable Works. Rydin soon made his influence felt, and his death is a great loss to the Sievert Cable Works as well as to the whole Ericsson Concern.

As a civil servant, Rydin was quite free from red-tapeism. He expressed his opinions freely, not only to those in inferior positions, but still more to the higher authorities and to the outside public. His was a pronounced personality, and the success of his life-work is largely accounted for by his very human point of view, both in official and private matters.

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News items from the Ericsson Concern.

— The postal address of the Dutch subsidiary company of the Telefonaktiebolaget L. M. Ericsson, the **"Nederlandsche Ericsson Telefoonfabrieken"**, is: **Reyen** (N. B.), telegraphic address: Ericsson, Reyen, (not Amsterdam and Kjoebmand respectively, as stated in the list of companies associated with the Ericsson Concern).

— The **Equadorian** agency of the Ericsson Concern, **"Compañía Sudamericana S. K. F."**, has removed from Guayaquil to **Quito**, Postal address: Casilla Correo 536; telegrams and cables: Roulement, Quito.

L. M. Ericsson system of Automatic Telephone Exchanges.

— An order for the extension of the *Söder* automatic exchange by 10,000 lines, i. e. from 30,000 to 40,000, has been received from the *Royal Swedish Telegraph Office.*

— The following automatic exchanges have been opened for traffic:

In **Bergamo,** Italy, 4,000 lines in March 1930.
» **Concepción,** Argentina, 640 lines in March 1930.
» **Narvik,** Norway, 1200 lines in May 1930.

— Extensions of automatic exchanges already at work:

In **Naples**, Piazza Nolana, by 2,500 lines in April 1930, to 4,500 connected lines.
» **Verona,** by 1,000 lines in April 1930 to 3,000 connected lines.

— For Tallinn (Reval), the capital of Esthonia, the P. T. T. Administration of the Republic has ordered from the Telefonaktiebolaget L. M. Ericsson:

1) extension of the Central Exchange by 4,000 lines, i. e. from 1000 to 5000;
2) extension of the sub-exchange by 500 lines;
3) a 500-line satellite exchange of the same system for the Nömme suburb.

The order also includes a trunk exchange for 70 trunk lines, (final capacity of 120 lines), 13 operating positions with trunk junction lines to the Tallinn automatic and manual telephone exchanges.

— **On p. 3 of the "Ericsson News" Nos. 1—3 this year** the St. Rafael automatic exchange is reported to have started work in Nov. 1929. We now reproduce on p. 12 some views of this exchange.

— Among other matter, the 1929 Annual Report of the **Ungarische Allgemeine Creditbank** reports:

During the past year the »Ericsson» Ungarische Elektrizitäts A. G. vorm. Deckert & Homolka, in which concern we have an interest, has completed the alteration to the automatic system of our Head Office telephone plant. The advantages of the new system, both as regards faultless communications and reduced working

costs, are already apparent in spite of the very short time it has been in action.

— **Cooperation in Greece between L. M. Ericsson and Siemens & Halske.** For some years competition for the Greek telephone concession has been very keen between the great international telephone firms. In the beginning of this year, however, steps were taken to promote cooperation between Siemens & Halske and L. M. Ericsson, on the basis of an acceptance by Greece of the Siemens & Halske quotation. L. M. Ericsson having in consequence ceased working for their quotation, that of Siemens & Halske — with some minor modifications — has been accepted by all the authorities concerned.

The principal features of the telephone concession thus obtained are:

A Greek telephone company will take over the concession, build all the local telephone lines, and operate the local telephone plant for a period of 38 years. The long distance lines, however, will be built for the Greek Government, but the concessionaires will operate these lines for 13 years.

L. M. Ericsson will find a certain share of the operating company's capital, the remainder being subscribed by Siemens & Halske and some interested Greek parties.

Three Swedish engineers have already been at work for a month in Greece, preparing the project for the first installations.

— The **"Comité Consultatif International de Téléphone à grande distance" (C. C. I.)** — the International Consultative Committee for Long Distance Telephony — met in Stockholm on May 1st to 14th. Ten countries were represented at this congress, viz.: Belgium, Denmark, France, Germany, Gt. Britain, Holland, Soviet Russia, Sweden, Switzerland, and the United States. The Belgian representative, Mr. Fossion, acted as chairman, and the secretariat was managed by the Secretary General, Mr. Valensi, assisted by Mr. Rabillat and Miss Felix. Sweden was represented at this congress by A. Lignell, Superintendent of Telephones in Stockholm. On the 1st of May the Director General, Count Hamilton, welcomed the delegates in the premises of the Telegraph Office, which had been put at the disposal of the congress meetings, and these were immediately begun.

The main task of the sectional committee meeting in Stockholm was to draft a proposal for common international regulations for telephonists in various countries. The number of international telephone calls have lately increased rapidly, and a tendency towards further increase is noticeable. Swedish statistics, for instance, show that in March of this year no less than 408,805 international calls have emanated from Stockholm, while the number of local calls during the same period was 21,000,000. So far, no statistics have been collected for the whole world, but the number of international calls may be conceived by considering that 37.2 mill. telephones are now installed in all civilized parts of the globe, about 500,000 (c. 8 per 100 inhabitants) of which are contributed by Sweden.

The instructions for international telephone operators at present in force in various countries differ considerably. Undoubtedly the introduction of uniform regulations all over the world would facilitate and simplify international telephone communication.

The Mexican subsidiary of the Ericsson company, the "Empresa de Teléfonos Ericsson, S. A.", is also represented on the C. C. I. This is one of the few private enterprises which, in addition to local telephone nets, also operate long distance telephone lines. Since 1926 the concessions held by this company for local and long distance telephone service include the whole of the Republic of Mexico. Previously, the concession was limited to Mexico City and its surroundings, the so called Federal District. The number of subscribers in this area, 21,381 at the end of 1926, had at the end of 1929 increased to 29,190, a growth of 7,809. During these three years the company has either acquired or built some thirty telephone nets in different part of the country, comprising about 11,600 subscribers at the end of 1929. At the beginning of this year, the Ericsson Telephone nets in Mexico had about 42,000 subscribers. A number of nets are in course of construction and will be put in operation in the near future. At present the long distance lines of the concern are abt. 4,000 km. (2,400 miles) in length, with about 8,400 km. (over 5,000 miles) of double lines. The slender but strong poles are made of mannesman tubing. For long distance telephony, amplifiers are provided at suitable points along the lines. To increase the possibilities of simultaneous transmission, the most important lines are provided with devices for high frequency telephony. All amplifiers and high frequency devices are supplied and installed by the Svenska Radioaktiebolaget in Stockholm, affiliated to the Ericsson Concern. On account of the geographical and topographical conditions, which are unsuitable for putting up poles or laying cables, wireless telephony is also used for communication in the southern parts of the country.

In September of last year the Empresa de Teléfonos Ericsson, S. A. concluded an agreement with the American Telegraph and Telephone Co. for intercommunication between the long distance systems of the two concerns, and international telephone communication from Mexico to Europe and to other countries of the world that have joined the international telephone lines is thereby established.

— **The 1929 activities of the Ericsson Concern.** The annual general meeting of the Telefonaktiebolaget L. M. Ericsson took place in Stockholm on June 2nd. The table below, extracts from the Report of the Board, shows the result of the 1929 activities. The small figures give the corresponding values for 1928.

The 1929 net profits of the Telefonaktiebolaget L. M. Ericsson, including profit brought forward from 1928, are Kr. 7,169,348.52. Out of this amount, 4,839,904 kr. were distributed to the shareholders, i. e. a dividend of 8 per cent; 750,000 kr. were appropriated to the reserve fund, and 1,579,444.52 were carried forward to the 1930 Profit and Loss Account.

During the year the Company has taken over almost all the shares of the Förenade Signalverkstädernas Försäljnings A.-B. (Signalbolaget), about half of whose share-capital was previously held by L. M. Ericsson. The total sales for 1929 of this company amounted to 988,000 kr.

The installation of private telephone plants, fire alarm plants, time recorder apparatus, electrical clock installations, directors' telephones, etc., up to now undertaken by the Company, has during the year been transferred to a separate company, the L. M. Ericssons Anläggningsaktiebolag, in which the parent company holds practically all the shares. A concession has been applied for from the City of Stockholm for this company to put up electrically driven clocks, timed by a central control clock. In this connection, cooperation has been arranged with one of the largest German electrical clock makers, C. Theod. Wagner A. G., Wiesbaden, and a common sales organization, the C. Theod. Wagner Vertriebs A. G., Wiesbaden, has been formed.

During 1929 also, the Company factories have been fully occupied, and at times overrun by work. To expedite delivery of certain materials from the Telephone Factory, the Company has acquired the A.-B. Alpha, Sundbyberg, to which factory the manufacture of bakelite insulating material, electric condensers, and materials for railway signals has been transferred. At the end of the year this factory employed 194 persons.

Energetic rationalization has proceeded during the year, up to date machinery having been provided and improved processing methods introduced.

The foreign subsidiary factories have been increasingly utilized for the performance of special work on behalf of the Stockholm factory.

Among foreign subsidiary companies the British, Ericsson Telephones Ltd., is worthy of special notice for the excellent 1929 results. In spite of considerable sums written off as well as deposition for the covering of taxes, interests, and percentages for the directors, total about £ 45,000, this company made a net profit of c. £ 65,000. The corresponding figures for 1928 were £ 28,000 and £ 31, 000 respectively. In spite of having thus written off 60 per cent more, the net profit is more than doubled. When a dividend of 7 per cent had been paid on the preferred shares, the ordinary shares received 8 per cent, compared to 5 per cent last year. In actual fact the dividend is doubled, as this year's dividend is free of income tax. The company's position as a supplier of automatic telephones is

Units	Orders during 1929, in Swedish Kronor					Employees	
	On hand Jan. 1st	Received	Total	Completed	On hand Dec. 31st	1/1/1929.	31/12/29.
Stockholm Telephone Factory	17,674,448	29,098,934	46,773,382	26,363,050 25,903,279	20,410,332	2,825	3,336
Cable Works, Älvsjö	1,166,939	6,320,206	7,487,145	5,540,409 5,243,208	1,946,736	248	294
Sievert Cable Works	3,788,906	13,648,860	17,437,766	13,529,284 9,252,952	3,908,482	410	453
Svenska Radio-A/B	593,585	3,466,319	4,059,904	3,787,953 1,992,731	271,951	342	524
Total	23,223,878	52,534,319	75,758,197	49,220,696 42,392,170	26,537,501	3,825	4,607
Factories and Sales Organizations abroad	14,686,000	46,325,000	61,011,000	39,912,000 35,741,000	21,099,000	10,259*)	12,642*)
Total	37,909,878	98,859,319	136,769,197	89,132,696 78,133,170	47,636,501	14,084	17,249
Revenue from Concessions	—	—	—	28,800,000 23,500,000	—	—	—
Grand Total	—	—	—	117,932,696 101,633,170	—	—	—

*) Including Home plants and all concessions.

well established, and considerable contracts for deliveries both to the British Post Office and abroad have been secured. During the year the company engineers have been engaged in designing a wholly automatic and effective totalisator system for race meetings, and large contracts have been made with the British Race Course Betting Control Board.

A comparison of this Report with those of previous years indicates an activity expanding year by year. The gross sales of Swedish and foreign manufacturing and selling companies have increased by 14 per cent compared to the 1928 results, while orders on hand at the end of the year are c. 25 per cent larger. During the last year the number of subscribers to the concession concerns affiliated to the Company has increased from 141,005 to 175,661, and at the same time the gross income from these companies has increased by more than 23 per cent. It should be noted that 175,661 subscribers is nearly the same number as in 1917, i. e. before the Stockholm and Moscow telephone systems were transferred to the respective Governments. Compared to 1928, the total 1929 turnover of the Concern has increased by 17 per cent. This increased activity demands the investment of large capital sums for building factories and extending telephone lines in the Company's concession areas. The factory of the French subsidiary company at Colombes, for instance, is being extended to a production capacity many times larger than before. During a trip of the Managing Director's to South America and the U. S. A. this year, an agreement was made for the extension of the telephone lines of the Concern in the province of Entrerrios in Argentina to include the whole northern and western parts of the Republic, and another with the Bell Telephone Company for intercommunication between their telephone lines in North America and the Ericsson Mexican lines. Capital is moreover required for taking up new concessions, negotiations for which have been in progress for some time. The prospects of obtaining new concessions are good. A tangible result, mentioned elsewhere in this number, can already be shown, as the Company, in conjunction with Siemens & Halske, has taken over the building and operating of the Greek telephone system.

On the recommendation of the Board, the meeting resolved to increase the present share capital of L. M. Ericsson, 60,498,800 kr., by 40,332,500 kr. to a total of 100,831,300 kr.

— **Newly installed Fire Alarm Plants** on the **L. M. Ericsson modern supervisory current system.** On January 26th last, the Fire Alarm Telegraph supplied by L. M. Ericsson to the Borås Fire Brigade was taken into use, replacing the previous, more than 30 years old, indicator operating current system.

This plant comprises a station equipment consisting of an alarm board (see illustration p. 6) in four sections, to 3 of which are connected alarm box loops — 3 to each section — and the fourth is provided with apparatus and devices for local alarms in the Fire Station, time recording of the turning out, devices for charging accumulators, etc.

A novelty of this installation is that, in addition to the double morse apparatus to each section of the alarm board, (corresponding to two single morse receiving sets) a double morse control apparatus is provided, common to all the sections and combined with a time recording apparatus.

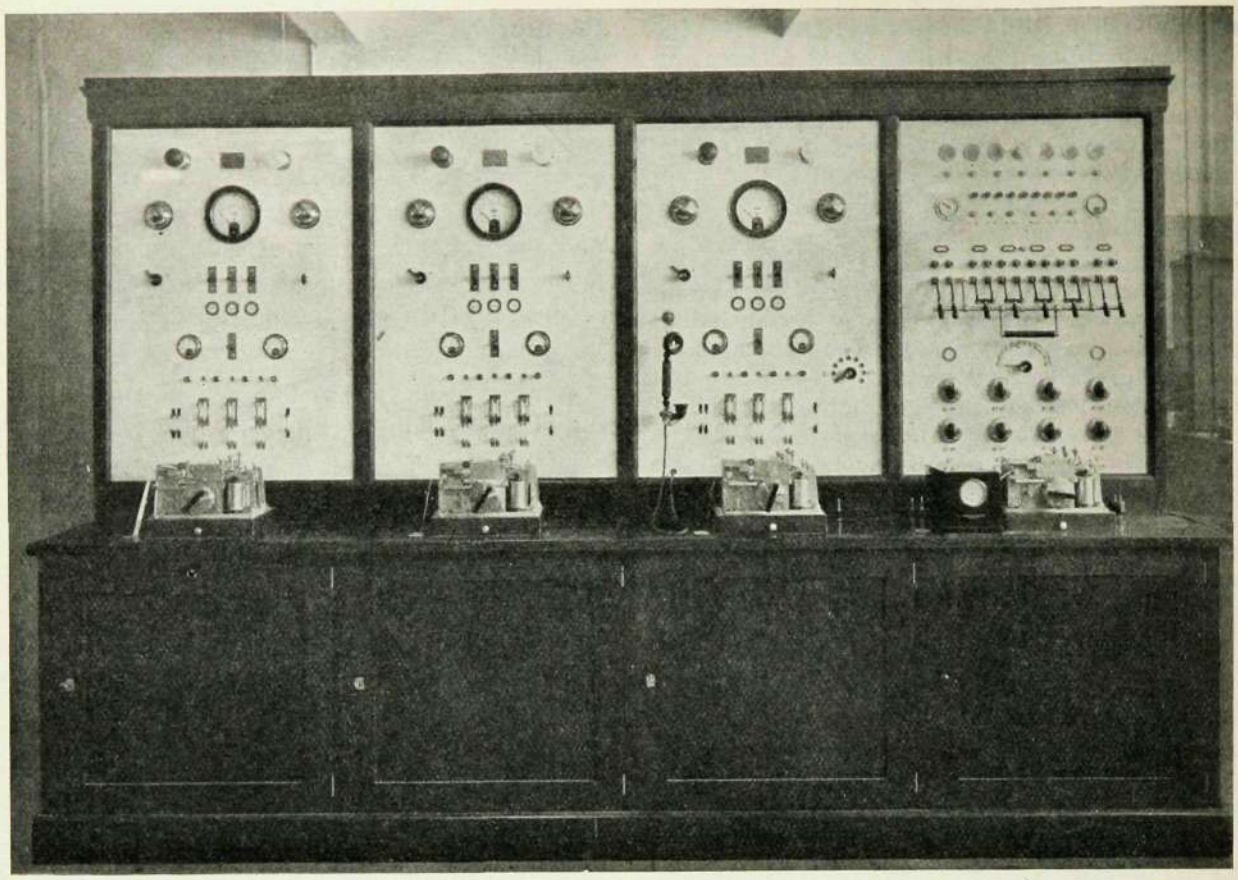
Normally, this device causes all alarm signals coming from a fire alarm box to be automatically registered by two double morse apparatus, i. e. by what corresponds to 4 single morse sets. The controlling morse, worked partly from a separate source of power, acts quite independently of the main apparatuses, thus rendering the whole arrangement considerably more reliable than if only two single morse sets were used. — To avoid accidental contacts between live parts, totally enclosed switches of an entirely new design are used for charging and switching over the accumulator batteries of the system, instead of the knife-switches previously used.

The telephone equipment of the alarm board is connected to the private Fire Brigade Exchange, with extensions to all brigade offices, living quarters, etc. in the fire station, which makes it possible to put through calls in the usual manner from any fire alarm box.

The present number of alarm boxes is 114, of the L. M. E. TH 371 type worked by a handle, and with fixed telephone apparatus (as described in the pamphlet "Ericsson Fire Alarm Systems", B 12 E, p. 18 fig. 8), about 90 of which are public and private boxes, the latter installed in industrial plants, hospitals, theatres, and other places.

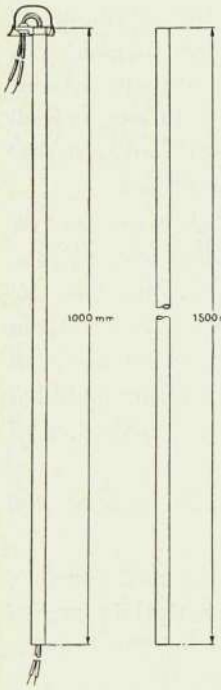
The plant can be extended to include 200 alarm boxes.

Insulated fire telegraph wire is used for outside lines, and all conducting materials are of the highest quality. The length of the lines is about 65 km. (39 miles).



R 1617 Alarm Board in the Borås Fire Station.

All the outside lines and alarm boxes have been most satisfactorily put up by the firemen, who have also done any other installation work required for the proper working of the plant — with the exception of the instrument board, put up by the contractor.



Another novelty of this installation is the new type of leading-in pipes for wires to the alarm boxes, shown in the illustration below.

Beyond this comprehensive and excellent outfit, fully up to the high standard of other up to date fire-preventive appliances in Borås, about 20 other new plants have been supplied during the last two years. Among these, except of the town of Lund, the plant of which was decsribed in No. 12 of Ericsson News, 1929, the followings might be mentioned: the towns of Enköping, Landskrona, Sollefteå, Vänersborg, Värnamo, Ängelholm, and Örebro, as well as the communities of Kiruna and Kumla. In all these places the morse supervisory current system has been installed.

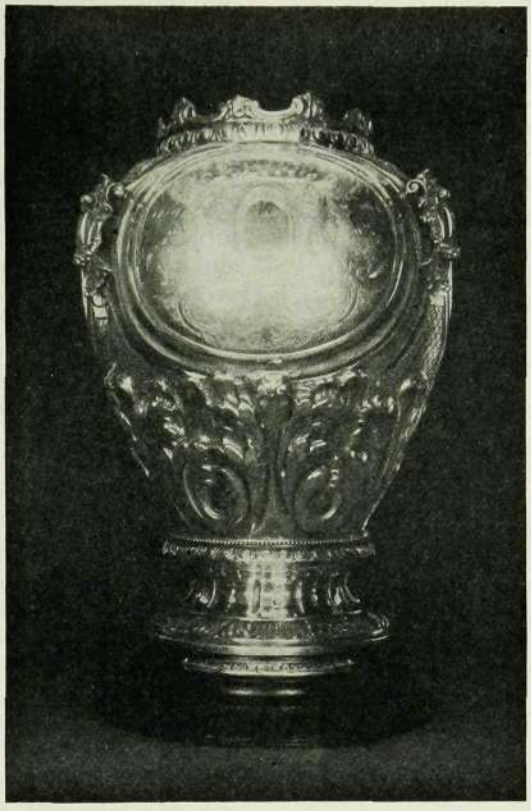
For other plants in smaller communities the Ericsson Fire Alarm System with Ringing Generator has been employed which system is gradually gaining ground.

— **Ericsson Automatic Fire Alarm System in Action.** In the forenoon of March 26th, the Stockholm Fire Brigade was turned out by an alarm from the new Stockhaus Building on Blasieholmen. On this occasion the automatic fire alarm recently installed by the L. M. Ericssons Anläggningsaktiebolag functioned, thereby alarming the Fire Brigade direct and simultaneously ringing the alarm bells in the building. The fire was soon discovered; it was in a part of the basement seldom visited, where some waste paper had ignited. The Fire Brigade

arrived before any one had observed the fire and turned in an alarm. If the fire had had time to spread, the firemen might have had a troublesome job — as it was, a couple of bucket pumps turned the trick in a few minutes.

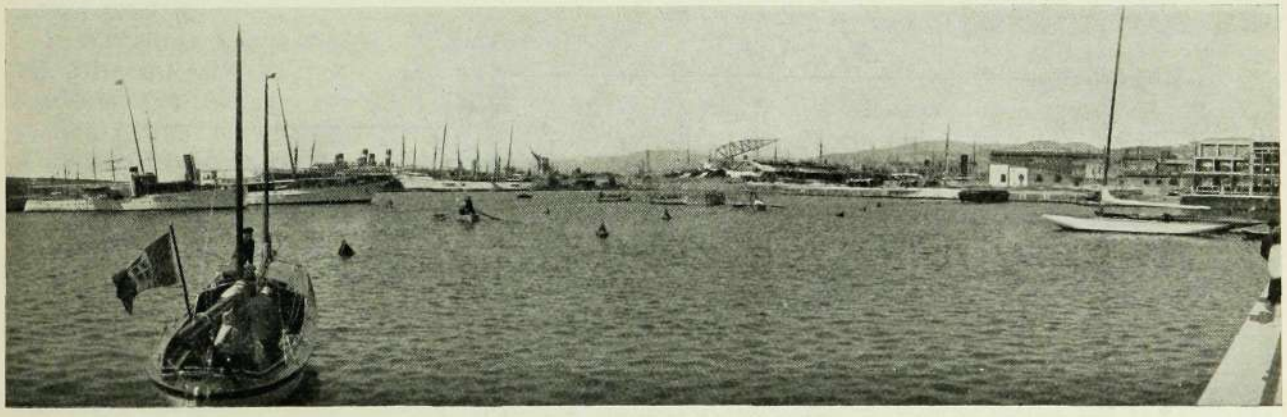
The origin of the fire has not yet been fully established, but some sparks may have found their way through a ventiduct from the attic, where certain welding operations had been performed the same morning.

— **The world-famous Genoa International Regatta** was held April 19th —27th inclusive. These competitions were of special interest to Swedish yachtsmen in general and to Swedes in Italy in particular, as the 6-metre class (in which a number of nations were represented) competes for the so called "Coppa Ericsson", among other prizes. — The "Coppa Ericsson" was instituted in 1928 by Director Elow Kihlgren, who is living in Genoa and for many years has been a warm adherent of all sailing sport; the annual costs are borne by subscriptions from Swedes, members of the Ericsson staff in Italy and Sweden. The first year this challenge cup was won by the "Aeolus" yacht club of Gothenburg with the boat "Windy". The second year Denmark carried off the trophy with the "Dana". This year nine nations took part in the race, viz.: Italy, Sweden, Denmark, France, England, America, Germany, Cuba, and Spain. Sweden was represented by Erik Åkerlund's "Bissbi", handled by Sven Salén, that very successful helmsman. Italy brought a new Six, the property of the wellknown yachtsman Comm. Bruzzone. Denmark sent the "Dana", well known from previous occasions, and the "Da Du". Nor was Madame Heriot, the popular French yachting lady, absent with her new "Ailée". America sent two Sixes, the U. S. A. 36 "Lucia", owned by Mr. Briggs S. Cunningham, and U. S. 40 "Sallema", belonging to Mr. Walter Bowes, both newcomers to Genoa.



R 1611 The »Coppa Ericsson».

This time the prize was won by Spain, represented by the light wind boat the "Lau", with Count Tarsi, a sportsman who is well known in Sweden also, at the helm.



R 1612 The yacht harbour of Genoa.

Some Reflexions on Line Balancing.

For balancing cable capacity between the wires in a quad there have hitherto, as is well known, been chiefly employed two methods, viz. the condenser-balancing and the test-balancing method. Svenska Radioaktiebolaget has elaborated a couple of methods which enable capacity balancing of telephone lines to be made easily and cheaply.

It has been found that by augmenting the mutual induction between the wires it is possible to compensate for both the capacitative and the inductive unbalances for all frequencies, which can also be verified theoretically.

This increase in the mutual inductance can easily be attained by locating at suitable points of the line magnetic circuits consisting of strip, wire, compressed iron powder or similar magnetic materials, which surround the wires which are to be balanced. The desired increase in the mutual induction may most easily be accomplished by winding with iron wire or iron strip.

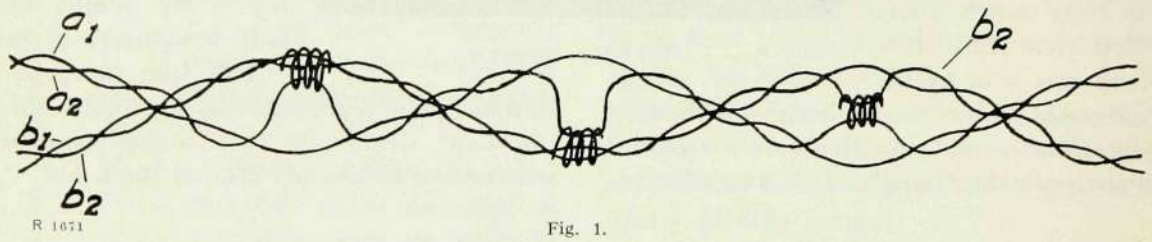
In fig. 1 is shown diagrammatically a quad consisting of two phantomed physical circuits (a_1, a_2 and b_1, b_2 respectively), in which compensation is brought about by winding or wrapping with magnetic material those wires whose capacity unbalances are to be compensated.

In fig. 2 is shown a method for balancing a section of the quad. An alternating current source S is connected to the lines in different manners. The figure illustrates the source switched to the centre point of the circuit terminations x_1, i. e. to the phantom circuit. By means of a telephone T, we are able to discover any possible crosstalk (due to capacity unbalance) between the phantom circuit and either of the side circuits. For balancing the two side circuits we switch the current-source to one of the side circuits and the telephone receiver to the other. Balancing is effected by winding an iron wire around the cupper wire until the receiver is silent.

In fig. 3 is shown a method of balancing the loading coils of the line separately and the sections of the line between the loading coils separately. The balancing of the line sections properly takes place at their centre point (DE) and the balancing of the loading coils at respectively B and H. The splicing at D, E should preferably be made in such a way that one quad from D and one from E, which possess the most different characteristics possible, are spliced together. In this way some of the inductive balancing is replaced by capacity-balancing. It is advisable first to splice the quads with the greatest unbalances and then the quads with smaller and smaller unbalances.

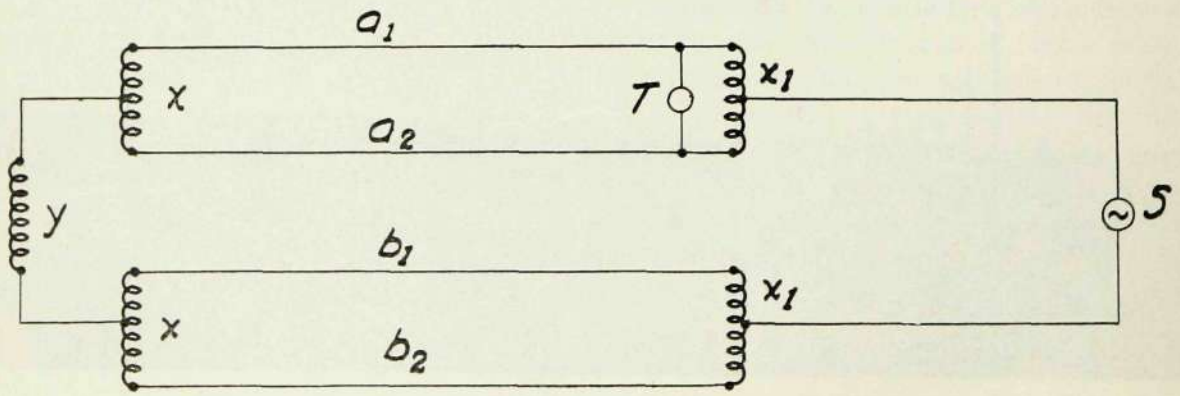
If for some reason one wishes to bring about balancing with the least possible quantity of material, the winding or wrapping had better be done with magnetic material with a high initial permeability, e. g. permalloy or "mumetal".

Balancing can also be effected in such a manner that a separate calibration impedance or



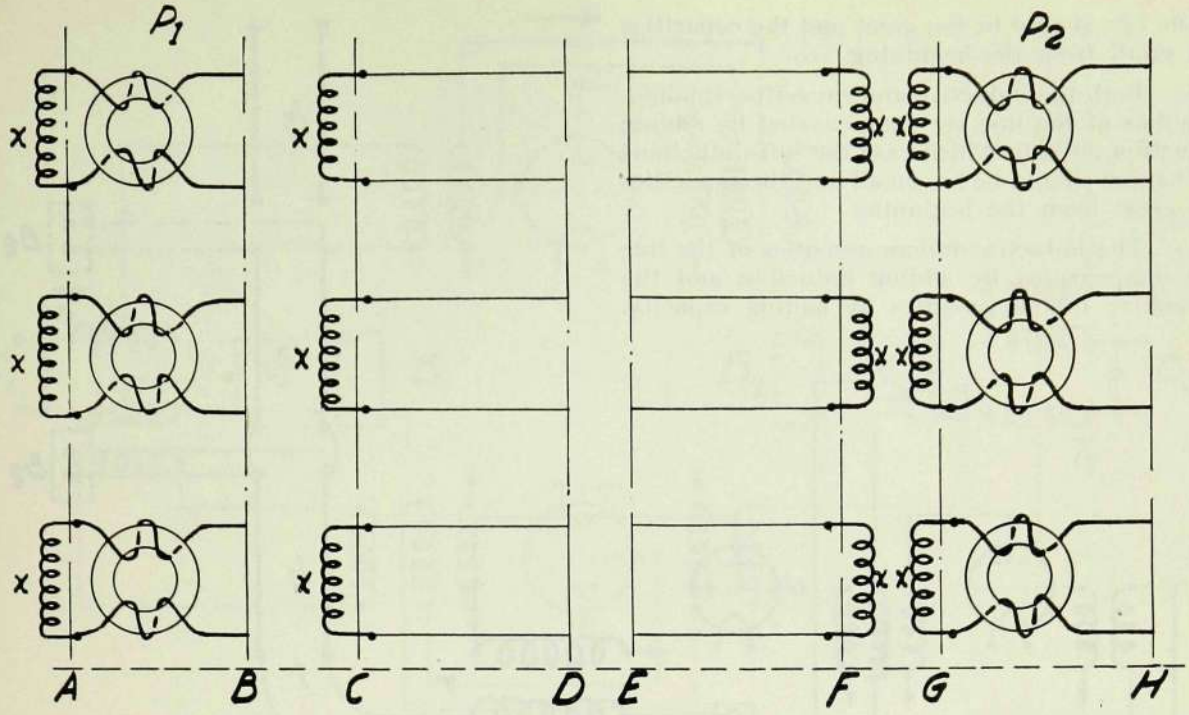
R 1671

Fig. 1.



R 1672

Fig. 2.



R 1673

Fig. 3.

standard balance is compared with the line's characteristic impedance, when the existing difference as compared to the said standard balance is smoothed out by any of the said methods of balancing.

In fig. 4 is illustrated a method of carrying out balancing with standard balances. The line is divided into a number of sections l_1, l_2, l_3 etc. A line balance B_1 with a certain fixed standard impedance is connected to the hybrid coil T, and this impedance corresponds to the characteristic impedance wanted for the line. The primary of the hybrid coil is connected to the output side of a two-valve amplifier and the two centre points of the hybrid coil winding are connected to a reaction coil on the input side of the amplifier. The intervalve transformer is provided with an extra coil to which is connected a telephone receiver.

In adjusting the balance it is advisable that the different sections l_1, l_2, l_3 are adjusted successively. We therefore commence with the first section l_1, the next section being disconnected. A standard balance B_2 of exactly the same kind as B_1 is connected at the distant end of section l_1. Now, if the characteristic impedance of line section l_1 were exactly the same as the impedance of the standard balances B_1, B_2, perfect balance would exist between the impedances connected to the two sides of the hybrid coil and there would be no reaction in the amplifier. If, on the contrary, inhomogeneities exist in line l_1 there will be a certain amount of reaction in the amplifier and it will become self-oscillating, which can be controlled by listening in the telephone receiver.

We now connect to line-section l_1 some small supplementary capacities, inductances or resistances, which are adjusted in such a way that the sound in the receiver ceases. Perfect balance is then attained. When the first section l_1 is finished, we pass on to the next section l_2. The connection between the sections is then closed and the standard balance B_2 transferred to the distant end of section l_2, after which section l_2 is adjusted. In this way the different sections are adjusted while successively prolonging the line. Of course, each section can also be adjusted separately.

As has been stated in the preceding, a capacity unbalance can be compensated by an inductive one, or vice versa, which holds good for all frequencies, if the characteristic impedance of the line is practically independent of the frequency. In balancing the inhomogeneities of the line we may therefore proceed in the following different ways:

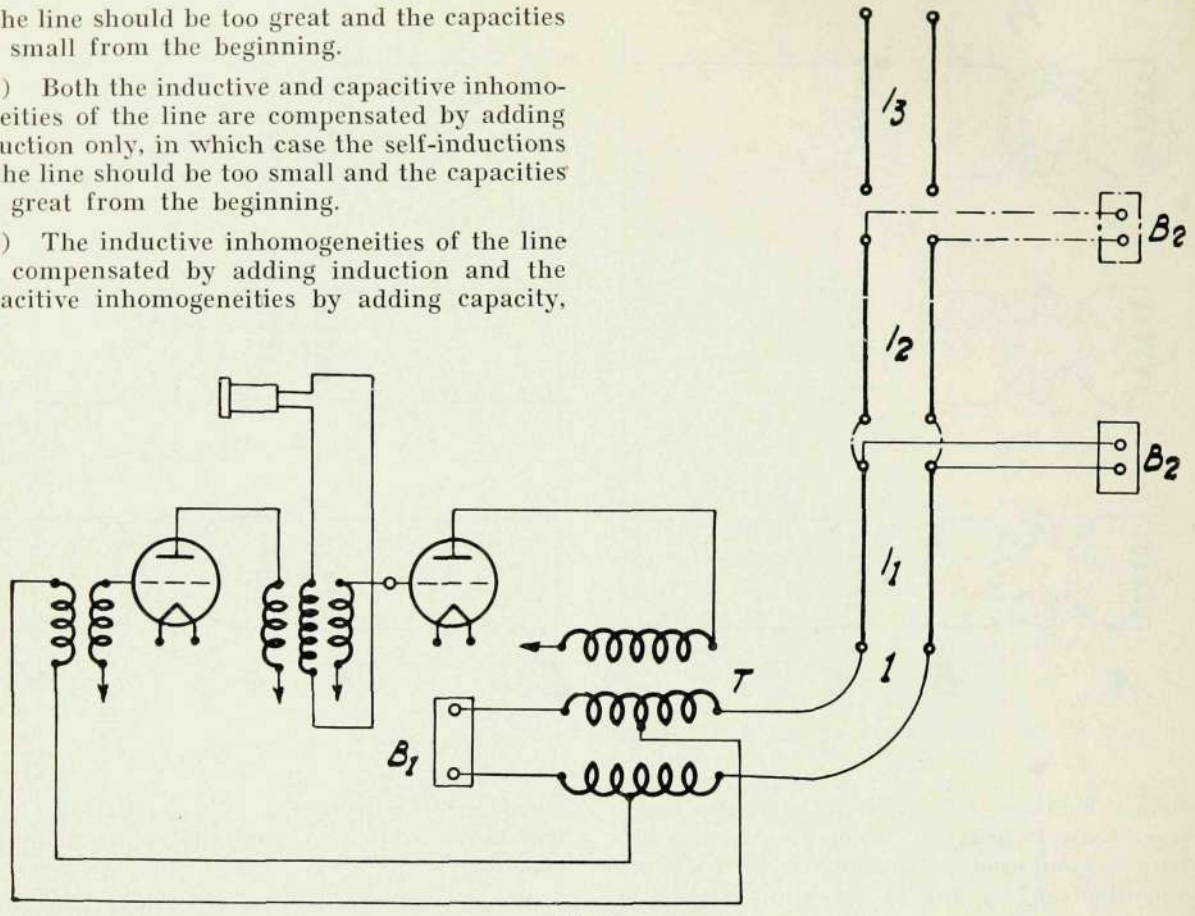
1) Both the inductive and capacitive inhomogeneities of the line are compensated by adding induction and capacity, the capacity having to compensate positive inhomogeneities and the induction negative ones.

2) Both the inductive and capacitive inhomogeneities of the line are compensated by adding capacity only in which case the self-inductions

of the line should be too great and the capacities too small from the beginning.

3) Both the inductive and capacitive inhomogeneities of the line are compensated by adding induction only, in which case the self-inductions of the line should be too small and the capacities too great from the beginning.

4) The inductive inhomogeneities of the line are compensated by adding induction and the capacitive inhomogeneities by adding capacity,



R 1674 Fig. 4.

in which case both the self-induction and capacity of the line should be too small from the beginning.

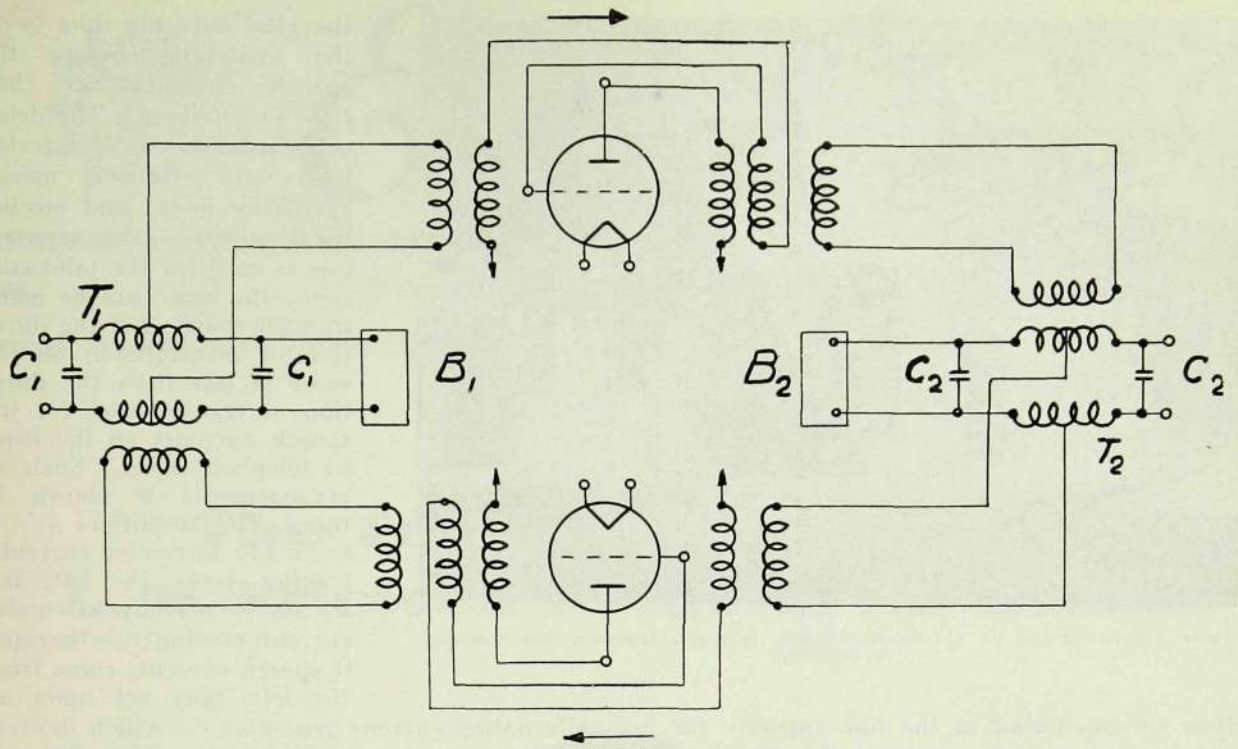
When splicing line section in a line-bundle with several lines it is advisable to pair the line-sections in such a way that the possibly existing or remaining inhomogeneities of the spliced sections balance one another as far as possible.

The standard balances used should have the same dependence on temperature as the line impedances and should therefore be made of material with the same temperature coefficient as the material used for the line. In making adjustments one should also remember that the standard balances must be subjected to the same temperature as the line.

On Devices Which May be Used for Counteracting the Development of Echoes in Two-wire Repeaters. (Echo-Suppressers).

Svenska Radioaktiebolaget has developed some methods for suppressing the echo-effects in two-wire repeaters. In ordinary two-wire repeaters a differential transformer is inserted between the line and a line-balance. The line-balance, whose impedance is adapted to the characteristic impedance of the line, has for its purpose to prevent incoming currents from circulating within the two amplifiers in a repeater. On the other hand, the line balance cannot prevent reflexion of incoming currents. This would, however, be possible if the same were directly connected to the line without the interpolation of the differential transformer.

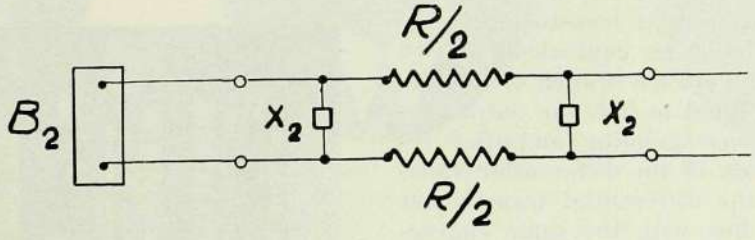
To enable this, the differential transformer including the input and output impedances of the amplifiers connected to the same, is designed as an artificial line (four pole) whose characteristic impedance is equal to the characteristic impedance of the line and accordingly also equal to the impedance of the line balance. If the said artificial line has no attenuation the result is



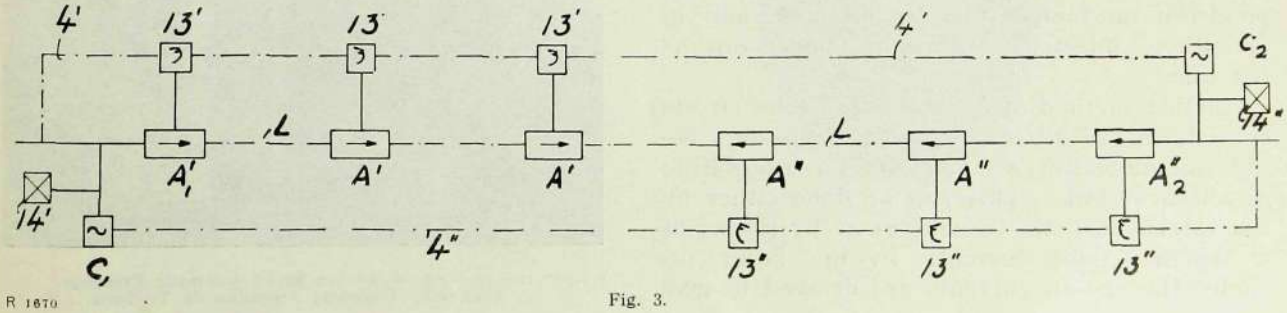
R 1668 Fig. 1.

the same as if the line-balance were directly connected to the line.

In the two-wire repeater shown in fig. 1 the input transformers are made with very great self-induction so as not to have any influence on the characteristic impedance of the artificial line. The amplifiers are furthermore constructed as compounded thermionic valves (according to Swedish Patent No. 62633 and several others), i. e. the influence of the anode load on the input voltage is compensated by help of reaction. By this means the amplifier is made to behave as if it had an infinitely great interior resistance and the action of the impedance of the output transformer upon the input and end impedances of the differential transformer is consequently eliminated. In order to make the characteristic impedance of the artificial line as far as ever possible equal to those of the line, two condensers C_1, C_1 and C_2, C_2 respectively are shunted to the line, the inductance of the secondary of the differential transformer being adapted in such a way that it is equal to the inductance of a loading coil on the line, and each of the two capa-



R 1669 Fig. 2.



R 1670 Fig. 3.

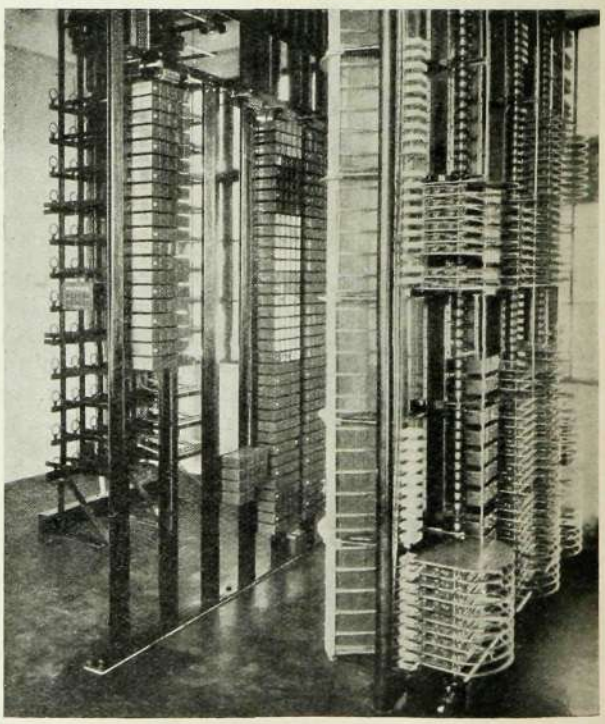
R 1614 Exterior view of the San Rafael Automatic Exchange, Argentina. Cia Argentina de Teléfonos.

cities corresponding to the line capacity for a half loading section, provided the line is terminated with a half loading coil-section. The differential transformer can also be designed in such a way that it is equivalent to several loading coils together with appartenant sections of the line.

If the amplifiers are not compounded, the output impedance of the amplifier represents a finite ohmic resistance. The two halves of the secondary of the differential transformer may, therefore, be considered as equivalent to two ohmic resistances, one in each branch of the line and each one being equal to half the output resistance R of the corresponding amplifier reduced to the secondary of the differential transformer. To make the differential transformer act as an artificial line with the same characteristic impedance as the line, two impedances x_1, x_2 are shunted to the line. As regards its relation to the line, the differential transformer may, therefore, be represented by the diagram shown in fig. 2.

In the practical design the line balance and the artificial line formed by the differential transformer must be made with the same dependence on temperature as the line, and in operation subjected to the same temperature as the line.

Another method of counteracting echo effects consists in the different two-wire repeaters being automatically switched over for alternating direction of talk. This can be done either by the speech currents themselves or by means of a separate pilot current. In the latter instance the speech currents are delayed to give the pilot currents time to do the switching before the speech currents have had time to get there. The delay or retardation can be effected both with electrical means (artificial lines) and mechanical means. If a separate line is used for the pilot currents, the same can be made in such a way that the duration of transmission on the same is less than the duration of transmission for the speech currents on the loaded telephone lines. Such an arrangements is shown in fig. 3. The amplifiers A_1', A' are ready to receive currents, coming from the left, and A_2'', A'' are ready to receive currents coming from the right. If speech currents come from the left, they act upon an alternating current generator C_1, which delivers a pilot current over the line 4″. The pilot current gets there before the speech currrents and switches over the amplifiers A_2'', A'' for this direction of speech. The pilot current also actuates a switch 14″ which disconnects C_2 from the line. The switches 13′, 13″ respectively 14′, 14″ can preferably be made as electrical relays, e. g. with neon-lamps, which work much more rapidly and safely than mechanical relays.



R 1615 Interior view of the San Rafael Automatic Exchange, Argentina. Compañía Argentina de Teléfonos.

Kurt Lindberg, Boktryckeriaktiebolag, Stockholm 1930.