Automatic Section Blocking on the Line Stockholm Östra—Stocksund.

By H. Forssberg, telegraph superintendent.

The line between the stations Stockholm Östra and Djursholm is the first stretch on the Stockholm Roslagen Railway. The traffic here is very heavy, with electric trains to Djursholm, steam trains to Roslagsnäsby, Täby, Vallentuna, Viggbyholm and Österskär, and some passenger and freight trains to upper Roslagen.

The stretch between Stockholm and Stocksund is 4.5 km in length and is a double-track line except on the bridge over the Stocksund sound, which is single-tracked. This bridge is within the Stocksund station area.

The appearance of the line previous to its being equipped for automatic section blocking is shown in fig. 1.

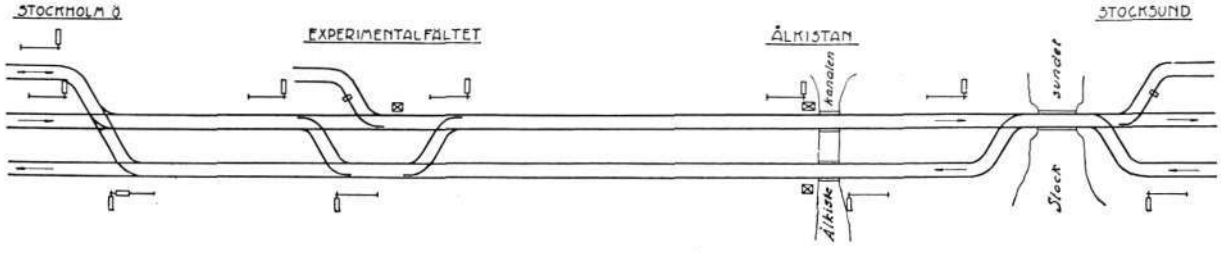

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Fig. 1. The line Stockholm Ö—Stocksund.

Blocking posts were arranged at Experimentalfältet and Ålkistan and the line was divided up into three block sections. This sectioning of the apparantly short line between these two stations was necessitated by the train frequency, which at times is very close — this line being trafficked daily by about seventy trains in each direction —, besides which the block posts served as protection for the switches in the main tracks at Experimentalfältet and for the bascule bridges over the Ålkiste canal at Ålkistan.

The line is trafficked during about twenty hours of the entire day, the working hours at the block posts being divided up into three shifts with one man per block post and shift. Consequently, the personnel required at the two block posts amounted to six men.

The appearance of the line after the introduction of automatic section blocking is schematically illustrated in fig. 2.

According to the new system, each track has been divided into six sections, permitting a doubling of the train frequency. The sections vary in length from 529 to 718 metres, the number of stopping places — three arbitrary stops being provided for the electric trains — as well as the curves on the line having been taken into consideration when determining these lengths. The block sections are denoted by the letter I together with the numbers 1 to 6 for the left track and 15 to 20 for the right track.

The system is built on the track circuit principle, i. e. with energized rails and with each block section insulated from the adjoining sections as well as from

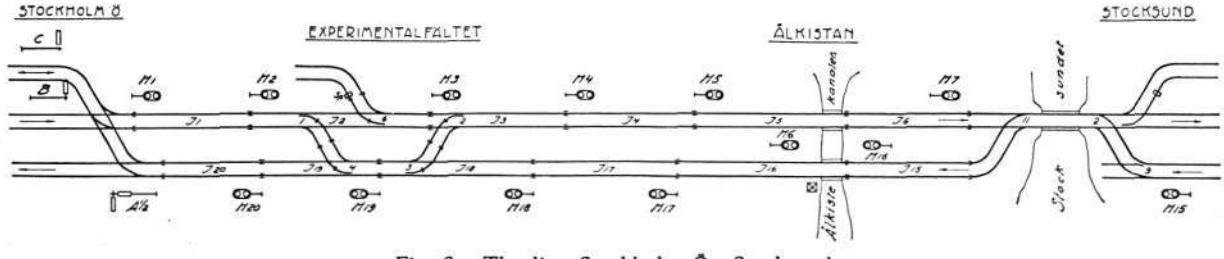

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Fig. 2. The line Stockholm Ö—Stocksund.

that part of the line not included in the system. This principle is illustrated in fig. 3, which gives the schematic diagram of a block section with the arrangements at its ends, and adjoining block sections.

The track circuit current is obtained through a transformer Spt (220/1 to 12 volts). The connections of the track relay Sr being placed at the opposite end of the section.

The diagram shows how a contact group on this relay serves to switch on the different lamps of a light signal. Sit are two signal transformers for reducing the tension of the light current from 220 to 12 volts. The arrangements I f at the circuit limits are impedance bonds. The system is more closely described under the various subtitles.

In the foregoing we have already mentioned that this line is trafficked by electric trains, from which we have understood that it is electrified. The traction current is 650 v. D. C., all four rails of the two tracks serving as return conductors. For this reason A. C. has been chosen for the block system, so as to avoid disturbances from the traction current.

The necessary current for the block system — in the form of 2-phase, 220-volt, 50-cycle alternating current — is obtained from the Stocksund power plant and delivered to the signal cabin in Stocksund, in which is mounted a switchboard with fuses, meters and switches. From here an underground cable — containing 2+6 conductors of 25 and 3 sq.mm. respectively — leads to the Stockholm Östra station.

Light signals and relay cabinets are placed at the ends of the block sections (see fig. 4).

The above-mentioned cable is led into all of the relay cabinets and connected with the terminals of the various instruments which they contain. Fig. 5 shows the placing of these instruments in a relay cabinet containing apparatus for two opposite block sections (I 6 and I 16), in which respect it differs from the other cabinets.

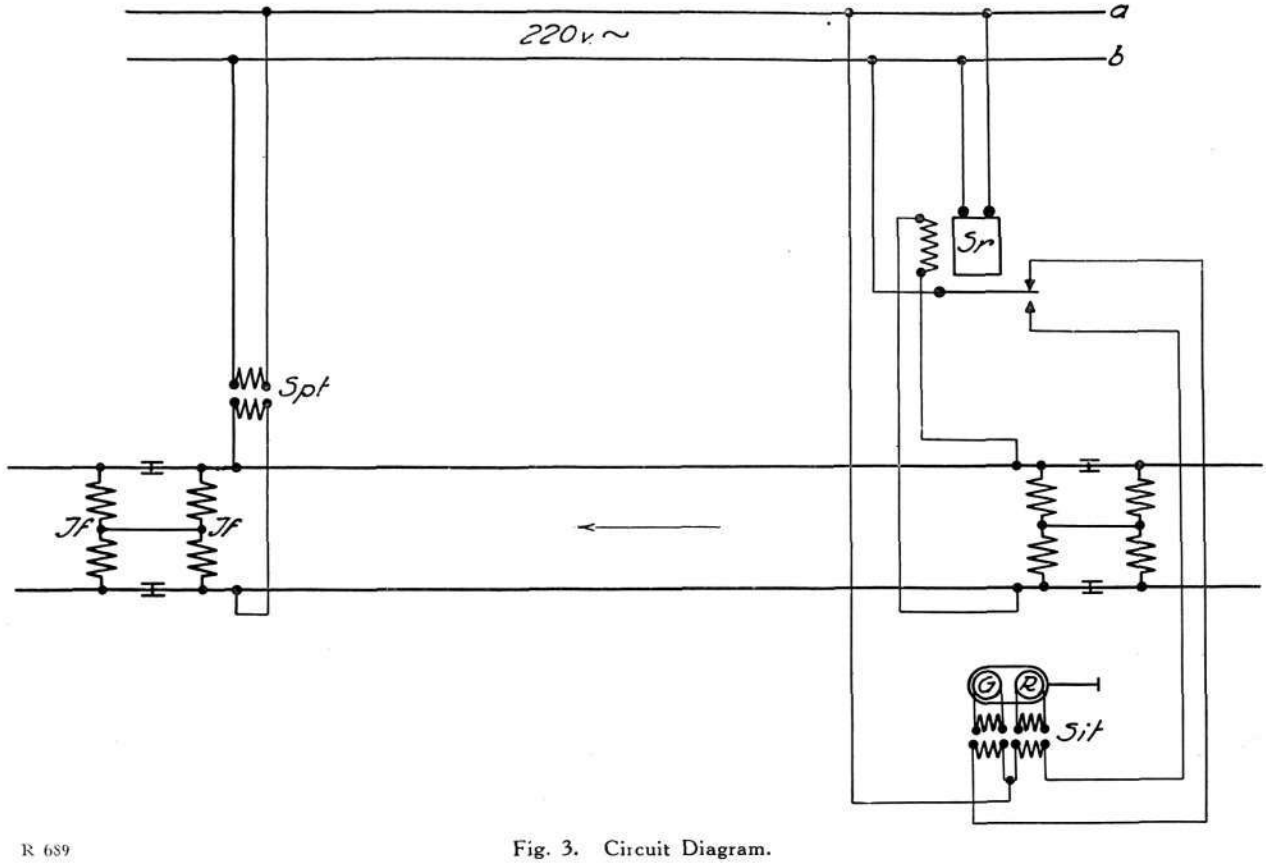

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Fig. 3. Circuit Diagram.

The light signals have two lights, the one showing green and the other red. Each light has an inner coloured lens and an outer colourless converging lens. The lamps are for 12 volts and have an effect of 12 watts, a special adjustment permitting the accurate focusing of the lenses so that a clear and strong light is obtained in spite of the low effect of the lamps.

The light signals are mounted on standards of steel tubing, the cable from the relay cabinet being

led up inside the tube. The standard is provided with a ladder giving easy access to the signal.

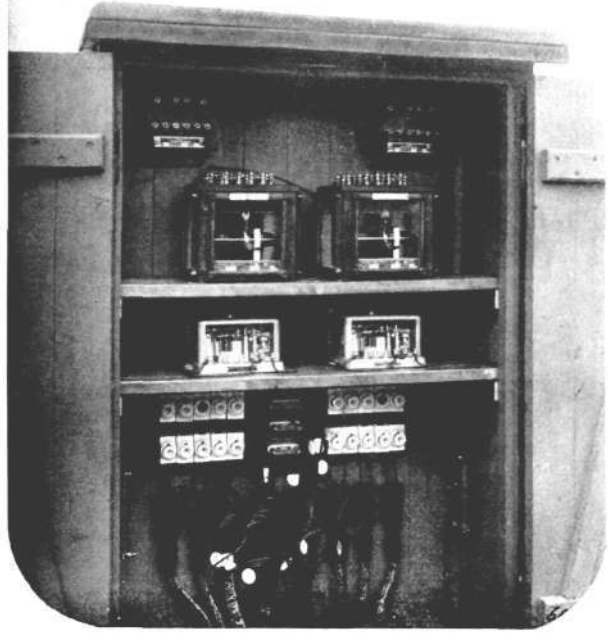
The light signals are denoted by the letter H and one of the numbers 1 to 7 and 15 to 20 (see fig. 2).

The different apparatus of this plan are as follows:

Track transformer for 220/1 to 12 volts. The secondary winding has terminals for all the different voltages between 1 and 12, from which the track circuits are supplied with a 6 to 7 volt current. A safety device is placed between one of the transformer terminals and one of the tracks, while between the other terminal and the other track is placed a rheostat of 1 ohm and 8 amperes for regulating the track current. A certain portion of the resistance of this rheostat must always be in circuit to prevent the transformer being short-circuited at the same moment in which a train passes the feed points of the transformer.

Track relays: two-position, two-element relays for a local tension of 220 volts and a tension of the track current at the relay of 1.1 volts. Both windings of these relays — for the local current and for the track current — must be calculated so as not to counteract each other. This arrangement with 2-phase current gives added reliability to the system, as demonstrated in fig. 6.

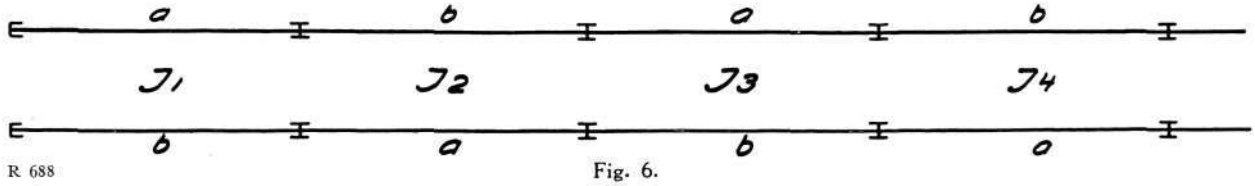
R 681 Fig. 4. Light Signal and Relay Cabinet.



R 682 Fig. 5. Relay Cabinet.

The so-called *a* and *b* phases (see also fig. 3) are connected to the same rail at every other block section. If a phase were to be connected to the same rail in two adjoining block sections and the insulating joints should become faulty, the relay in one section would be actuated by the track current of the other section. This danger is eliminated by the above described arrangement, because the unduly admitted track current cannot energize the relay on account of its different phase.

The relays are provided with six back contacts and



R 688 Fig. 6.

four front contacts, wherewith a large number of circuit combinations are obtained.

Signal transformers for 220/12 volts, mounted in the relay cabinets. As already mentioned, the signal lamp current of 12 volts' tension is obtained from the signal transformers, one transformer being provided for each lamp in the signal. The method of connecting up these transformers is shown in fig. 3.

Lastly, these relay cabinets contain electric *intermittent flashing devices*, working with a 220-volt current. The method of connecting up the flashing devices is shown in fig. 7. As indicated in the diagram, the flashing device for a certain signal is placed in the relay cabinet for the following block section. Thus, the flashing device which produces a flashing light in the signal H 1 (see fig. 2) is placed in the relay cabinet at H 2. As soon as a train entres a block section, the working current to the flashing device for

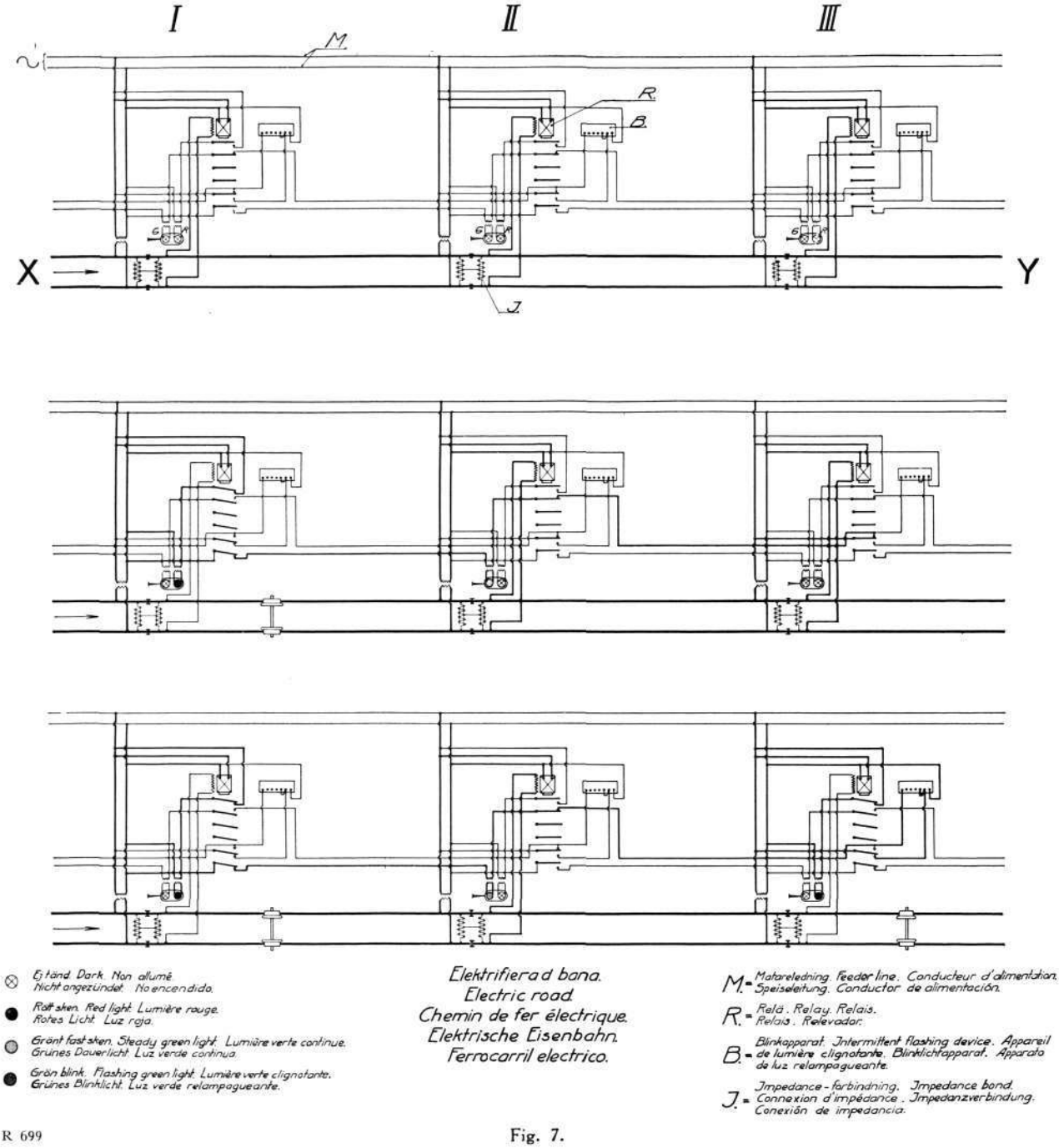


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Fig. 7.

the next signal to the rear of the train is connected up although this signal remains dark.

This block system differs from others previously installed in that the signals are dark when in normal condition.

This system affords a decided saving in electric current, as well as a longer life for the lamps, the total burning time per lamp being reduced to not more than 2.5 to 3 hours per day.

Fig. 7 illustrates the three different phases in the functioning of the block system. The upper figure

R 683 Fig. 8. Impedance Bond.

represent a stretch of track X—Y clear of trains, the relays being energized and the signals dark. The middle figure shows a train that has entered the first block section, the signal to the rear showing a red light and the signal in front of the train a steady green light, thereby indicating »clear». The lower figure shows the condition of the track with trains on the first and third sections, the first and third signals showing a red light, while the middle signal shows a flashing green light (caution). The heavy lines in the diagrams indicate the circuits in each special case.

As already intimated, special arrangements have been provided at the ends of each track section for the purpose of confining the track circuits to each respective section, at the same time providing a good metallic bond between adjoining sections for the return of the traction current. To accomplish this purpose impedance bonds have been placed at both ends of each block section and connected to the rails. Fig. 8 shows two impedance bonds, the cover of one having been removed to show its construction.

As may be seen in the illustration, four heavy copper cables — each with a cross section of 160 sq.mm. — are used for the connections between the bonds as well as for the connections to the rails. The ohmic resistance of the impedance bonds is negligible, the copper bands in the windings having a cross-section of about 200 sq.mm. In order to equalize the electric traffic load in the two tracks in case the traffic over one of tracks is heavier than over the other and so as to be able to utilize all four rails for the return current, equalizing connections — consisting of copper cables with a cross-section of 100 sq.mm. — have been provided between the pairs of bonds in the one track to the nearest pair of bonds in the other track, these connections terminating at the middle outlets of the impedance bonds.

The starting semaphores B and C and the home semaphore A½ are connected to the automatic section blocking system at the Stockholm Östra station. As concerns the starting semaphores, the connection is made in such manner that the wing couplings receive their current over the track relay for section I 1. Thus, if this section is blocked and the relay de-energizes, the wing couplings receive no current and it is not possible to set the semaphore to »clear». Wing contacts are also provided, over which current is fed to the green light of the signal H 1. Consequently, if the section I 1 is clear and one of the semaphores B or C is set to »clear», the green light of the signal H 1 is lit, thereby giving a »clear» signal. After the train has entered the section I 1, the wing of the starting semaphore drops to »stop» and H 1 shows a red light as long as the train remains in this section.

The home semaphore A½ is connected up with the block system in such manner that the light signal H 20 serves as an advance signal for A½. Thus, if A½ is set to »clear», H 20 shows »clear» for an arriving train; on the other hand, if it is set to »stop», H 20 shows an intermittent flashing green light. Further, the semaphore A½ is provided with two wing couplings — one for each wing — actuated

over a rail contact situated about 20 metres inside of the semaphore. When the first wheel axle of a train passes this rail contact, the wings drop to »stop».

Controlling lamps, which receive current over the track relays for the sections I 1, I 19 and I 20, are mounted in the signal cabin and office of the train dispatcher at Stockholm Östra. These lamps glow when the sections to which the respective relays belong are occupied by a train. Their purpose is primarily to facilitate the dispatching of trains to and from the station for the steam trains.

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Fig. 9. Point Contacts and Control Lock.

Special arrangements at Experimentalfältet and Ålkistan.

The one skotch block for the siding and the five points, all at Experimentalfältet, are provided with point circuit breakers in conjunction with the tongues of the switches. The track relays for the block sections on both sides of Experimentalfältet are furnished with current from the local net over these point circuit breakers. If any of the points should not be in the correct position for traffic over the main track, the track relays for the respective block sections are de-energized and the respective signals are set to »stop». For instance, if the switch to the siding (point 6) is open or the skotch block set over, H 2 will show a »stop» signal. Furthermore, the points and skotch blocks are provided with mechanical point locks, the keys for which are kept sealed by the train dispatcher at Stockholm Östra.

The traffic over the bascule bridges at the Ålkiste canal has been safeguarded in the following manner.

In the manoeuvering tower is placed a crank apparatus for the setting, partly of a locking disc which locks the knife switches for the bridge manoeuvering motors, partly of a blocking wheel, the bar of which actuates a toothed rack which, in turn, communicates with the wedged splice plates of the bridge rails. The racks and wedged splice plates are electrically manoeuvered. The crank apparatus is also equipped

with a track lever which must be set to permit the setting of the blocking crank. Before any measures whatsoever can be taken towards the opening of the bridges, permission is required over a lock and block apparatus placed over the crank apparatus and communicating with Stocksund, since the bridges at Ålkistan stand under the supervision of the train dispatcher in Stocksund.

stop, enabling the bridge-tender to control the signals. If one of the lamps of the red lights in H 6 or H 16 be put out of commission, causing indistinct stop signals to be given, an alarm bell rings in the signal tower as soon as the track lever is set, thus giving warning to the bridge-tender who immediately stops the preparations for opening the bridges and takes steps for the replacement of the defective lamps. The

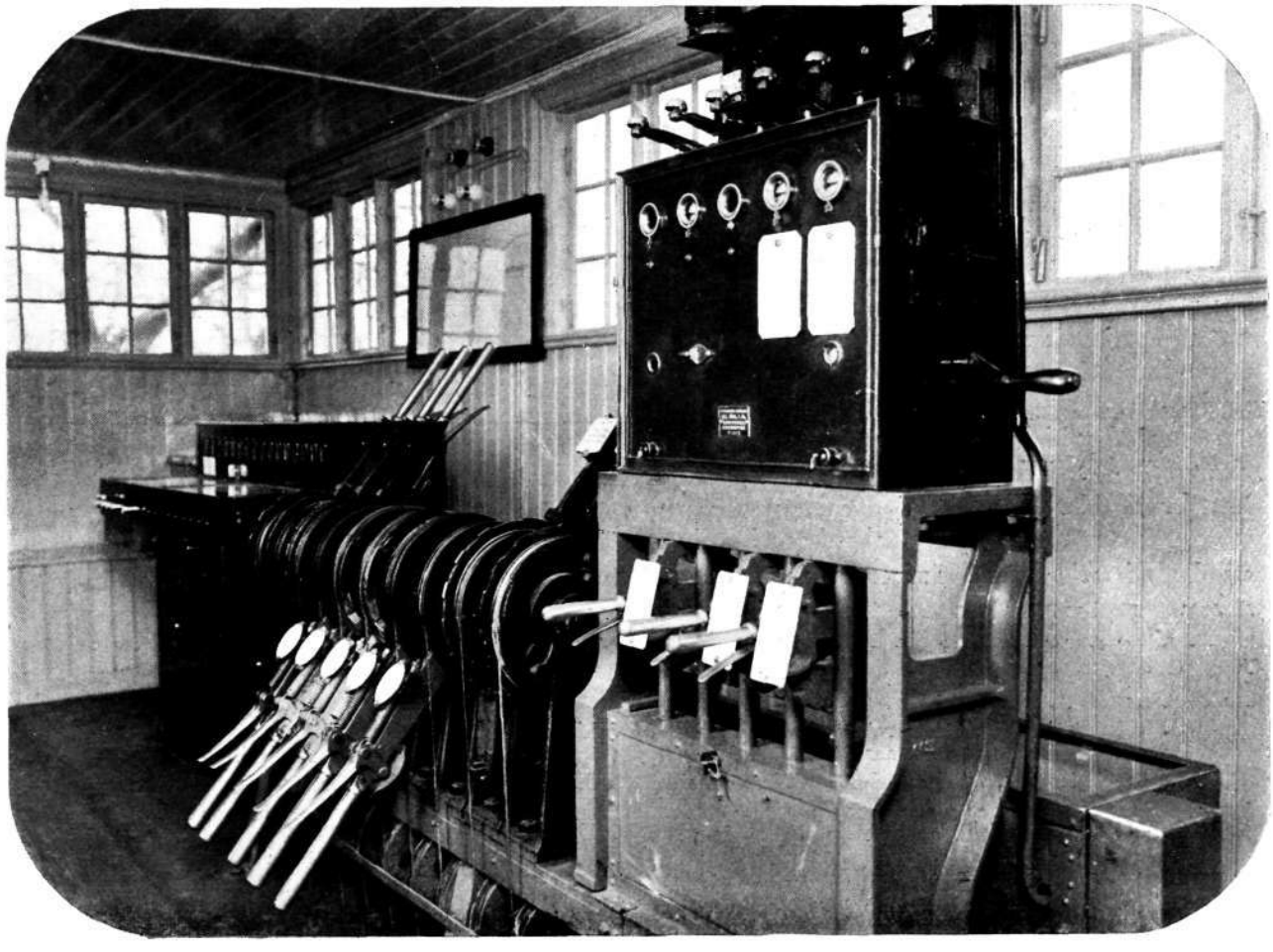

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Fig. 10. Stocksund.

When permission has been obtained from Stocksund, the circuits of the track relays I 6 and I 16 are cut by means of a switch on the locking rod of the lock and block apparatus at Ålkistan, causing the signals H 5, H 6 and H 16 to show »stop». The starting signal H 15 in Stocksund must be set to stop before permission can be given from there, and as soon as permission has been given it is impossible to set the signal H 15 to clear.

The controlling lamps in the manoeuvering tower glow as soon as the signals H 6 and H 16 show signals H 5, H 6, H 15 and H 16 cannot be set to clear until everything is again in normal condition at Ålkistan and has been repeated at Stocksund.

The light signals H 1 to H 6 and H 16 to H 20 are fully automatic and are called block signals. The signals H 7 and H 15 — home and starting signals respectively for Stocksund — are manoeuvred from here by the aid of an electric interlocking machine, installed in conjunction with the automatic section blocking system. The interlocking machine contains also levers for the electrically set point where the line

passes from double to single track south of the Stocksund bridge, as well as levers for the locking of some of the points in the station yard.

The section blocking installation was put in service on February fifteenth of this year and has filled every safety requirement for which it was intended.

The entire plant between Stocksund and Stockholm, including the lighting of the signal cabines and of some semaphores at Stockholm Östra, does not require more than about 25 kilowatt-hours per day. With electric current at 0.10 Swedish crowns per kilowatt, it is evident that the cost of operation is very low indeed.

The project for this plant has been prepared and the material furnished by Signalbolaget, a subsidiary of L. M. Ericsson. The work of installation has been done by the railway itself, with the author as superintendent and under the supervision of railway engineer Hjalmar Ekholm.