The L. M. Ericsson Review

VOL. 3 JANUARY–FEBRUARY 1926 Nos. 1–2

R 410

DIRECT CURRENT RELAY.

ENGLISH EDITION

L. M. Ericsson

THE L. M. ERICSSON REVIEW

ENGLISH EDITION.

JOURNAL OF

ALLMÄNNA TELEFONAKTIEBOLAGET L. M. ERICSSON, STOCKHOLM.

HEMMING JOHANSSON, Director.

Issued monthly. — — — — — — — — — — — — Yearly subscription rate: 7/ –

All communications and subscriptions to be forwarded to the Editor.

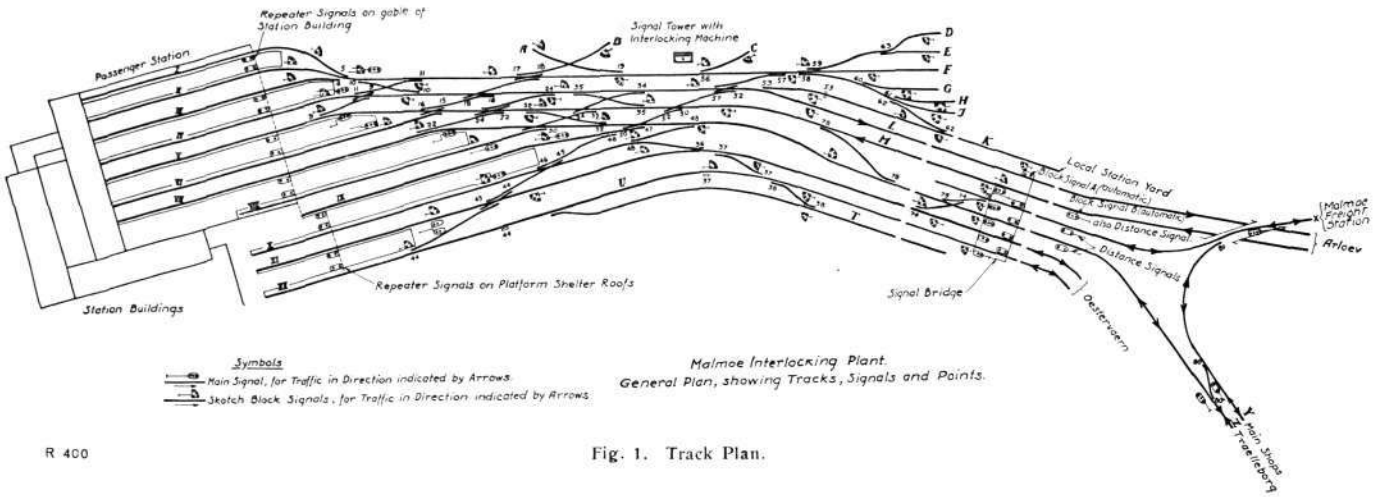

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Fig. 1. Track Plan.

The New Interlocking Plant in Malmoe.

We hereby have the pleasure of presenting an article by Lieutenant I. Larsson, signal engineer for the State Railways of Sweden, describing the new electric interlocking plant at the Malmoe state railway terminal. The project for this plant has been prepared by Mr. T. Hård, engineer and member of the Board of The Royal Railway Administration of Sweden, the work of installation having been executed by Signalbolaget of Stockholm with electrical equipment from L. M. Ericsson in Stockholm and Westinghouse in London, and signal lanterns from the Avos company in Örebro.

The Malmoe terminal of the State Railways of Sweden has, during the past decade, been subjected to a number of radical changes and improvements, culminating in the installation of a new interlocking and signal control plant.

The previously existing interlocking plant, consisting of three mechanical interlocking machines — could, it is true, be temporarily adapted to the new track system, but as it no longer

filled the demands of modern railway practice, the installation of an entirely new plant was decided upon by the railway administration. Following the custom which has become general during latter years, the choice was in favour of an electrical system, in which have been embodied a great many of the most recent developments and improvements achieved within the field of railway signal engineering. A number of designs and methods used in England and America, in particular, have been applied to this plant after having been modified to suit our requirements.

The Malmoe passenger station is a terminal station at which the traffic — during certain periods, at least — is very lively. The following lines enter this station: Stockholm—Malmoe, Gothenburg—Malmoe, Trelleborg—Malmoe (the so-called continental line) and the privately owned lines Malmoe—Simrishamn and Malmoe—Genarp. The two last mentioned use a common, hitherto single-track line between Malmoe and Oestervaern, a second track having now been completed, however. The lines from Stockholm and Gothenburg meet at Arloev, thus making the double-track line between Malmoe and Arloev common for them both. Judged from a Swedish point of view, the traffic on all of these lines is very lively, and there are times when express trains from Stockholm, Oslo, Copenhagen and the continent arrive at Malmoe simultaneously with a number of local trains, creating traffic conditions which put the interlocking and signal control plant to a very severe test.

The entire track system of the Malmoe passenger terminal as well as some of the tracks to the Malmoe freight station are controlled by a single interlocking machine, the interlocking zone, in consequence, being unusually extended, as may be seen from the track plan in fig. 1. All of the points, skotch blocks and signals shown on this plan are manoeuvered from the interlocking machine, none of the points or skotch blocks being set locally.

The plant has been executed with provisions for arranging a large number of track combinations for the purpose of providing the greatest possible freedom in the choice of platforms, this matter being of great importance on account of

R 401 Fig. 2. Signal Bridge, looking away from Track Yard.

changes in the time table and the possibility of new train combinations.

The track combinations are as follows:

Incoming.

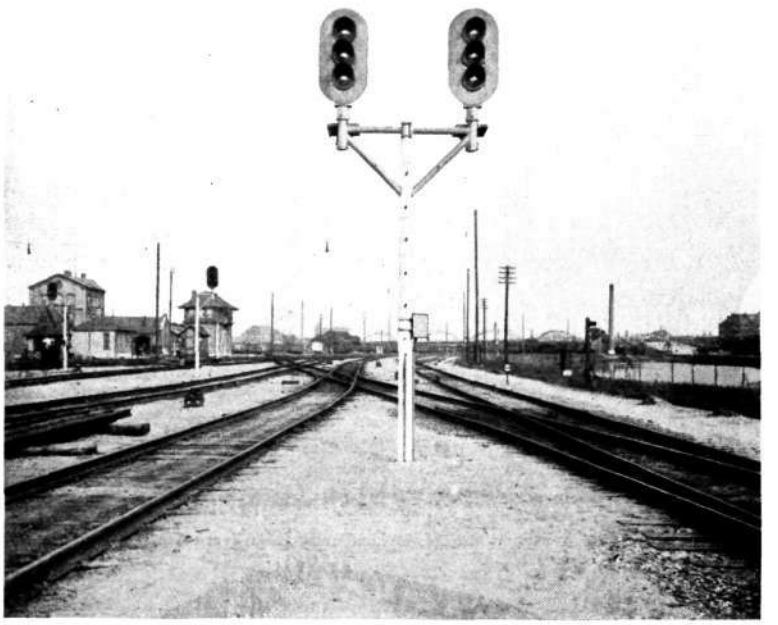
From Arloev to all the tracks Nos. I to XII,
» Malmoe freight station to all the tracks Nos. I to XII,
» Trelleborg to all the tracks Nos. I to XII,
» » to Malmoe freight station,
» the main shops to Malmoe freight station,
» Oestervaern over the North track to tracks Nos. X, XI or XII,
» Oestervaern over the South track to tracks Nos. X, XI or XII.

Outgoing.

To Arloev from all
» the tracks Nos. I to X,
» Malmoe freight station from all the tracks Nos. I to XII (the trains being directed over the passenger track yard proper by means of shunting signals without main signals).
» Trelleborg from all the tracks Nos. I to X,
» » » Malmoe freight station,
» the main shops from Malmoe freight station,
» Oestervaern from the tracks Nos. XI and XII.

The track combinations in their entirety form track circuits with track current. The track system is divided up into a suitable number of insulated sections, alternating current — which energizes a relay — being fed to each section. When a car enters a section the current is carried off through the wheel axles and the relay de-energizes. Various signals are influenced by these track relays, making it impossible to signal »clear» for a track when a car is standing on any section forming a part of the track in question. Automatic control of the fact that the track is actually clear is thus obtained before a »clear» signal can be given.

All signals are so-called »day signals», i. e. signals are given both day and night by means of certain light combinations. The signals are of two different kinds, i. e. main signals and skotch block or shunting signals. The former are colour signals, the different combinations being formed by means of vary-coloured lenses, while the latter are placement signals, the different combinations being formed by altering the mutual positions of two or more lights.



R 402 Fig. 3. Double and Single Starting Signals.

Such light signals have come into use more and more during latter years, especially in America and England. They have some decided advantages over semaphores, revolving signals and the like, in that they have no moving parts that are affected by sleet, ice or other unfavourable weather conditions. Furthermore, they are more easily discernible in foggy weather, and their clearness does not depend on the colour of the background, as with semaphores. The use of specially constructed lenses makes it possible to discern these signals at a sufficient distance during the brightest sunlight

without having to resort to exceptionally strong lamps.

The main incoming signals are mounted on a special signal bridge, shown in fig. 2. They have been hung from this bridge, partly so as to bring them as close as possible to the level of the locomotive engineer's eyes, partly on account of a street viaduct which spans the tracks at a distance of about 250 metres from the signal bridge and under which the signals must be visible at the greatest possible distance.

The incoming signals do not show whether or not the entire track is clear, but occur in the form of *one green light* for incoming trains to tracks VIII to XII (the shorter track group) and *two green lights* for incoming trains to tracks I to VII (the longer group). Thus, it is not possible for the engineer to ascertain — by means of the incoming signals — whether or not the entire track is clear, but the information given is sufficient to enable him to choose a suitable speed and — with regard to the insulated tracks, which prevent the giving of a »clear» signal for an occupied track — this has been deemed a sufficient safeguard.

The main starting signals are arranged partly as inner signals — placed at the ends of the platforms — and partly as outer signals on the previously mentioned signal bridge. Thus, an outgoing train must necessarily pass double signals. The inner signals are mounted on concrete poles, most of them at the ends of brackets which bring them closer to their respective tracks than the supporting poles themselves. This arrangement makes the signals more easily discernible, especially as it is not always possible — on account of insufficient space between adjoining tracks — to place the signals to the left of their respective tracks. The inner starting signals — when set to »clear» — do not denote which track is cleared except in those cases when outgoing tracks can be laid in two different directions: *one* green light to Arloev and *two* green lights to Trelleborg.

R 403 Fig. 4. Repeating Signals on Gable of Train Shed.

The work of the station master is simplified by the use of repeater signals — which repeat the various starting signals — placed further in on the platform or on the gables of the platform roofs.

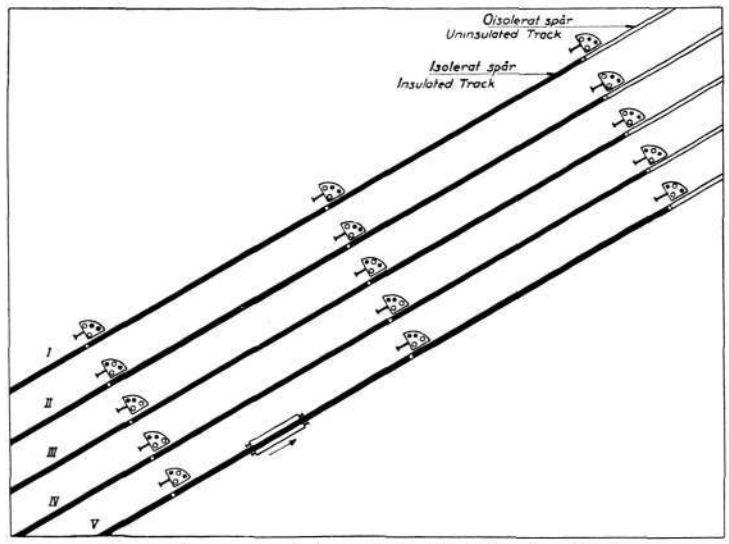
The passing of the outgoing train sets all the starting signals to »Stop».

The shunting which takes place at this station is often very lively, since the fact that it is a terminal station makes such operations necessary for every train. The existing branch lines, especially the Malmoe—Lund line, have a very lively traffic, judged from a Swedish point of view. The more important express trains usually have through traffic, and in Malmoe they are taken apart and made over for various destinations. In order to create as safe conditions as possible

R 404 Fig. 5. Skotch Block Signals. The nearest one indicates »Caution» and the one in the left background »Stop».

for these shunting operations, the shunting tracks have been provided with the same control and locking devices as the incoming and outgoing tracks. To accomplish this end, a large number of special skotch block signals are required, since all operations permitted by this system are controlled by the interlocking machine.

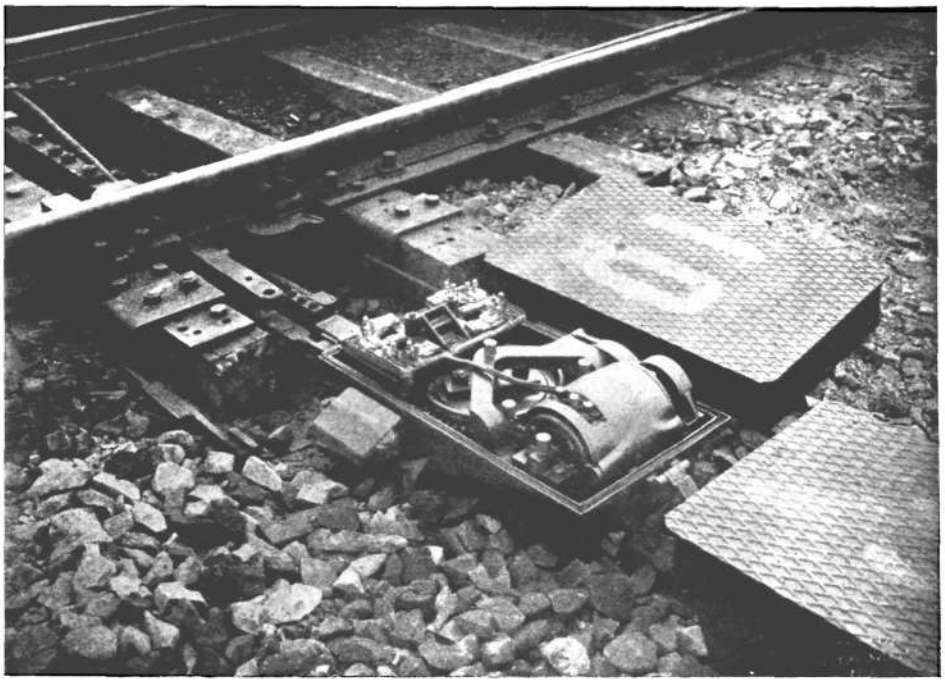
These signals have been given the form of dwarf signals, which require very little space, the various signal combinations being obtained by the different placing of two white lights in relation to each other. The signals are three in number, viz. »Stop», »Caution» and »Clear».



R 405 Fig. 6. Co-operation between skotch Block Signals and their relation to Occupied Track.

Alternative I. All three signals show »Stop».
» II. Left signal shows »Caution», because middle signal shows »Stop».
» III. Left signal shows »Clear», because middle signal shows »Caution». (Right signal shows »Stop»).
» IV. Left and middle signals show »Clear», because right signal shows »Caution».
» V. Car has entered left insulated track section after having passed a »Clear» signal to the left, which is then automatically set to »Caution».

For »Stop» the connecting line between the two lights is horizontal, for »Caution» it forms an angle of 45°, and for »Clear» it is vertical. When a signal is set to »Clear», all the points beyond it and up to the next signal on the shunting track, are locked. As soon as a car has passed the first signal, the points remain locked even if the signal is set to »Stop», and are released only in the measure that the car passes the respective points; thus the points are released as soon as this possibly can be done without risk, so as to provide the greatest freedom of movement for the interlocking machine.



R 406 Fig. 7. Point Driving Mechanism.

R 407 Fig. 8. Cable Distribution Box.

R 408 Fig. 9. Signal Tower.

The skotch block signals do not show in which direction the cleared track leads, neither have point signals been arranged for this purpose; but, since a signal cannot be set to »Clear» unless at least one track is actually clear, and since, furthermore, shunting tracks which interfere with each other, cannot be simultaneously cleared, all movements are safeguarded, even if it should happen that a cleared track leads in a different direction than the switch operator has intended. The absence of point signals makes for increased simplicity and clearness, and experience has shown that the possibility of observing at a distance how the points are set is of minor importance, since all movements are controlled from the interlocking machine by means of signals.

A succession of skotch block signals co-operate mutually according to a definite system, so that one signal serves as advance signal for the following one. A signal cannot be set to »Clear» unless the preceding track section is clear and the following signal indicates »Clear» or »Caution», this co-operation being automatic. The interlocking machine maneuvres for »Stop» or »Clear» only, the actual signal given depending upon the setting of the following signal and the condition of the tracks. This association is clearly shown in fig. 6. Besides being used for shunting operations, skotch block signals also regulate the movements of the trains. The skotch block signals for a cleared track, therefore, are set to »Clear» in advance of or in conjunction with the setting of the main signal to »Clear»; thus, a cleared track is always indicated to a certain degree by means of the adjoining skotch block signals which show »Clear».

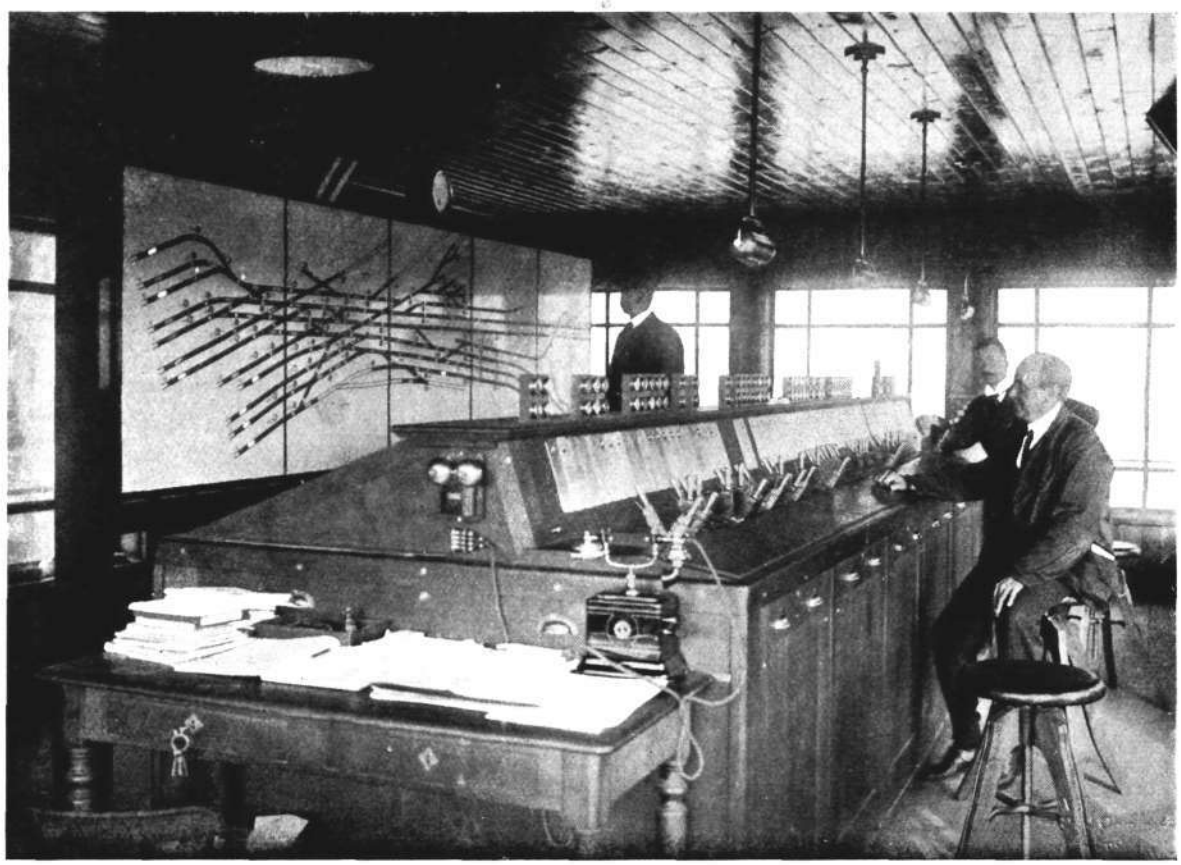


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Fig. 10. Interlocking Machine and Illuminated Track Plan.

The point driving mechanisms are of Ericsson's latest design and are constructed for 130 volts d. c. An opened driving mechanism with motor, friction clutch and contact arrangement for the motor current and control current is shown in fig. 7.

All electric current is led through armoured underground cables. Fig. 8 shows an opened distribution box, also designed by Ericsson's. The type illustrated is for distribution from one main cable to eight smaller cables.

The signal tower, shown in fig. 9, has been erected in three stories.

The first story contains the power plant, storage batteries and a repair shop; in the second story are mounted the relays, and in the top story the interlocking machine and other apparatus are placed.

The interlocking machine (see fig. 10) is of English manufacture, delivered by The Westinghouse Brake and Saxby Signal Co. The point levers maneuvre one, two or — in a couple of instances — three driving mechanisms each. Two is the most usual number, as the track system contains several pairs of points, both points of which can and should be maneuvred simultaneously. The two driving mechanisms are connected in parallel, so that the time required for maneuvering them both is not longer than for one.

The signal levers are normally in vertical position and can be set either inwards or outwards thereby actuating different signals. The same lever can actuate both main and skotch block signals, the actuating of several different signals with the same lever being made possible by leading the signal circuits over point lever contacts or relay contacts.

The various levers are associated with each other by means of a cross locking gear, located behind the vertical front of the machine. This gear contains all the necessary control locks, and that they are very numerous can readily be understood if one reflects over the fact, that the interlocking machine, with its 74 levers, must have locking combinations for 70 starting and incoming tracks and 175 shunting tracks.

The necessary control and locking operations are obtained partly by means of contacts actuated by the levers and locking magnets which influence the levers, partly by means of a large number of relays, mounted in the second story of the signal tower.

The interlocking machine is in no wise connected up with other apparatus for the releasing of points. A cleared track remains locked until the train has passed and released the points itself, the points being generally released one after the other as the train leaves them.

This plant requires a large number of different types of relays for both d. c. and a. c., mounted under protective glass covers. The illustration on the title page shows a relay for d. c., of Ericsson's manufacture.

A satisfactory view over the very extensive zone which is controlled by the interlocking machine, cannot be obtained even in broad daylight, and at night conditions are still more unsatisfactory. For this reason, an illuminated track plan (see fig. 10) has been designed and constructed by L. M. Ericsson, and has been placed above and back of the interlocking machine. The main as well as the dwarf signals are indicated on this plan and it is divided up into track sections which represent the corresponding sections of insulated track out in the track system.

The different signal combinations are repeated on the track plan by means of differently coloured lights, obtained by the lighting of coloured lamps placed back of the small windows which represent the signals. The presence of a car on a track section is indicated by the lighting of a lamp behind a window placed in the track line; when the track becomes unoccupied, the lamp is extinguished. In this way it is possible to follow all the movements out on the track system as well as the maneuvering of points and signals without having to make inspections on the spot.

This plant was put in operation in August 1925.