The Skövde and Herrljunga Interlocking Plants.

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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.

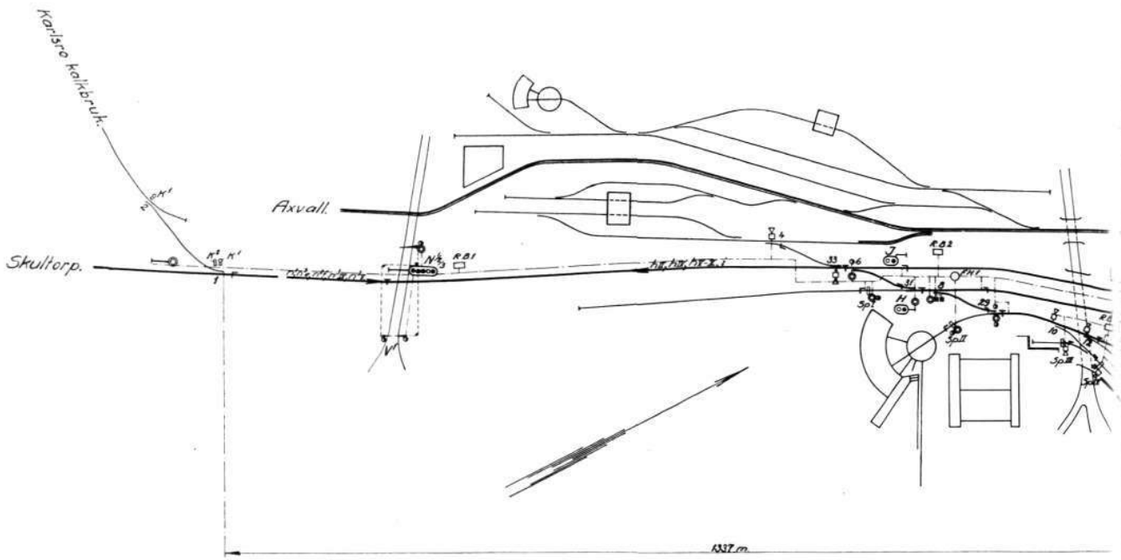
As already mentioned, the interlocking machine is not manned except during the passage of a train. For shunting purposes, the points provided with central control are set locally: consequently, there is no necessity to manoeuver the interlocking machine on such occasions.

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.

R 776 Fig. 2. The Interlocking Machine at Skövde

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



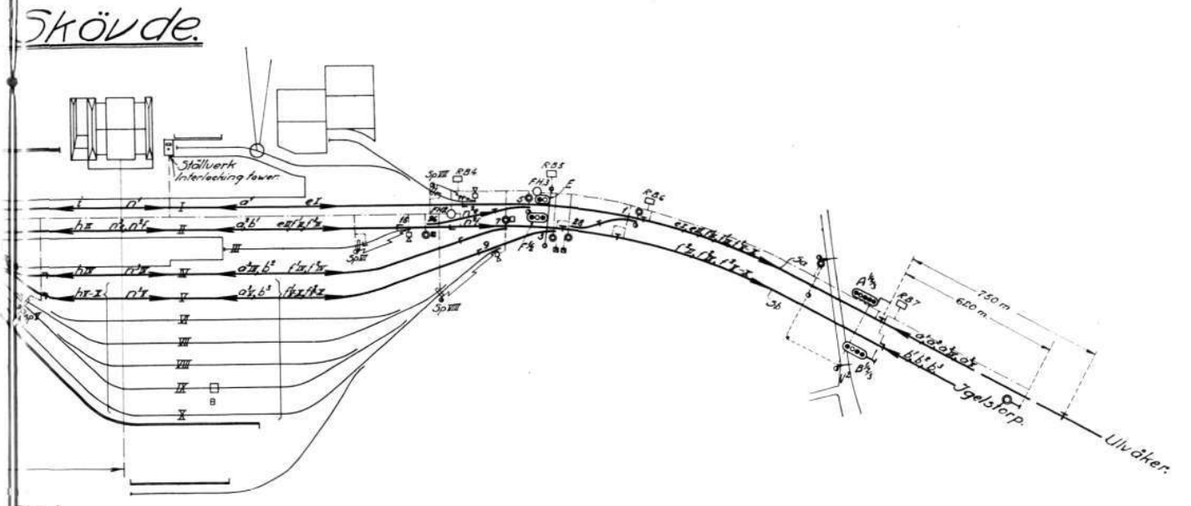


Fig. 1.

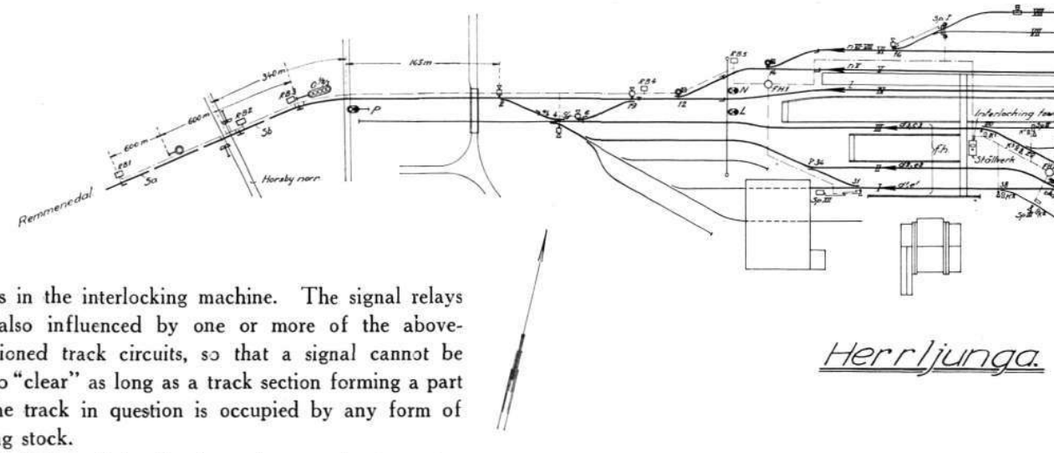


Fig. 9.

levers in the interlocking machine. The signal relays are also influenced by one or more of the above-mentioned 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.

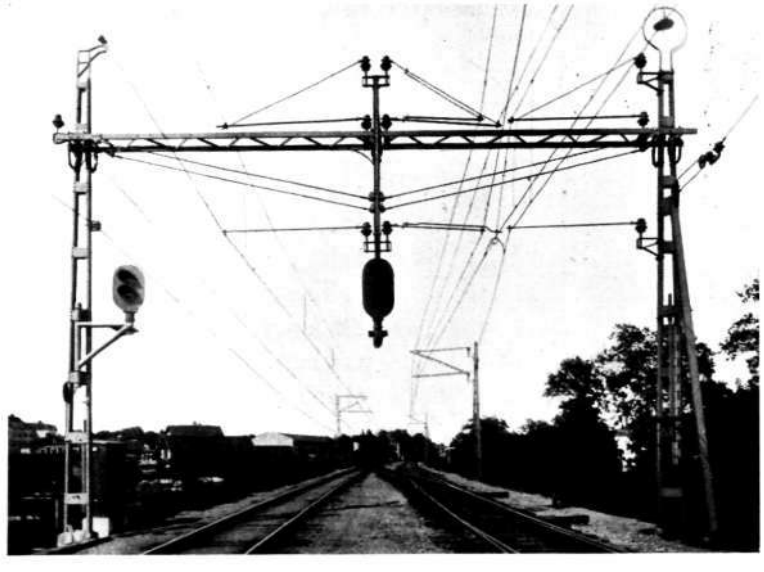
The light signals receive their current (110 volts, 50 cycles) over a feed line from the interlocking machine. Transformers, mounted in cabinets in the vicinity of the respective signals, reduce the tension of this current to about 12 volts. A good luminosity is obtained with this low voltage, since 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

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).

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.

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.

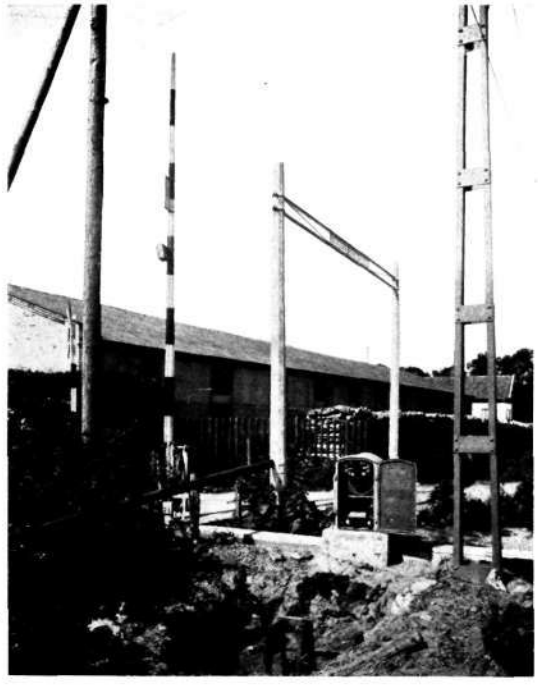
The *crossing gates* at both ends of the station yard are also power driven and controlled by means of levers in the interlocking machine. The signal relay

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

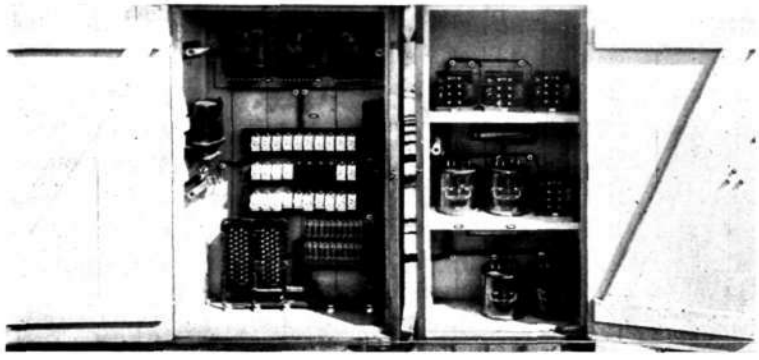


R 781 Fig. 7. Crossing Gates at the North Grade Crossing, Skövde.

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.

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

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.

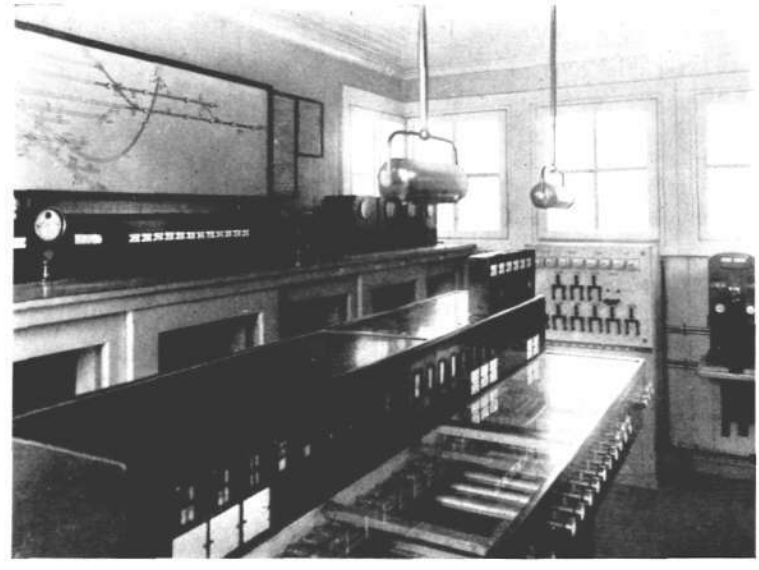
The a. c. relays are energized by a normal pole tension of two to three volts, the current in the track circuits having a tension of about six to eleven volts. The current over the relay maintains a strength of about 8.5 amperes.

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.

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,



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

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.