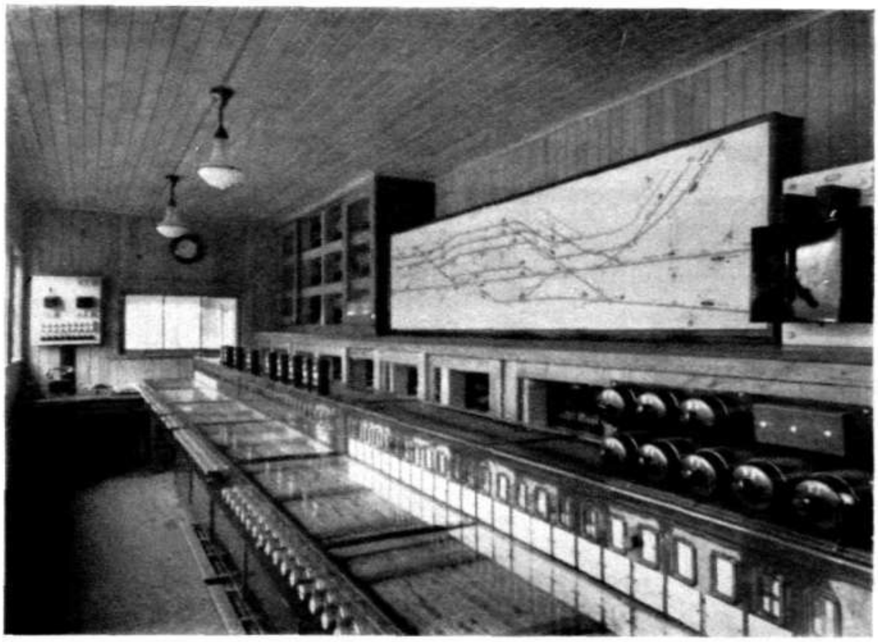
The Hallsberg Electric Interlocking Signal Plant.

By Herman Holmqvist, Signal Engineer.

Progress in the field of electric interlocking signalling devices has been rapid in recent years, and the system applied in the Malmö plant (1925) led to further improvements. The first step was the Hässelholm interlocking plant (1926), where the mechanical locking system was wholly discarded, and the levers only connected electrically. As this plant has now been in use for some years, and has proved perfectly satisfactory from the point of view of security and reliability, the time has been considered ripe to apply the system to other large installations planned, primarily then at Lund, Gothenburg, and Stockholm C. In the mean time, however, plans for another large plant, Hallsberg, had been completed in the beginning of 1928, with the intention of using the elder mechanical locking devices, i. e. allowing only two train routes to be laid by each lever. But the advantages of the Malmö system, permitting trains from any of the lines to enter or leave all tracks, were considered desirable at this heavily trafficked junction. The plans were therefore revised, and the result may be said to be a compromise between the old system and the new which is of great interest and has worked well in practice.

The Hallsberg railway station is a junction of two important railway lines, the electrified Stockholm—Gothenburg line and the steam Krylbo—Mjölby line, which latter has double tracks from Örebro to Hallsberg. On account of the topographical conditions the Krylbo—Mjölby line is not a through line, but the tracks from Kumla and from Åsbro both enter at the east end of the station yard. This implies a change round or exchange of the engines of all the trains at Hallsberg, and the Pålsboda track must necessarily be crossed either coming in or going out. In addition there are through carriages to and from Örebro in a majority of the trains on the Stockholm—Gothenburg line, involving a hurried shunting of passenger coaches from one train to another. Train traffic goes on all day and night.



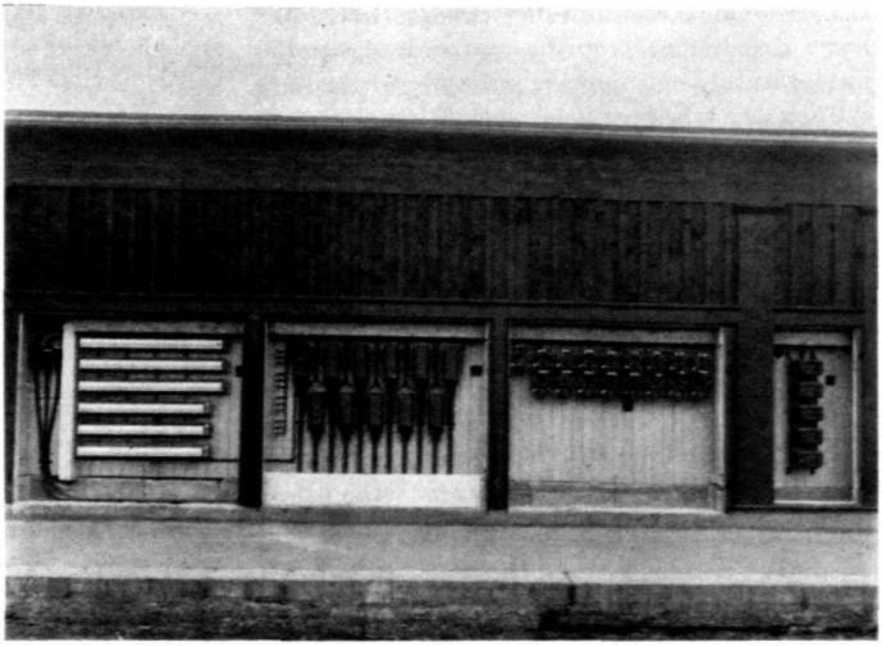
R 1721

Fig. 1.

Hallsberg
Kumla
Pålsboda
Åsbro
Östansjö
SHUNTING YARD
Outgoing group
Engine shed
Train dispatcher's box
Signal cabin
Approach Track
Track to station
SIGNAL CABIN
1 green light to track II
2 „ lights „ tracks I and III
1 green light to track IV
2 „ lights „ tracks I, II, III and to tracks V and VI across points 34 b
3 „ „ to tracks V and VI across points 35
1 green light to track II
2 „ lights „ tracks I, III and IV and to tracks V and VI across points 34 b
3 „ „ to tracks V and VI across points 35
1 green light to track I
2 „ lights „ tracks II and III
3 „ „ „ „ IV, V and VI
MAIN SIGNAL
green
red
green
green
DISTANT SIGNAL
REPEAT SIGNAL
green
green
green
DWARF SIGNAL
"go" and "shunting allowed"
"caution" and "shunting allowed" — track engaged or next signal at "stop"
"stop"
"neutral"
Drop gate signal with screen
Drop gate with signal lamp towards the road
Blocked-line lamp
Point signal lamp
Local point lever

Fig. 2.

with groups of express trains between 1—2 and 3—4 a. m. Further, a number of goods trains, usually very long, pass the station on their way to and from the shunting yard, situated immediately to the west of the passenger station. This is a centre for the State Railway long distance goods traffic to and from Gothenburg, Malmö (Nässjö), Stockholm, and Krylbo (Norrland). As far as possible, the more important goods trains are made up and sorted out in this marshalling yard, and the work is mostly done at night.



R 1722 Fig. 3.

The above indicates that safety devices at this place must fill a very real need, and such have therefore long been planned.

The electric interlocking plant now erected at Hallsberg is principally concerned with the passenger station only. The attached diagram (fig. 1) shows the disposition of the tracks in the junction, 4 passenger tracks and 2 goods tracks. Between the passenger tracks there are two platforms, connected mutually and to the station building by subways. The signal cabin is situated on the outer platform between the covered in stairways to the passenger subway, and is intended to be run by the train dispatcher alone, which for the present, however, does not seem feasible without assistance when large train groups are passing. In the signal cabin (fig. 2) is an illuminated track plan, as well as shelves for relays, instrument panel, etc. Space being rather limited on account of the siting of the cabin, the outer wall towards track No. IV has been doubled, forming a kind of bay (fig. 3). The outer wall consists of hinged shutters, and on the inner wall the terminals of most of the cables from the yard, safety devices, signal transformers, crossing-gates relays, and so on are mounted.

R 1723 Fig. 4.

All the tracks are provided with track circuits extending beyond the distant signals, whereby the arrival of trains is signalled. This is essential, as no less than five pairs of level crossing gates are controlled electrically from the cabin. All main signals are electric light signals, and the distant signals are gas light signals. On account of the curving track, the home signal from Åsbro has a repeat signal 150 metres further out, showing only green lights, but extinguished when the home signals indicates stop. A number of dwarf signals are also put up in the station yard, normally showing the neutral signal — two lights at an angle of 45° to the right (fig. 4). The dwarf signals are in this instance not used for the guidance of ordinary shunting, but are designated for the laying of starting routes and for the passage of goods trains to and from the shunting yard. The centrally controlled points are as a rule connected in pairs on the same lever, all of which are provided with point locking devices in connexion with track circuits. The points can also be changed over locally from local operating contacts in the yard. Certain points and scotch-blocks are locked by electric locking devices, and others are locked by control locks, the keys of which are kept in locks, electrically connected to the respective coupling circuits, in the signal cabin. A smaller, mechanical, switching stand is put up in the shunting yard for safeguarding the start of the goods trains towards Östansjö, which have to cross the track leading to the shunting yard.

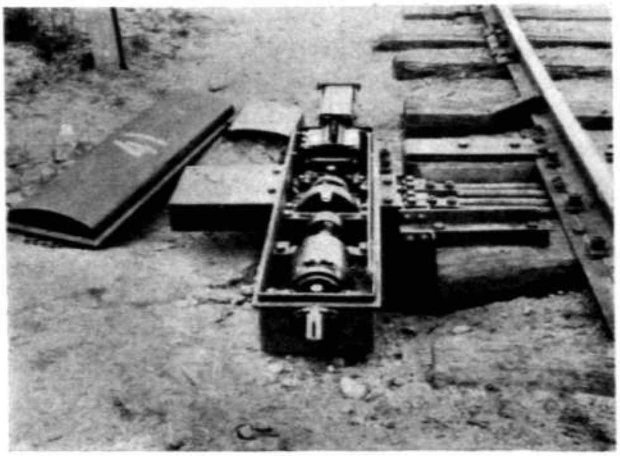
A detailed study of the signal interlocking gear shows that this is comparatively roomy, with space enough for 72 levers numbered in sequence. Signals and points are given the same numbers as their respective levers. The dwarf signals are designated by the letter D, and the main signals by the letter H, for instance D 61 and H 69/70, The former signifies that this dwarf signal has been set for neutral when the lever 61 is to the left, and the latter that the main signal is controlled by the levers 69 and 70. The points, as we have said above, being generally interconnected, both points are given the same number, e. g. 18, the one furthest westwards being called 18 a, and the other one 18 b.

The interlocking plant is of the Ericsson standard design, but with an unusually broad track locking gear, providing space for no less than 40 road rulers (fig. 2).

To lay the points for an incoming train, two levers have generally to be moved, an inner one, choosing the right track, and an outer one actuating the light signal. Either lever locks the point levers in its group mechanically, and checks the stop position of the dwarf signals required. The incoming tracks are indicated to the engine driver by different main signal combinations, but not by the dwarf signals as is the case for the outgoing tracks. The start signals show a green and a red light only, but each outgoing route is indicated by two dwarf signals also, each controlling its section of the track. Three levers must therefore be moved to lay an outgoing route. The centre dwarf signal is first set, and moving the lever sets this in the 45° go-position. When the inner dwarf has also been set to 45°, the outer start signal lever is moved, which sets the start signal to clear line and the two dwarf signals to the 90° go-position. On the power cable gallows across the platform repeat signals with green lights are fixed, announcing to the station master when the line is clear for start, when the number of lights enables him to check which of the three lines is indicated. If the train is so long that it reaches beyond the first dwarfsignal, the go-signal may still be given from the start signal, although the dwarf signal will only show 45°.

No clear line signal can be given for either incoming or outgoing tracks until the level crossing gates are down. The normal procedure is therefore first to set the signal levers for the proper route, which does not give a clear line signal. When the train enters the outermost track circuit, or for the outgoing line when the train is nearly due to start, the gate lever is turned. When the gates are right down, which, including the cautionary ringing signal, will take about 40 to 50 secs., the clear line signal automatically appears in the respective signals. The wiring connexions are such that when the signal has once shown clear line, the gate lever may again be turned to its normal position, which does not affect the gates until the last truck axle has passed the level crossing, when the gates are automatically raised.

The abovementioned division of the train routes into several sections, each with its signal lever, makes it possible to combine these levers so that each line entering the junction may be routed to or from any track, wherever the track system will permit this. Track V and VI may also be entered or left by two routes, an inner one by points No. 39 and an other one by points No. 35. This is of great importance in avoiding, as much as possible, blocking the level crossing in the western part of the station yard by the long goods trains.



R 1724 Fig. 5.

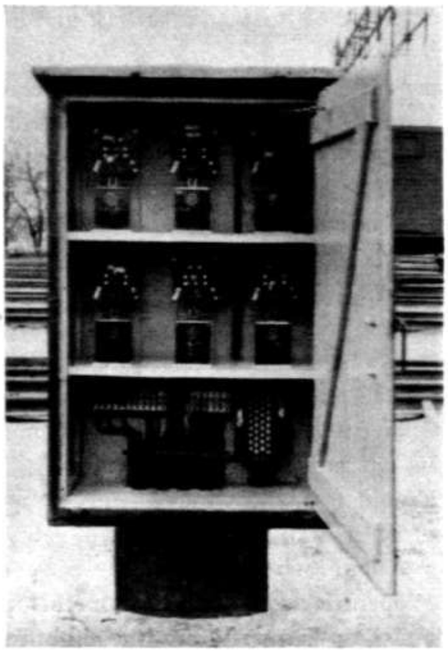
The new L. M. Ericsson designs of operating machinery, incorporating a point lock (fig. 5), control the points electrically. The motors are driven by 130 volt D. C. By discarding the hook locking device (fig. 4) lubrication and cleaning of the points is facilitated, especially in winter time when ice and snow often interfere with the working of the hook locks. Rollers are further provided underneath the point tongues, which will carry the tongues during switching and make lubrication of the points quite unnecessary.

The arrangements for local operation of the points are of new design in so far as, to allow this, the switch lever must not only be placed in an intermediate position, but a relay placed in a small box close to the switching lever must also be dropped. This is done by means of a tumbler switch above the interlocking gear (fig. 2, the far part of the cabin). A control lamp in this box is also lit when the relay is attracted. When the relay drops, the motor circuit from the levers is broken and the scotch-block is disconnected from the track circuit. Permission for local switching may thus be given and retracted even if the train is standing on the track circuit through the points concerned, which is a great advantage when the trains are so long that there is not room enough for them in the loops. A dim light at the local operating controls in the yard announces in the now usual manner that the points may be operated locally.

The loose key used for local switching must be taken out after each switching operation and inserted the opposite way in the key-hole. This is designed so that when the key is inserted the handle must point the way in which the tongues have to move. When the points are connected in pairs, the points furthest from the local lever always move the first, which makes it easy to see when the switching is completed, as there will be no current for the near points until the far ones have closed. As an additional check, a switching light is always provided at the far points.

As mentioned above, five pairs of level cross-

R 1725 Fig. 6.



R 1726 Fig. 7.

ing gates, the furthest of which is no less than 950 metres distant towards Pålsboda, are controlled from the signal cabin. No shunting takes place either at this crossing or at the one on the Åsbro line, and consequently no proper gate signals are given for the trains. The dropping of the gates here is controlled solely by main signals. As the motor traffic at these level crossings is very heavy, light-signals are installed which show a red light to the road when the interlocking gear by means of a control lock, provided with contacts on the local lever. This makes the main signal independent of the position of the gates. When the gates are set for local control, a dim light on the local lever contact is lit. When the gates are set for central control this is shown by a light in a control lamp close to the switch in the cabin.

The illuminated track plan in the signal cabin (fig. 2) is of a neat and practical design, and

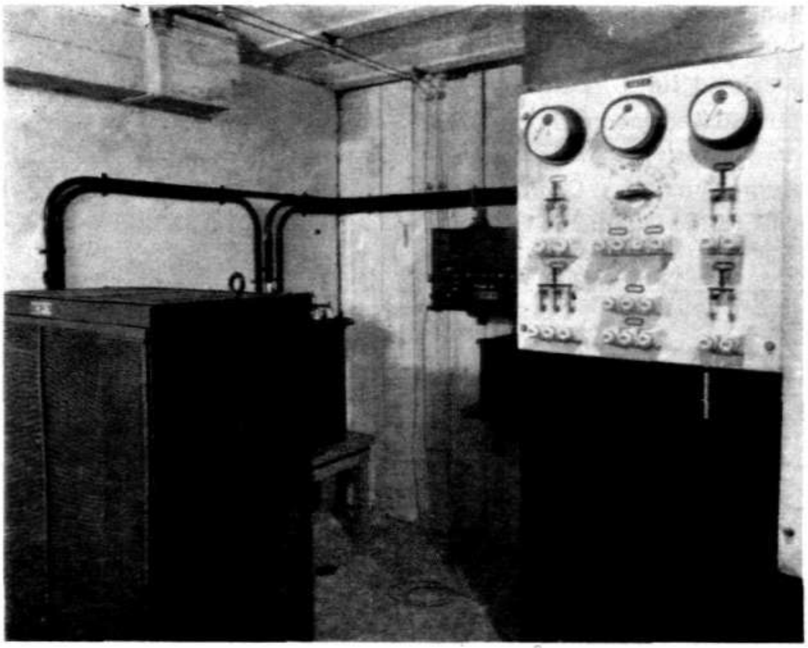
R 1728 Fig. 8.

cautionary ringing signal begins. A special device in the gate lifting machinery disconnects these signals while the bar is still lifting, before it is right up. Similar light-signals are installed at the level crossing in the western part of the station yard. The gates are raised and lowered by electric winches of the usual type, placed near the gates and joined to them by steel wire ropes (fig. 6). Contact devices on the gates provide a check that the gates are actually down. Switches in the signal cabin (fig. 2 to the right) make and break the current for the bar winches. If the current should fail, the winches may be operated by means of a crank handle. The gates at the crossings where shunting occurs may also be closed or opened on the spot. For this purpose a special switch is turned in the cabin, and the guard at the gates must then drop a relay in the indicates the position of both track relays, signals, and level crossing gates. The track plan lamps are 3 and 6 volt telephone lamps behind varicoloured lenses. White lights on the track circuits indicate that these are free of vehicles. When the lamps in a dwarf signal in the plan are extinguished, that signal shows stop. Neutral is marked by a white light, the 45° position by a yellow light and the 90° position by a green light. The main signals show red and green lights. When the distant signal shows a green light, this is also shown on the plan. When the light is changed to white, the lamp in the plan is turned out. The level crossing gates in the plan are marked by lamps showing a red light when the bars are up and green when they are down. There is also a plain check light for the level crossing signals towards the roads. The signal levers that must be moved for a certain combination of the various train routes are plainly noted on the track plan. Normal points positions can also be read from the plan. A train route may thus be laid without recourse to locking schedules, solely by observing the position of the points in the plan and the number of the levers for the route in question.

A special connexion has been used for the track circuit, with a condenser connected in front of the feed transformer. This gives a practically constant secondary current, which is advantageous for the shunt values of the track circuits. The track relays are of two-phase type and placed in the interlocking machine, with relay transformers in cast iron boxes along the track (fig. 4). Feed transformers and condensers are placed in wooden cases in the station yard (fig. 7). Track circuits outside the main signals are fed from D. C. primary cells, and have repeating relays in the cabin.

A machine room for the supply of current is arranged in one of the station buildings, where three-phase 220 volt A. C. is provided by the railway light-supply (fig. 9). A reserve of 2×220 volt D. C. is also available from local supply lines. D. C., 130 volt for the point-driving and level crossing gate motors, and 30 volt for control current, is obtained from two Westinghouse metal rectifiers (to the left in figs. 8 and 9). In case of A. C. failure, this may also be obtained from a D. C. driven rotary converter (to the right in fig. 8).

A plant of this size naturally requires a large capital outlay, but the operating economies effected by the reduction of staff made possible by the installation of these safety devices provide good interest on the initial expenditure.



R 1727

Fig. 9.