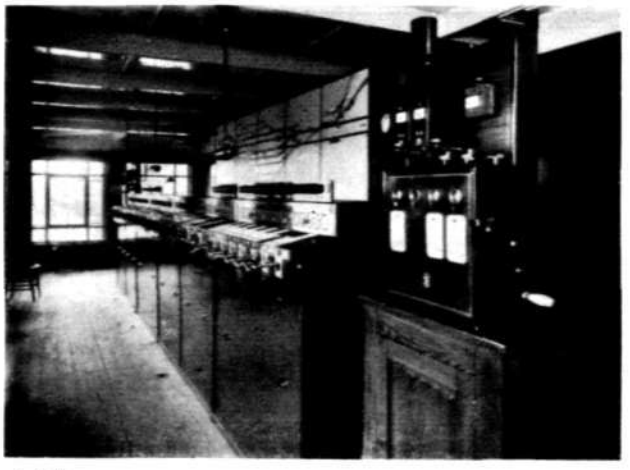
New Interlocking and Signalling Plant at Lund.

By Ivar Larsson, Signal Engineer in the State Railways.

The railway station at Lund was one of the first in Sweden to be equipped with interlocking and signalling installations. In the years 1899—1901 there was erected a plant with two mechanical interlocking machines for the south part of the station, and in 1901—1902 there was erected an interlocking machine in the northern part, so that a complete plant was obtained that was equipped with those devices and arrangements for safeguarding trains and securing the work of the station service which were then considered perfect. Signalling technics have, however, progressed incessantly, and, when the station was rebuilt in the year 1927, the old plant was quite antiquated. It was provisionally adapted to the new station, and there was, of course, no impossibility of completing the same, but without doubt a new structure was the only rational thing to be able to satisfy up-to-date requirements of safety and labour saving. For this reason a perfectly new interlocking and signalling safety plant was erected, following those modern lines and principles which have been the foundation of the plants erected by the State Railways in recent years.

R 1675
Part of the station yard. The signal cabin on the right.



R 1676
Interior of Cabin.

The L. M. Ericsson Company, through its subsidiary company, the "Signalbolaget", received an order to supply the material and erect a complete electric installation.

This new installation embraces only one interlocking machine. This has been located at the northern end of the station. The switch movements there are more numerous and more complicated than in the south part of the station, and it was in consideration of this circumstance that the place was selected.

The cabin is on three floors. The ground-floor contains the power plant for the interlocking machine, a workshop for repairs and the heating installation for the cabin. The first floor is reserved altogether for relays and other auxiliary instruments, while the top-floor is the switch-room proper. From the same a good view is obtained of the northern part of the station, but no view can be had of the central and southern parts of the station.

The switch apparatus is manufactured with only electric interlocking register; all locking and dependencies are, therefore, carried out electrically. Previously a similar interlocking installation had been erected by L. M. Ericsson on behalf of the State Railways, viz. at Hässleholm (described in

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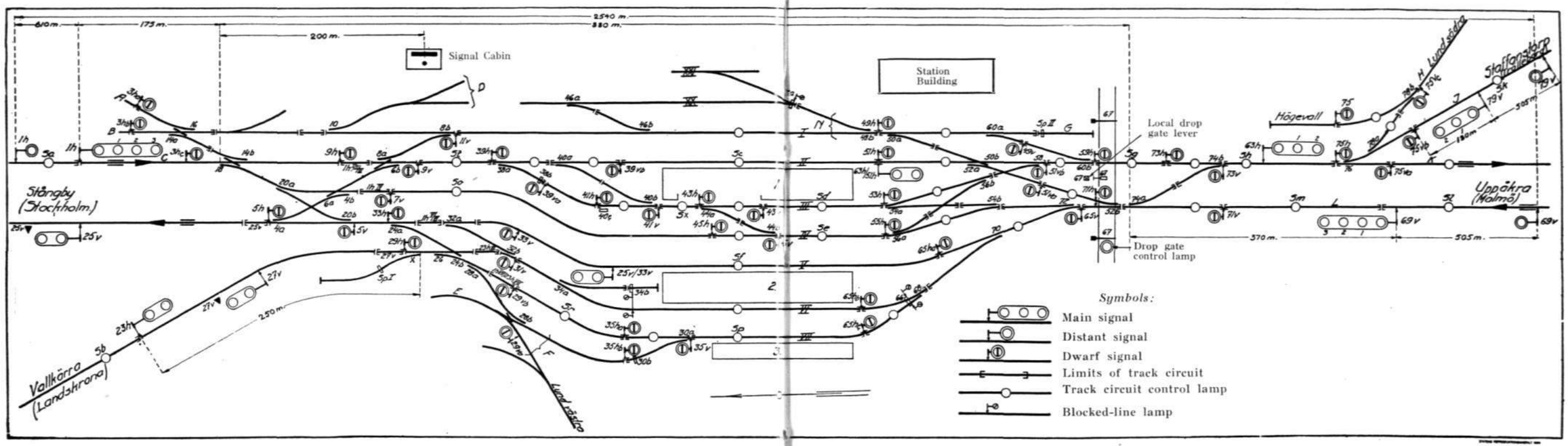


R 1681

General plan of tracks, signals, points, and track circuits.

this Review in 1927, Nos. 1—3). The machine supplied for Lund is constructed on the same lines as that at Hässleholm, but the design had been altered by making use of the experiences gained at Hässleholm. The whole machine is higher, so that the levers are approximately on a level with the elbow of an average-sized man. By this means the advantage of a more natural grip of the levers is gained. These levers are arranged in a row the same as in L. M. Ericsson's older interlocking machines. The shape of the handle on the lever has been altered so as to present similarities to a small door-handle. It has been possible to effect such grouping on the apparatus that every other lever is a signal-lever and every other an interlocking lever. The signal-lever is in a normal position with its handle straight up. It can be switched over to right or left (each movement 70°), thus being used for operating different signals. The switch-lever has in its normal position the handle obliquely downwards to the right, and on switching over it is turned 140° to the left. Particular care has been devoted to the development of the design in so far that both the lever's horizontal shaft, which is rigidly connected with the handle, and the co-operating vertical contact-shaft get a perfectly steady and exact motion, so that make and break occurs with all desirable precision. Control windows above the lever have been utilized in the following way. The switchman is informed by a white or red signal-plate if the switch occupies a position coincident with the lever, and closes completely, or if such is not the case. Besides, a blue pointer in the window of the lever indicates that the switch is blocked for changing. This pointer disappears when the switch is free. A white or blue signal-plate in the windows above the signal-lever indicates if the lever is disengaged for changing over or locked.

The interlocking machine is in no way connected with any release instruments or the like operated by the train dispatcher. The signalman must, therefore, himself lay the tracks and display the "clear" signal. This arrangement is considered suitable here, because safety measures have been adopted for automatic control that the tracks are free from vehicles when a start-signal can be displayed. This system is preferable when the traffic in a station is in any way extensive. As, therefore, the operator on his own responsibility lays the tracks, it is important for him to be able to control in a simple manner that the track is clear to or from an *intended* track when the start-signal is given. This has been done in such a way that the switch installation is equipped with small auxiliary instruments in the shape of a push button switch, one for each track. On a sign-board belonging to each switch it is indicated which incoming or outgoing signal is meant, as well as the number of the track to or from which a track is to be laid. Before the signal lever for a main signal becomes disengaged for switching over, this push-button switch must be changed over. If the signal lever then becomes free for switching over, the operator is sure that the points or switches are set for the very track intended, i. e. he obtains a simple and easily grasped control instead of having to examine with meticulous care the position of the levers, in order to prevent shifting switches.

On enamelled signs above the levers there are given the necessary directions for the position which other levers must occupy to enable the lever to be operated, and by this means all the track-tables are set out on the very interlocking machine.

The installation is made for altogether 80 levers, and was at the beginning fitted with 29 signal-levers, 31 switch-levers, 3 interlocking levers, 1 bcom-lever, and 16 spare places. Its length is 6.6 m. It is lacquered the ordinary deep-green colour, and its appearance is smart and attractive.

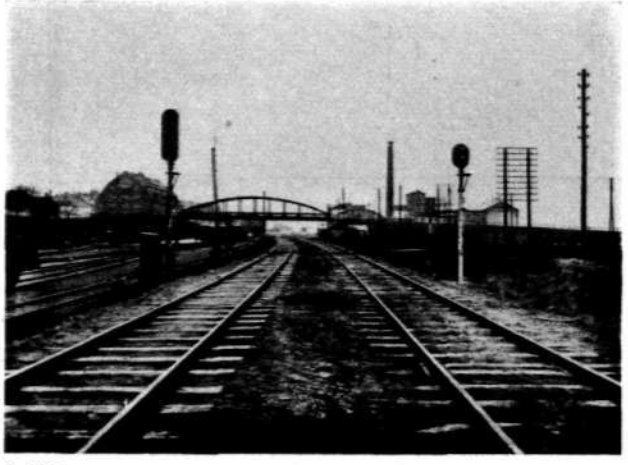
For the State Railway lines connected to it, double track line to Uppåkra and Stångby, the blocking of the line is arranged by means of a 3-field block instrument located at each gable of the machine.

The illuminated track plan is set up separately behind the interlocking machine. On this plan are set out the signal images of the main and dwarf signals, as well as the condition in the track sections provided with track line. All instructions on the track plan take place by means of lamps countersunk behind separate index windows. An occupied track is marked by a lighted lamp in the track window, and a free track with an extinguished lamp, an arrangement which on fairly large track-plans gives a better survey than if the more customary opposite method were employed.

All tracks (19 home and 19 outward tracks) are locked by track interlocking, and the release

is effected automatically by the train. For emergency release there are separate, sealed keys. The track for the home roads are not locked until the train has reached the track-line immediately outside the home signals, i. e. it is approximately 1400—1200 m. outside the appurtenant advance signal. If an expected train has not reached this point, the signal can be taken up and the road released without having to break the seal and using the emergency key.

With the exception of the interlocking group in the north, the track area of the interlocking installation is equipped with complete track lines. These have been excluded in the north on account of the expense, because the direct survey from the



R 1677
Incoming and outgoing signals at north end of yard.

interlocking apparatus has been considered to constitute sufficient safety measures.

The devices for actuating the switches are of a new design, and they are made with interior mechanical locking, for which reason the hook- and link-locks hitherto employed for locking the point can be dispensed with. It is hoped by this means to counteract, inter alia, to some extent the difficulties arising in case of a fall of snow. The switches are, in so far as circumstances permit, coupled in pairs to the same lever, and it happens in some instances that three motor actuating devices, two for switches and one for scotch block, are connected to the same lever. Both parallel coupling and serial coupling have been employed. The entire number of switch and scotch block actuating mechanisms is 49. There are no mechanisms for local manipulation. Four interlocking mechanisms for merely locally operated switches and scotch blocks are laid down.

The entire station area connected with the interlocking installation is equipped with a complete system of dwarf-signals. These are used not only for interlocking motions but also for train movements. All switch roads are interlocked by these signals, and for the southern and central parts of the stations switches in front of switch-vehicles are locked when the appurtenant dwarf-signal has been passed, even if the signal in question is taken to stop. As to the northern part of the station, which can be surveyed direct from the interlocking plant, no such locking has been employed, because, as has been stated here before, no track-lines necessary for this purpose have been put down. The dwarf-signals are of the standard type used by the State Railways, optical signals being made by two white lights which form a horizontal connecting line at an angle of 45° or vertical. For the outward tracks the dwarf-signals have also to serve as outward signals. The circumstance that a track is switched off is shown by the vertical position of the dwarf-signals. By this means one has obtained safe signalling with the aim that the locomotive driver will be able to check that this outward track is set and clear, without having to resort to outward signals for each track. We are, therefore, restricted to one outward signal for each line, and also an inner outward signal of main type near the main tracks in view of the trains passing at a high speed.

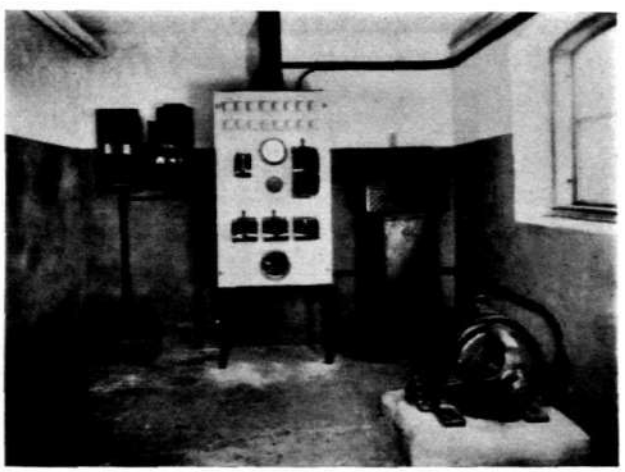
All main signals are light signals. Track signalling on the main home signals is done with one to three green lights. Besides, the home signal shows on signalling for a main line train whether there be a free passage or not. In the former case a white intermittent light is visible, in the latter case a green intermittent light, of course also in boht cases a fixed green light. Tracks can be set to and from all seven pairs of rails for the State Railway lines, whereas the trains of the crossing private railway can be signalled in and out on tracks 6 and 7 north and south, as well as in and out on track 7 in the south.

On platform 1 near the station building are located repeaters for the home and outward signals, so that the train dispatcher can check their interlocking. To facilitate the work of the train dispatcher in his clearing, there are also arranged

at certain places separate repeat signals for the most commonly used outward tracks.

One detail of the installation that may be specially mentioned are the arrangements for the level crossings, which exist south of the station building, about 650 m. from the interlocking installation. The street is shut off by means of electrically operated booms, which are operated from the interlocking plant. The booms are interlocked by the home and outward signals, so that there is no need to risk the booms being forgotten and the trains are yet signalled along over an open road. When the booms are lowered and a signal is set for a train to go ahead, the boom lever can at any moment whatsoever be returned to a position corresponding to raised booms. The booms remain nevertheless in a dropped position, but the boom-motor obtains automatically a current when the train has passed the level crossing. For the purpose of warning street traffic (this place is very busy occasionally) there have been set up special signals which by a powerful red light, visible even in daylight, show that the booms are being, or have been, lowered. These signals, one outside each room, show stop already when the warning bell on the booms begin to ring, i. e. a good while before the booms themselves begin to drop. When the booms rise the signals go out as soon as the booms have been raised sufficiently for allowing vehicular traffic to pass. These extra signals have proved to be of great benefit; no difficulties whatsoever have occurred to have the road traffic stopped and the crossing cleared when the booms are lowered, though they are operated from an interlocking cabin from which the street traffic cannot be observed. It is obviously so that when the way-farer knows that a drop-boom is operated mechanically so as to drop unrelentlessly, it inspires a great deal more respect than a crossing-keeper close by, who, in case of need, can stop the motion; in the latter case many a way-farer is tempted to hurry on to the track, although the lowering of the boom has started, in order to escape having to stand waiting before dropped booms.

The interlocking installation is operated both with direct and alternating current. The City of Lund Electric Works supplies both kinds of current. 3-phase alternating current, 50 periods, is taken from its alternating current net, with a high voltage transformer erected within the station area, and on the secondary side $3\times130/100/55$ volt are drawn in the interlocking installation's own transformer. The lamp voltages are 55 in the dwarf-signals and 12 volt in the main signals; the latter voltage is obtained from local transformers set up in cabins close to the signals. The track-lines are fed with alternating current, c:a 2 volt tension between the rails, and this voltage is stepped up to about 4.5 volt for feeding the track-phase of the track-coils located in the interlocking cabin; the local phase is fed with 110 volt, the interlocking control coils (the SS-coils) operate with two phases, both with 110 volt. Direct current (12 volt) for operating currents for signal and release coils as well as block magnets is obtained from a



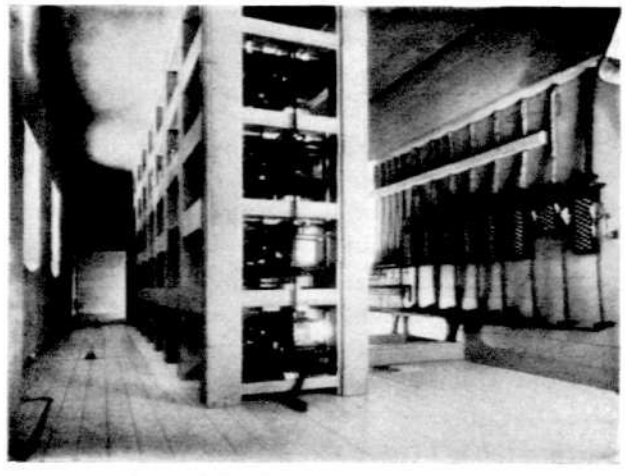
R 1679 Power station.

metal rectifier (copper oxide rectifier). The interlocking motors, made for 120 volt direct current, are fed direct from the city's direct current net. A converter is also set up in the power-room of the installation as a reserve. The latter is operated with direct current. It has been considered that since the city has very reliable arrangements for the supply of direct current, a separate reserve battery can be dispensed with. It has, therefore, been possible to carry out the entire power plant comparatively simple. The energy consumption of the installation is about 32000 kwh alternating current and about 450 kwh direct current per annum.

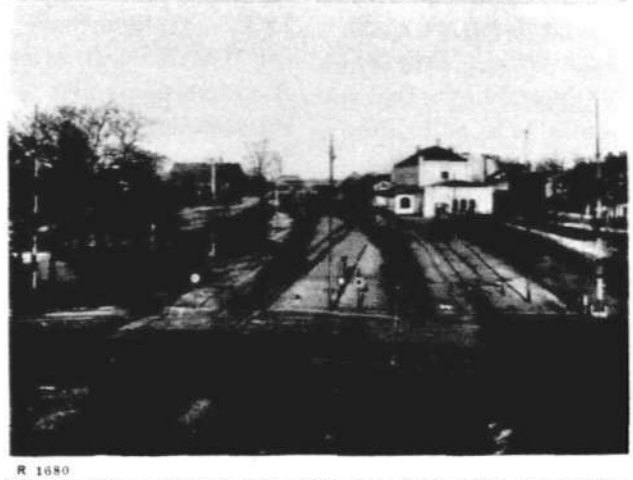
As has been stated in the preceding, the entire operation is now confined to a single interlocking machine. This concentration affects, as a matter of course, the signalling staff beneficially. In

the old plant, with its three interlocking machines, 11 men were on interlocking duty with the same traffic conditions as now. The new interlocking installation has hitherto been served by a staff of altogether 6 men, but it is quite possible that this number can be reduced when the staff have become sufficiently accustomed and expert. The saving in personnel is thus at least 5 men. The installation has cost 280000 Swedish kronor. Although the motive for such installations in the first instance must be considered as a measure for safeguarding the trains and bringing about sufficient speed and rapidity in operating the station, the saving in personnel already effected in this case constitutes a very good contribution towards paying interest and amortisation on the initial investment.

The installation was fitted up in the summer of 1929, the work taking about 3 months, which must be looked upon as very smart. Electrically operated special drilling machines and welding machines are, as much as possible, used for the mechanical work of fitting up, and this work was done by the State Railways themselves. When working at a very busy station it is of great advantage for the rate at which the work is done, if electric current is available and can be used for operating portable machine tools.



R 1678 Interior of relay room.



R 1680
View of station yard with level crossing. Station building on the right.