The New Interlocking Plants in Linkœping and Mjœlby.

Electric interlocking plants in Linkœping and Mjœlby on the main line between Malmœ and Stockholm were put in service in May 1928. The work on these plants was begun in late summer 1927 and constituted the final step in the reconstruction and modernization of the station equipment carried out in conjunction with the construction of a double track line between Oaby and Mjœlby instead of the previous single track line.

The total cost of these two interlocking plants amounts to 320,000 Swed. crowns, and their construction has permitted a reduction of thirteen men in the station force, corresponding to a yearly saving of at least 40,000 crowns. Since the cost of operation and maintenance for these two plants does not exceed eight to ten thousand crowns per year, the saving on wages for personnel is sufficiently large to render an interest of 5 percent on the cost of installation and to permit its amortization within fifteen years.

This saving has been made possible through a centralization of the signalling and track clearing operations by the use of track circuits and electric power for the control of points and signals. It might have been possible to reduce the first cost to a certain extent by eliminating the use of track circuits and by dividing the interlocking area into several smaller ones, but this would not have permitted any reduction in the number of station hands.

Traffic conditions.

These two stations differ somewhat from each other as concerns traffic conditions. Mjœlby is the terminal of the double track line between Oaby and Mjœlby, forming a part of the south trunk line of the Swedish State Railways, this line continuing southward with a single track. To the north we have the single track line Krylbo—Mjœlby over which passes the direct traffic between the southern and northern sections of the country. The greater part of the freight traffic arriving over this line continues southward. Several passenger trains include through cars which are coupled to southbound trains, and this necessitates switching operations also during stops of express passenger trains at the station.

In addition to the State Railway lines, a private line enters Mjœlby and its trains make connections with those of the State Railways.

Finally, Mjœlby is a boundary station between two locomotive sections. A large locomotive station is situated here, engines being changed for all trains during their comparatively short stop.

Thus, while Mjœlby has the character of a junction station for the long distance express traffic, Linkœping is more of a through station where most of the trains make short stops but where switching operations with the through trains are more or less rare. On the other hand, quite some quantity of switching of the local freight trains takes place here.

One private line enters the southbound track of the State Rys. double track line one kilometre north of the station, at Ladugoardsbacke, where formerly a separately operated interlocking machine was provided to manœuvre the switches and their signals.

The traffic frequency at these stations is given in the accompanying schedules, which indicate the number of train arrivals and departures per day according to the time table.

Mjœlby:

	Express trains	Passenger trains	Freight trains
to and from Sya	10	9	9
» » » Skaenninge	—	8	6
» » » Stroalsnaes	8	9	9
» » » Hogstad	—	8	—
Total	18	34	24

Linkœping:

	Express trains	Passenger trains	Freight trains
to and from Linghem	10	11	10
» » » Malmslaett	10	9	9
» » » Tannefors	—	20	—
Total	20	40	19

Choice of type of plant.

Since it was important to choose the most suitable type of interlocking plant for these stations, it was evident from the very start that a centralization of the control devices for the safety of incoming and outgoing traffic would be of decided advantage for the safety of the traffic as well as from an economic point of view with regard to the cost of operation. The work of the clearing of tracks at Mjœlby was divided up between two signalling posts, one at each end of the station yard. At Linkœping there were four signalling posts — one at Ladugoardsbacke, one at the draw bridge between Ladugoardsbacke and the station and one at each of the grade crossings north of the station building.

The responsibility for the inspection of the tracks and of the clearing signals lay — as is customary for Swedish railways — with the train dispatcher on duty at the station. Due to the extensive area of the station yard the train dispatcher usually had to employ the services of an assistant in order to manage the inspection of all the points and tracks.

It was clear that the installation of a central interlocking machine for the manœuvering of points and signals and the placing of an illuminated track plan near this machine for the supervision of the track yard would enable the train dispatcher himself to accomplish much of the work which had heretofore been handled by special signal guards and track inspectors.

Although this centralization, as far as the trains were concerned, must needs have decided advantages, it was not considered advisable to provide a similar centralization for the extensive manœuvering of points directly located in the regular train tracks. Such an arrangement would necessitate the assignement of special interlocking machine operators during switching operations although it would not — with the existing traffic conditions — provide any corresponding advantage for the switching work. For this reason it was decided to let the brakesmen on the trains take care of the setting of the points, but in order to make this possible it was necessary to provide local setting possibilities for points manœuvered from the interlocking machine. This is accomplished by means of electric switch levers placed beside the respective points (see fig. 11).

In order to make the interlocking machine and apparatus easily accessible for the train dispatcher, it was found necessary to place them in the immediate vicinity of the station building and main platform. At Linkœping it was possible to find room in the station building beside the telegramme room. At Mjœlby a small separate building, located between the platform tracks and directly opposite the station building, was erected for this purpose (see fig. 4).

Track arrangements.

The main features of the track arrangements are shown in figs. 1 and 2, which are photographic reproductions of the illuminated track plans. The length of the area covered by the track plan is 2700 m. for Mjœlby and 4100 m. for Linkœping.

At Mjœlby there are four tracks — I, II, III and XX — with passenger platforms, the first three being for trains from Sya, Skænninge and Stroalsnæs while track XX is for trains from Hogstad. In addition to these there are three freight tracks numbered IV, V and VI, with a free length of about 700 m.

At the Linkœping station tracks I and II are for through trains. Track I is for one way traffic only, while track II is used for trains running in either direction. Track III is for freight trains making extended stops or which are passed by other trains at this station. Tracks V and VI are used partly for the local trains from Tannefors and partly for passenger trains on the main line which are to be passed by other trains at this station.

As indicated in fig. 2, the trains from Tannefors are run against the direction of traffic on the double track line between Ladugoardsbacke and Linkœping. This arrangement was adopted in order to avoid a switch connection between the two tracks at the junction point, which is situated at some distance from the station.

In addition to the track junction on the line at Ladugoardsbacke, the arrangements at Linkœping become still more complicated on account of the swing draw bridge (*Sv* in fig. 2) between the junction switch and the station. The draw span has a length of thirty-five metres and is opened several times a day for the passage of boats.

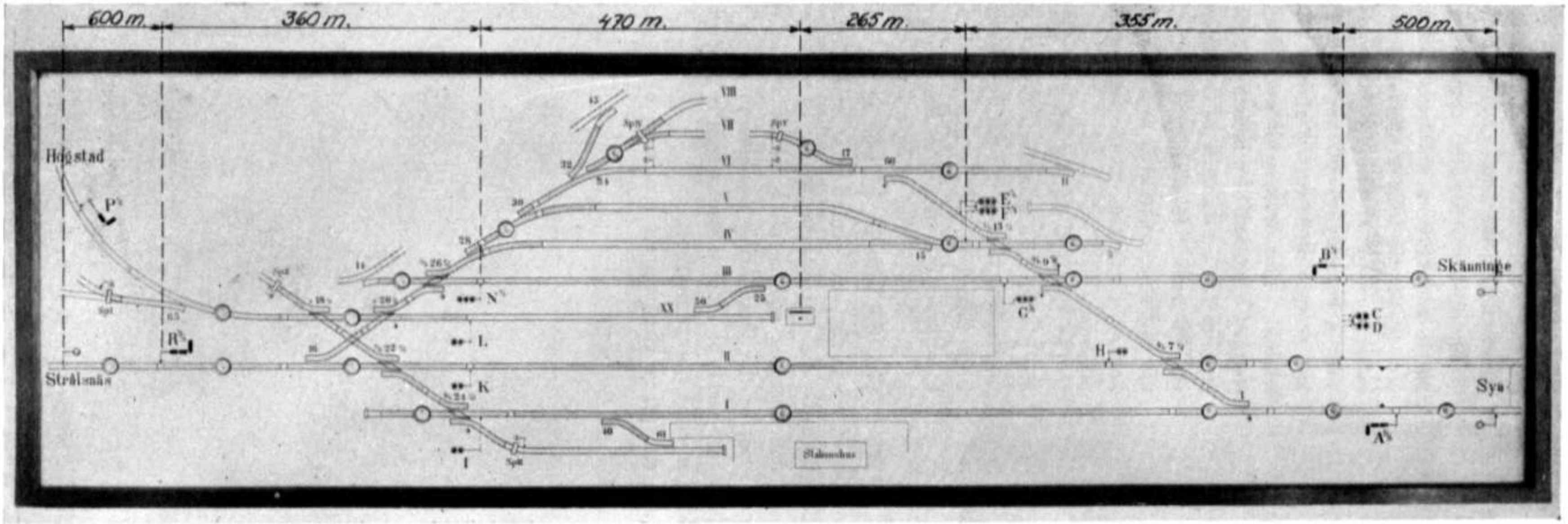
Further, the track yard has four grade crossings, marked v_1, v_2, v_3 and v_4 on fig. 2. The two last of these are heavily trafficked street crossings which must be closed by crossing gates on the passage of trains.

The traffic is not so heavy at v_1 and v_2, consequently it has been possible to replace the old safety devices with automatic bell warning signals.

The power plant.

Fifty cycle alternating current is available at both stations for the operation of the interlocking plants.

At Mjœlby, this current is obtained direct from the electric lighting net, from which the interlocking



R 1225

Fig. 1. Illuminated Track Diagram, Mjœlby.

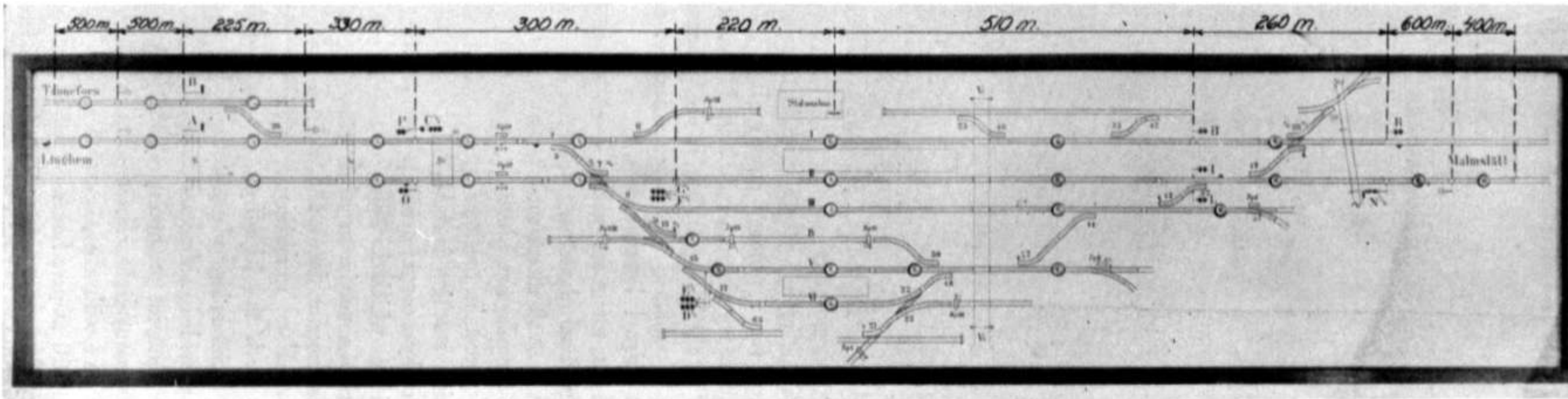


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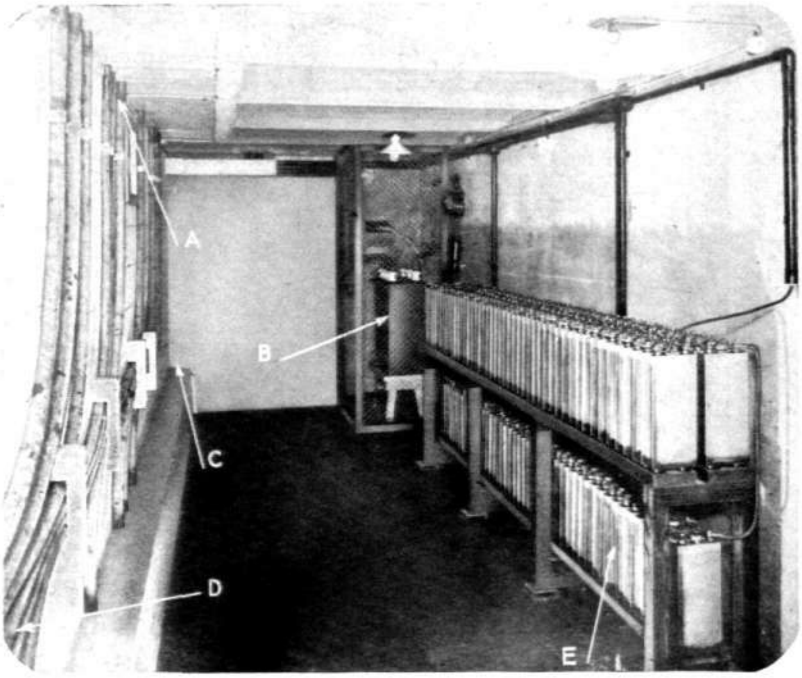
Fig. 2. Illuminated Track Diagram, Linkœping.



R 1227 Fig. 3. Interior View of Battery Room at Linkœping.
A. To interlocking machine. B. Main transformer. C. Cable intake.
D. Underground cables. E. Storage battery for 60 amp. hrs. 140 cells.

machine is furnished with 3-phase, 220/127 volt alternating current.

In Linkœping a special main transformer was installed for a primary circuit of 3×500 volts and a secondary circuit of 3×190/110 volts.

The alternating current is used unchanged for the direct feeding of track circuits and for semaphor and light signal lamps as well as for point and skotch-block lanterns.

A 30-volt direct current for relays and locking magnets in the interlocking machine is furnished by a copper oxide rectifier which is able to give a maximum of six amperes on the D. C. side. For emergency use, both the Mjœlby and Linkœping plants are provided with storage batteries comprising twenty-eight Nife cells and with a capacity of 60 ampere hours. They are charged at regular intervals by means of the rectifiers which for this purpose are provided with arrangements for regulating the tension.

The motors for the operation of points and crossing gates get the necessary current from a special storage battery composed of 112 Nife cells, with a capacity of 60 ampere hours and giving a direct current of 130 volts' tension. This battery is periodically charged by means of a mercury vapour rectifier for a maximum of 5 amperes at 180 volts. It is charged while in use and with the rectifier as well as the battery connected to the interlocking machine.

The batteries for the Mjœlby plant are placed in a small addition to the interlocking station, this addition having been placed in such a manner as not to obstruct the view from the windows of the interlocking room. At Linkœping the batteries, as well as the main transformer, relays etc., are located in an underground room beneath the interlocking room. The power board and charging equipment, however, are in the same room as the interlocking machine so as to be within easy reach of those whose duty it is to inspect and charge the storage batteries.

An emergency charging set consisting of a gaso-

R 1228 Fig. 4. Interlocking Station at Mjœlby.

lene motor and a small three-phase generator has been installed at Mjœlby in the same room as the storage batteries and is used during temporary failures in the feeder line. At Linkœping such an emergency set was considered unnecessary as the city power plant is equipped with emergency machines.

The consumption of effect at the Mjœlby plant is about 750 kilowatt-hours per month and at Linkœping about 900 kilowatt-hours during the same time. Of this quantity, about 40 % are used for the track circuits, 45 % for the signal lamps and about 15 % for rectification to D. C.

The cable net.

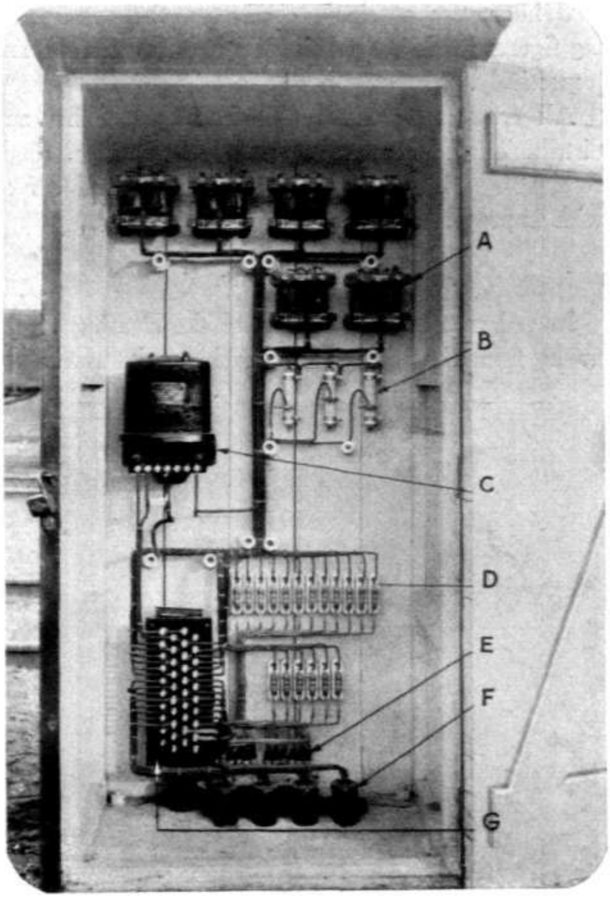
The lines between the interlocking station and the various station yard apparatus are carried in underground cables, such cables with 2, 5, 7, 14, 21 and 37 conductors being used. The cross-section of these conductors is either 1 or 2 sq. mm. Where larger cross-sections are required, several conductors in the same cable have been combined with each other.

The conductors are insulated with impregnated paper and bunched together to form a core which is wrapped with a layer of paper insulation and covered with a lead sheath. This is then served with a layer of impregnated jute and armoured with strong steel tape or wire. The armour is protected from rust by another serving of impregnated jute which is then covered by a thick layer of asphalt.

The multiconductor outgoing cables from the interlocking station are branched into smaller cables in

R 1229 Fig. 5. Cable Distribution Box.

special cast iron distribution boxes placed in the ground at surface level as well as in small sheds built of wood and which also contain transformers, rheostats etc. for the track circuits and signals. The



R 1230 Fig. 6. Cable Distribution Shed.
A. Relay transformer. B. Track resistance. C. Track transformer. D. Terminals. E. Rubber insulated cable. F. Cable terminal box for small capacity paper insulated cable. G. Cable box with binding posts.

cables terminate in cable end boxes at the interlocking station as well as in the distribution sheds. Boxes provided with screw terminals to which the cable conductors are directly connected are used for the larger cables, while flask boxes, in which the conductors terminate and are spliced to rubber insulated wires, are used for the smaller cables. The wires from the flask boxes are carried to screw terminals on the terminal box of the main cable or to special binding posts on the wall of the shed intended for cable conductors which are not to be connected to main cable conductors.

Twin conductor vulcanized cable without lead sheath is used in addition to the paper core underground cable. Such cable is used for the lines which are connected to the rails as well as for the switch lantern and semaphore lines. No cable boxes are required for these cables.

The total length of the underground cable in the Linkœping plant amounts to 15,500 metres with about

218 kilometres of single conductor, the corresponding figures for Mjœlby being 15,400 m. and 212 km. respectively.

All connections in the interlocking machine and distribution sheds are done with 1.5 sq. mm. single conductor wire, insulated with rubber and served with impregnated yarn.

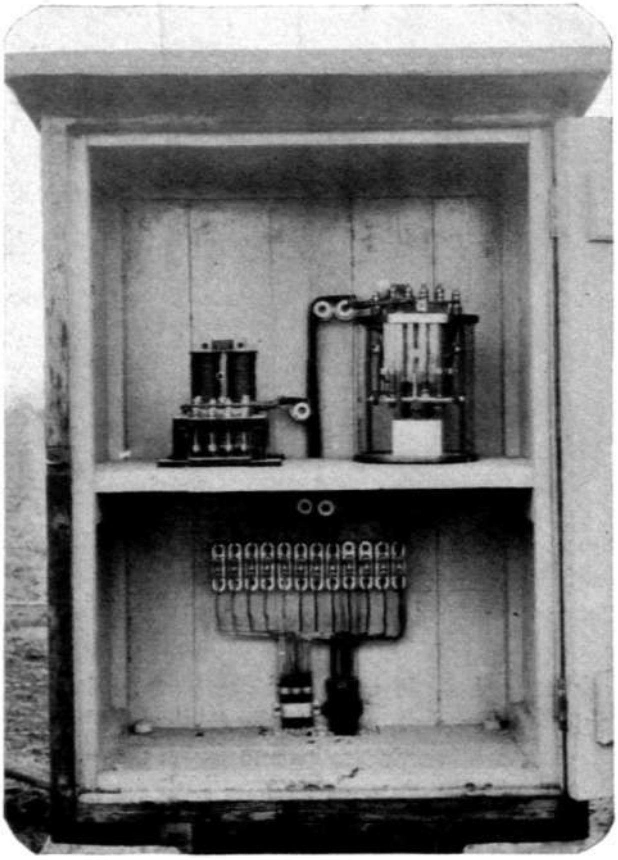
Track circuits.

In order to be able to control the clearing of the tracks from the interlocking machine, the tracks are divided up into sections electrically insulated from each other. Each such insulated section or track circuit is connected to a track relay which in turn controls an electric lamp on the illuminated track plan.

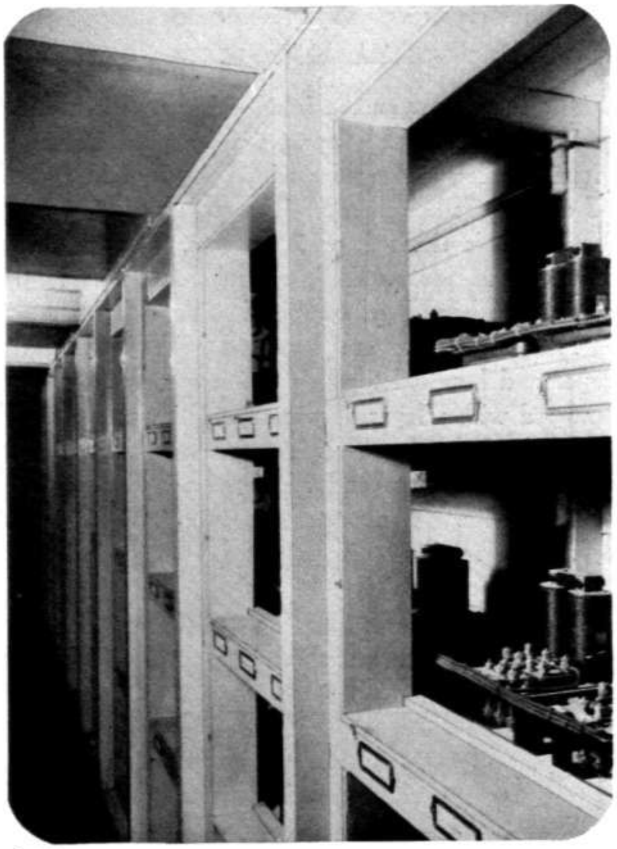
The track circuits are fed with A. C. except those situated outside of the home signals, which are fed with D. C. from primary batteries so as not to require special feeder lines.

The track relays for A. C. are two-phase disc relays all of which are mounted in the interlocking station. In order to reduce the drop in voltage in the long feeder lines between the tracks and the relays without having to use a conductor with large cross-section, a small so-called relay transformer which increases the tension in the relay line is introduced in this line close to the rail. These relay transformers are combined in groups in separate cabinets in which are also housed track transformers and resistances for keeping the current within certain limits when the track circuit is occupied by railway cars.

The primary sides of the track transformers as well as the local phases of the track relays are fed from the same triple phase net and connected to its phases in such manner that the phase displacement between the track phase and the local phase of the relay is of the greatest advantage for this latter.



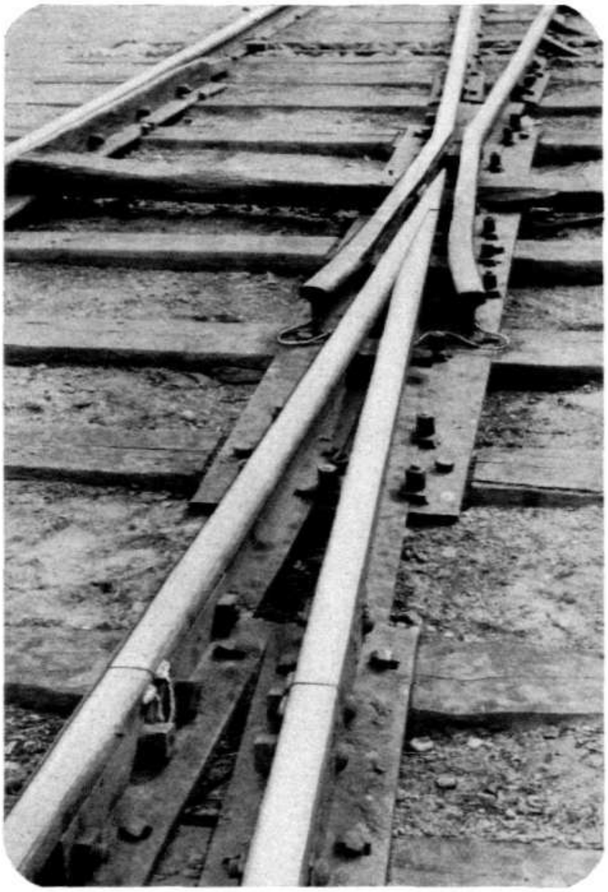
R 1231 Fig. 7. Relay Cabinet at Linkœping.



R 1232 Fig. 8. Relay Shelves in Underground Room. Linkœping Interlocking Station.

Track relays for the D. C. track circuits are mounted in cabinets beside the track and at one end of the track circuit and repeated in the interlocking machine by special relays connected to the 30-volt storage battery of the power plant.

The A. C. track circuits are so constructed as to de-energize the relay for a shunt of 1¼ ohms between the relays. The shunt resistance required for the de-energizing of the relays in the D. C. track circuits amounts to from ½ to ¾ ohms. The A. C. track circuits within the track yard are generally shorter and totally or partially located in side tracks, where one must figure on an increased resistance in the contact between the wheel and the rail, due to the accumulation of rust and dirt on the surface of the rail. For this reason a higher shunt value has been considered necessary for the A. C. track circuits than



R 1233

Fig. 9. Welded Track Bonds at Crossover.

for the D. C. track circuits, which are long and located on the line where efficient shunting may always be relied on.

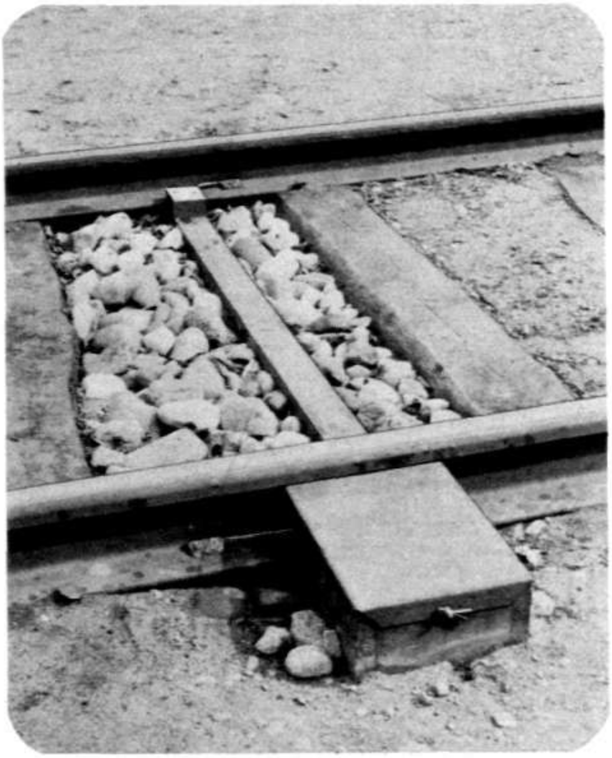
The track circuits are always connected so as to give opposite polarity to the two track ends in an insulated rail joint. In this manner a track relay cannot be actuated by current from an adjacent rail.

The bonds between the rails are made of copper cable welded to the head of the rail. This same method is used for the bonds between the rails and the conductors of the underground cables as well as between the rails at points and crossings.

Setting of the points.

The motors in the switch machines are D. C. series motors with a special field winding for each direction of rotation. The points in a cross-over between two parallel tracks are controlled by the same lever. The wiring is done in such a manner that the motors are put in circuit one after the other in the same sequence, either the setting takes place from normal to open position or vice versa.

Four lines are required between the interlocking machine and the point, two of which are for the



R 1234

Fig. 10. Welded Bond between Cable and Rail.

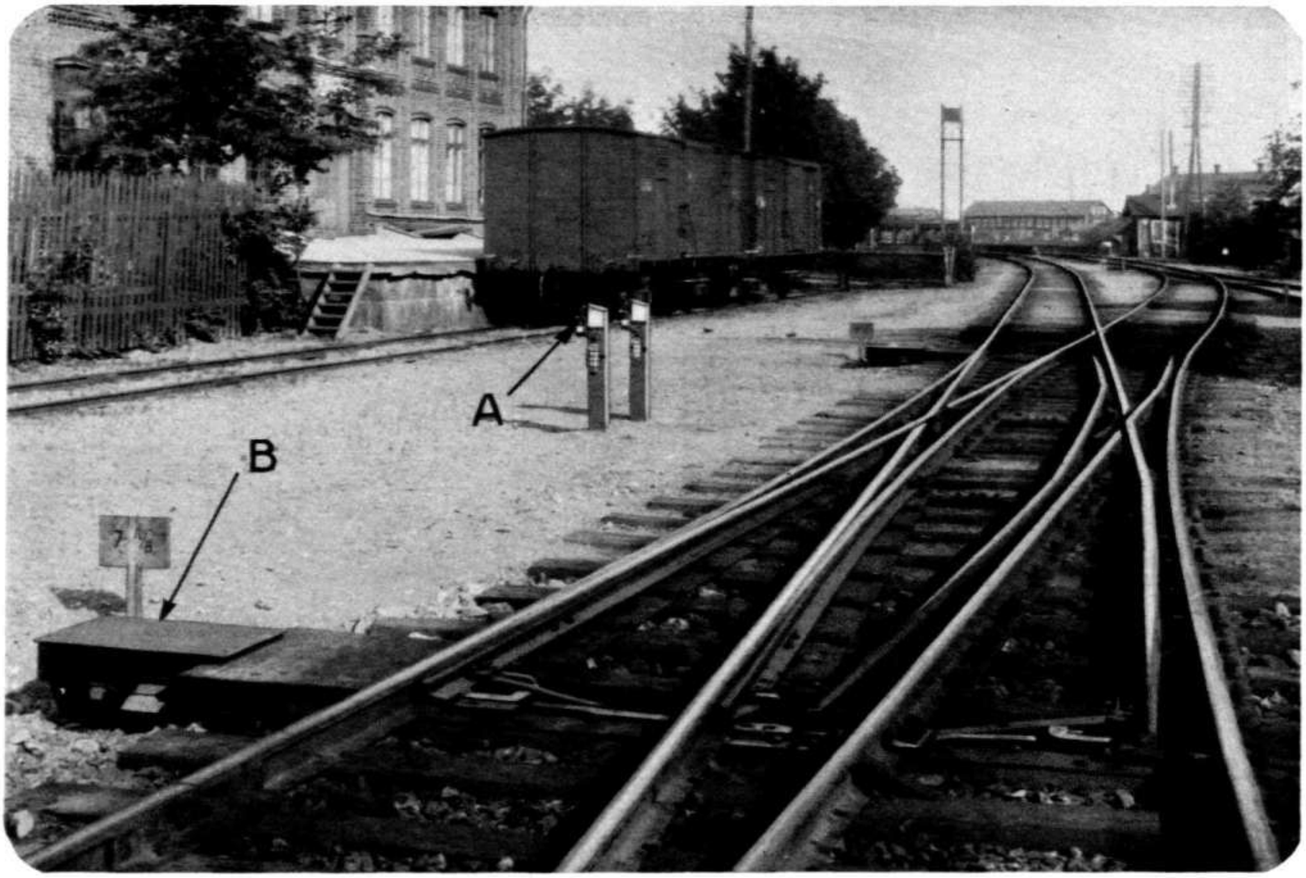
motor control and the other two for indicating the position occupied by the point. In addition to this there is a special line for the local manœuvering of the point. The same number of lines are required for coupled switches between the interlocking machine and the first point. Two extra lines for the protective earthing of the more distant motor are needed between the two coupled points. A common earthed return is used for the motor as well as for the indicator lines.

As a protection against foreign currents the indicator lines are earthed at both ends during the setting of the points. Also, the motor control line is shorted to earth when not in use.

The local setting of points is done with the aid of special levers mounted on posts near the points in question. For points coupled to the same lever, the local setting lever is always placed beside the point which is set last. In order to be able to observe the position of the point farthest away from the local setting lever, this point is provided with a lantern. The local setting of a switch is possible only after the interlocking lever has been set to a neutral position. The line which is connected to the local lever is then brought in circuit and the lines for the central manœuvering of the point are disconnected. The signals for all the tracks passing over this point are simultaneously locked in 'stop' position.

A lamp which glows when the control line is in circuit, i. e. when the interlocking lever is in neutral, is placed on the lever post and just below the local point lever. Glimmer lamps mounted in moisture proof fixtures are here used as indicator lamps (see fig. 12).

Certain points are made for local setting *only* and can be locked from the interlocking machine, electromagnetic locking devices being used for this purpose. The locking bolt, which is actuated with the aid of electromagnets, in turn actuates a point rod in the locking box, which is connected to the tongues of the point. Also, the rod actuates a contact device which closes a circuit over a locking magnet on the locking lever when the switch is in a suitable position. Thus, the switch must first be set to the right position before the points locking lever can be set and current admitted to the driving magnets.



R 1235

Fig. 11. Interlocked and Locally Set Double Slip Points.
A. Local point lever. B. Switch machine.

Fixed signals.

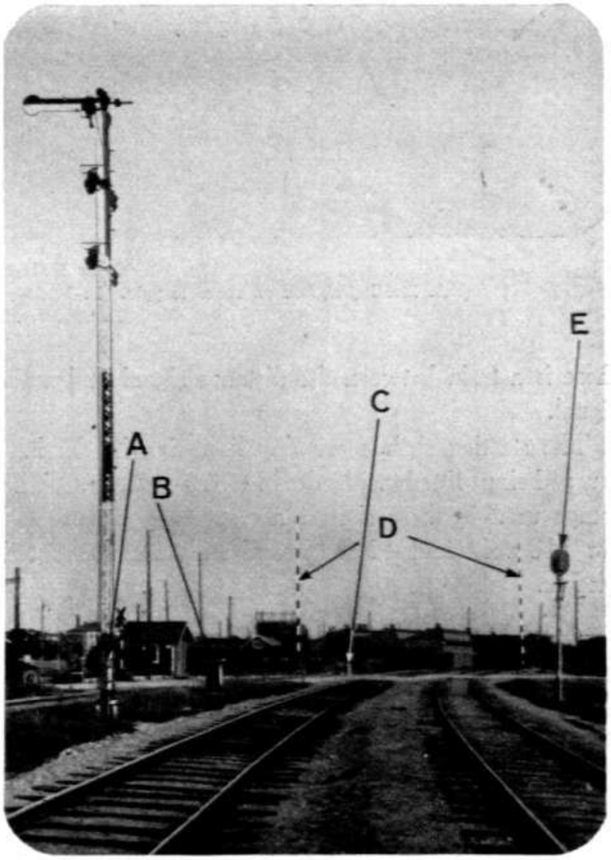
The home signals are standard type semaphores provided with one, two or three blades, depending on the necessity of special signal combinations for the tracks. One, two or three blades pointing upwards to the left mean 'clear'. *One* blade is used for the direct incoming track, two or three blades for side tracks. When the same signal combination applies to several side tracks, this means that these tracks are similar as to length and permissible speed of trains. At Mjœlby, for instance, a home signal from Stroalsnæs (R1/2/3) shows one blade for track II, two blades for track III and three blades for side tracks IV, V and VI. The home signal from Malmslætt (N1/2/3) in Linkœping shows one blade for track II, two blades for track III and three blades for tracks V and VI. At night, a 'stop' signal from a semaphore consists of a red light at the top signal blade. The 'clear' signals with one, two or three blades are replaced by one, two or three green lights on the respective blades.

R 1236

Fig. 12. Local Point Lever.

The signal lanterns are provided with electric lamps. The lamps of a signal with several blades are wired in series and connected up with an indicator lamp in the interlocking station which glows when all the semaphore light signals are glowing. A. C. is generally used for the semaphore light signals, but arrangements are made by means of which the signal lamps may obtain current from the interlocking battery during shorter breaks in the feed current from the A. C. net.

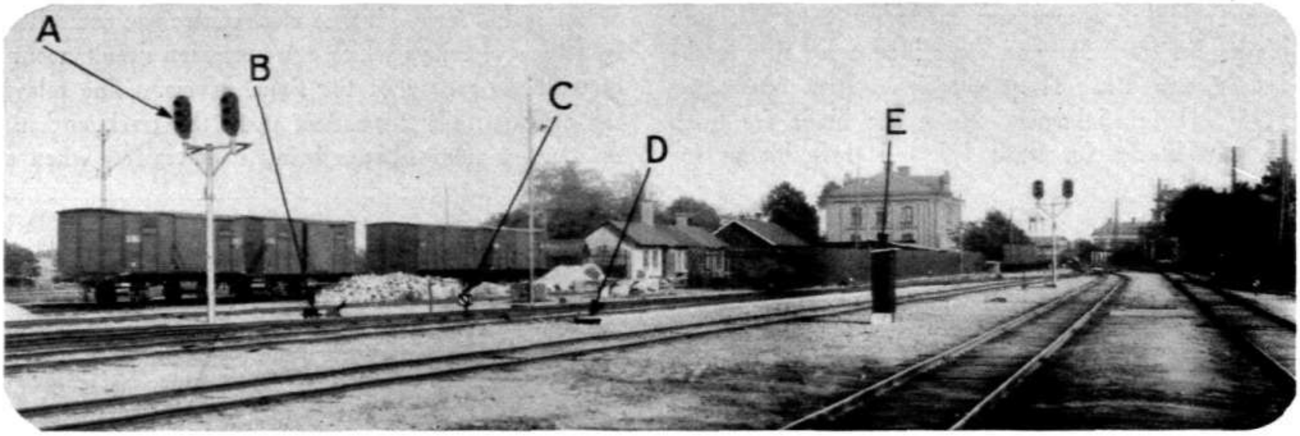
The blades of the home semaphores are controlled by means of special motor drive mechanisms mounted on the signal mast. These mechanisms are controlled by means of relays which are energized simultaneously with the setting of the signal levers. The relays are automatically dependent upon the track circuits, the control relay always being de-energized when a track circuit in the track is occupied by rolling stock. On the de-energizing of the control relay, the signal motor obtains current and is driven back to normal. Also, the signal blades are provided with electromagnetic control so that their own weight brings them back to normal in case the control circuit is broken.



R 1237

Fig. 13. Home Signal N1/2/3 to Linkœping from Malmslætt.
A. Signal motor. B. Transformer shed. C. Crossing gate control.
D. Crossing gates. E. Block signal.

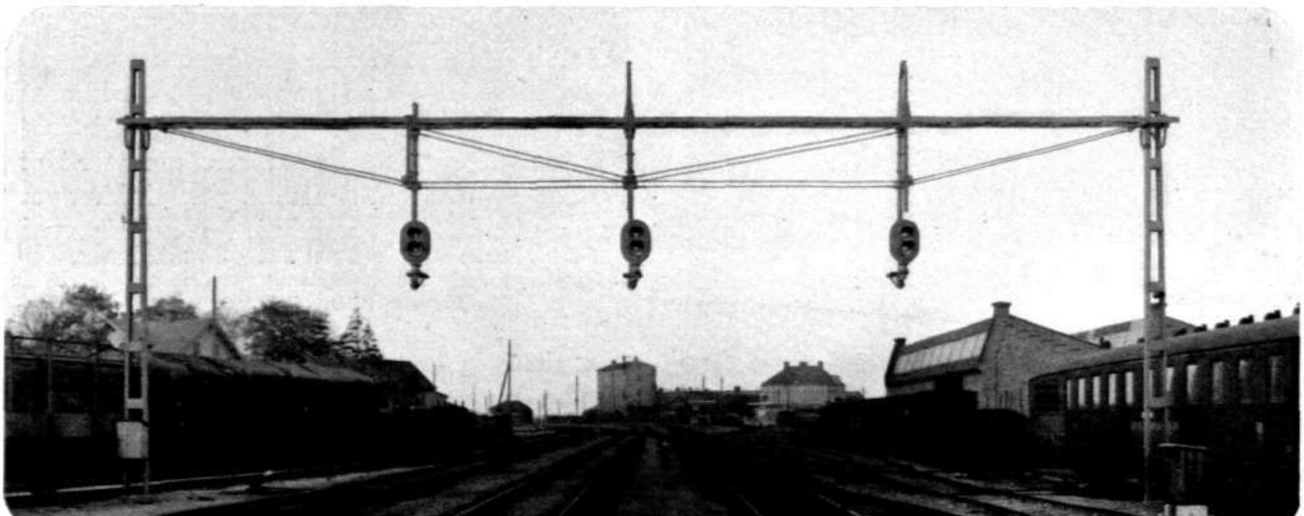
Distance signals showing a green intermittent light when the corresponding main signal indicates 'clear' are placed at a suitable braking distance outside of the home signals. These signals are day light-signals burning acetylen gas. Each signal has its own gas tank and functions uninterruptedly, not being affected by eventual disturbances in the source of electric power. The distance signal is also dependent upon the track circuit outside the home signal, the distance signal automatically indicating 'caution' as long as there is a train between the distance signal and main signal.



R 1238

Fig. 14. North End of the Linkœping Station Yard.
A. Starting signals on concrete pole. B. Locking device. C. Skotch block lantern. D. Switch machine.
E. Cabinet for transformers etc.

The starting signals are day light-signals, the lanterns being fitted with double lens systems. The lamps used in these signals are specially constructed for 110 volts and 40 watts and with a concentrated glower.



R 1239

Fig. 15. Starting Signals H, I and L, Linkœping.

A 'stop' signal is indicated by the starting signals with a red light. Signals intended for a track towards a certain line indicate 'clear' with a green light. A starting signal intended for a track leading towards two lines can also indicate 'clear' by means of two green lights in order to show towards which line the track has been cleared. Thus, signals E$^{1/2}$, F$^{1/2}$ and G$^{1/2}$ at Mjœlby show *one* green light when the outgoing track is cleared towards Sya and two green lights when the track is cleared towards Skænninge.

In addition to the starting signals placed at the ends of the station yard tracks, so-called outer starting signals are provided for such lines as are equipped for line blocking. These signals show a red light for 'stop' and a green light for 'proceed' and are placed exactly opposite the home signals, i. e. at the station yard limits and where the line proper begins. The outer starting signals depend upon the section

R 1240 Fig. 16. Light Signals C1/2/3 and P at Linkœping.

blocking field and are locked in 'stop' position when a train is located on the line. Co-operation is also provided between the outer and inner starting signals so that none of the latter can show 'proceed' until the outer starting signal in the continuation of the outgoing track also shows 'proceed'.

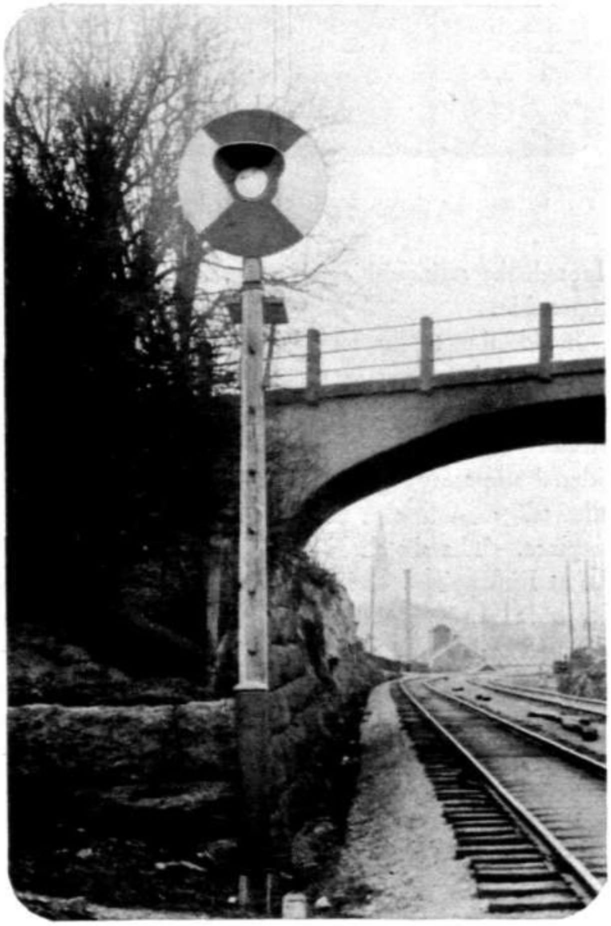
The light signals are mounted on concrete posts or standards or on gantries spanning the tracks. Gantries are used in such cases where the space between the tracks is insufficient for the erection of posts; thus, the signals at *I*, *K*, *L* and *N*1/2 at Mjœlby and *H*, *I* and *L* at Linkœping are placed on gantries, the construction of which is clearly shown in fig. 15. The gantries are of the standard type used by the Govt. Railways on electrified lines. The signals are attached to vertical pipe standards which are clamped to the gantry. A small platform used as a seat by the trouble man when exchanging broken lamps etc. has been provided in back of each signal. The starting signal *H* at Mjœlby has been suspended from an outrigged arm extending out over the track from a latticed iron mast (fig. 18).

Detached signal poles are made of reinforced concrete. As a rule they have been placed directly in the ground and have required no special base or footing. The poles are octagonal, tapering towards the top and are made hollow so as to reduce their weight. They are manufactured on a commercial basis and according to a special method by which a uniform and excellent product is obtained. Each pole terminates in an iron cap with a pin to which the signal lantern is screwed. The pole signals are also provided with a little platform for the caretaker when replacing broken lamps or adjusting the signal.

In certain cases two signals are mounted on a single pole. The signals are then mounted on brackets, one on each side of the pole, as shown in fig. 14.

The outer starting signals *O* and *P* at Linkœping are mounted on pipe standards which are clamped to the bridge girders.

On this bridge is also mounted a light signal C1/2/3, serving as a home signal for trains from Malmslætt and Tannefors. This signal shows a red light for 'stop', while 'proceed' is indicated by *one*



R 1241 Fig. 17. Acetylene Distance Signal at Linkœping.

green light for track I, *two* green lights to tracks II and III and *three* green lights to tracks V and VI.

The wiring of the light signals is about as follows. The current for the red light is led over an inductive resistance. When the signal is to indicate 'proceed' the red lamp is extinguished by closing a circuit with a low resistance over a contact in the control relay, in parallel with the red lamp. With a light signal with several green lights forming a single signal combination, the inductive resistance is arranged so that a signal to 'proceed' is not given unless all the signal lights are burning. A wrong signal combination

R 1243
Fig. 18. Starting Signals Mounted on Supporting Bracket Arms, Mjœlby.

through the extinguishing of a green light is therefore impossible.

In addition to the above-mentioned signals, which are for train movements only, skotch block signals are provided partly in connection with all the skotch blocks, partly at certain points where it has been considered necessary to specially indicate 'shunting not allowed' even though no skotch block has been laid in place. The skotch block signal behind point No. 44 at Linkœping, for instance, shows a 'stop' signal for train movements towards point 44 when points 27 and 44 are set for train movements over the cross-over track. The skotch block signals have the form of revolving lanterns and indicate 'stop' by means of a diagonal bar over a white field. The diagonal black bar leans toward the track for which the signal is intended.

In order to facilitate the observation of the positions occupied by the switches, switch lanterns are provided where necessary. Both skotch-block lanterns and switch lanterns have electric lighting, the lamps being switched on or off from the interlocking station.

Section blocking.

Section blocking has been arranged at both Linkœping and Mjœlby for safeguarding the train sequence on the double track lines to Malmslætt and Linghem on the one hand and to Sya on the other. Train reports per telegraph or telephone are used for the traffic over the single track stretches. The previously mentioned outer starting signals serve as block signals and are controlled by current levers in the interlocking machine. These levers co-operate direct with the block fields of the outgoing sections. One starting and one home section blocking field is provided for each line section. When a train leaves a blocking section, the starting signal automatically returns to 'stop' after which it cannot be reset to 'proceed' until after the block field of the outgoing section has been locked and again released. This is taken care of from the nearest station in the direction of the traffic when the train has arrived there.

The block field of the incoming section is used to release the starting signals at the nearest station, this being done by the locking of the block field of the incoming section when a train has arrived at Linkœping and Mjœlby respectively. In normal position the blocking section is free, i. e. the block field of the outgoing section is released and the one for the incoming section is locked.

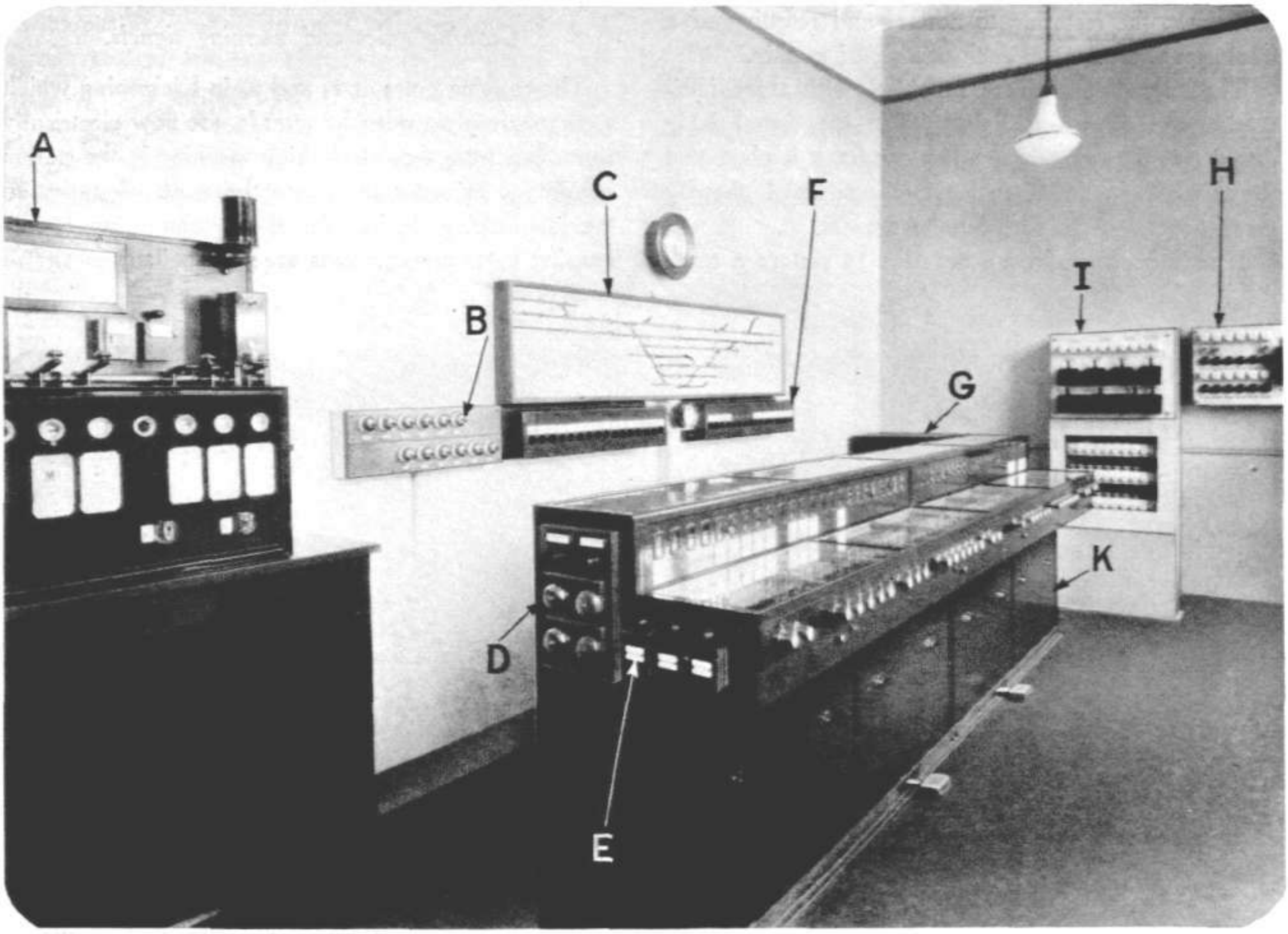
The interlocking machine.

The interlocking machines are of the usual type with point levers and track signal levers. Normal point levers are used for the control of the crossing gates and the electromagnetic locking devices.

The point levers are locked against setting when a track circuit in contact with the point in question is occupied by a train.

Each point lever is provided with an indicator to show that all collaborating points are set to their corresponding correct positions and also to show whether the lever is locked or not.

Track locking is provided for the tracks, the signal lever being locked after setting and automatically released after the passage of the train. Track locking is obtained with the aid of special relays, which are actuated by circuits which are closed over contacts in the track relays. These locking relays are also used



R 1244

Fig. 19. Interior View of the Linkœping Interlocking Station.

A. Lock-and-Block apparatus. B. Emergency release for point levers. C. Illuminated track diagram. D. Supervisory bell for warning signals. E. Emergency release for signal levers. F. Indicator lamps for light signals. G. Copper oxide rectifier. H. Distribution board for electric lighting. I. Power distribution board. K. Interlocking machine.

R 1245

Fig. 20. The Mjœlby Interlocking Machine.

to enforce the restoring to normal and resetting of a track signal lever after each passing of a train.

The signal levers are provided with three indicators, one of which shows when the signal is in 'stop' position, the other when the track is clear and the third when the track locking is released, thereby permitting the lever to return to normal.

It may be desirable on occasion to restore a track signal lever to normal even though no train has passed, and for this purpose sealed plunger keys are provided for emergency release. These keys are placed at one end of the interlocking machine.

Emergency release is provided for the point levers also in order to permit the resetting of a point lever should there be some fault with the track passing over this point. The plunger keys provided for this purpose are placed at some distance from the interlocking machine so as to require the collaboration of two persons for such an emergency release (see fig. 19).

Crossing gates and warning signals.

The crossing gates at v_6 and v_3 in Linkœping which were previously tended by guards, are now electrically controlled from the interlocking machine in the station building. In order to reduce the work of operating the interlocking devices for the manœuvering of the crossing gates arrangements are provided by means of which the driving motors for the raising of the gates are automatically started by the train itself. After the lowering of the gates and the setting of the main signal to 'proceed' the gate lever can be immediately restored to normal and the gates will remain down until the train has passed and the signal again shows 'stop'.

The crossing gates at v_3 may also be locally manœuvered by a special guard. This is necessary only during a certain part of the day when there are many shunting operations. When the gates are to be

R 1246

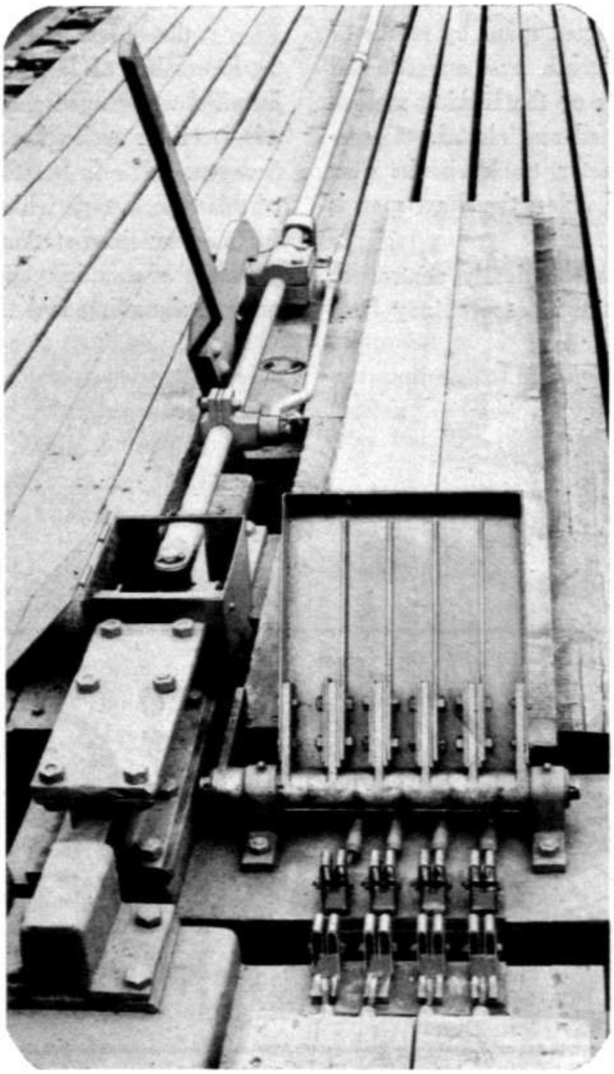
Fig. 21. Grade Crossing v_3 at Linkœping.
A. Concrete duct for mechanical connections. B. Driving mechanism for gates. C. Cable distribution cabinet.

manœuvered locally, the gate lever is placed in a middle neutral position after which the guard takes charge of the manœuvering by setting a special circuit lever. This locks the gate lever in the interlocking machine and all collaboration between the crossing gates and the fixed signals is broken. Thereafter all manœuvering of the crossing gates takes place on the responsibility of the guard.

The warning bells at the grade crossings v_1 and v_2 in Linkœping are automatically operated with the aid of the track relays. Bells for the supervision of the signals are placed in the interlocking station and connected in series with the warning bells so that the interlocking operator is immediately aware of the fact if these bells do not ring.

The drawbridge.

The drawbridge is connected to the signals on each side of the same in such a manner that the bridge must be in a position permitting the passing of trains before a signal to proceed can be given a train which is to cross the bridge. Permission from the interlocking station is necessary in order to be able to open the bridge. For this purpose a special block connection is provided between the interlocking station and the bridge operator's cabin. Permission to open the bridge can only be given when the signals show 'stop' and the skotch blocks for the main tracks between the station yard and the bridge are in position on the rails. Also, a block connection to Linghem



R 1242

Fig. 22. Bridge Contacts for Track Circuit Connections at Draw Span, Linkœping.

is provided necessitating the setting of the starting signals at this point to 'stop' before the bridge may be opened. When permission has been obtained, the signal and skotch blocks are locked until this permission has been relinquished and this cannot take place until the bridge is again clear for train traffic.

The track circuits continue over the bridge and the rails at the ends of the draw-span are electrically connected to the rails on the fixed spans by means of knife switches. These switches are opened and closed through the movements of the locking mechanism when the bridge is opened and closed. Consequently, the track relays for the track circuits over the bridge cannot be actuated unless the draw-span is closed and locked.

The bridge movements are electrically controlled. This can also be done by hand in case of any fault in the current supply. The locking arrangements actuate the electrical as well as the mechanical manœuvering devices.

Conclusion.

Plants similar to those here described although not so large have previously been erected at Flen, Jærna, Skœvde, Herrljunga, Vanneboda and Oaby. Of these Flen is the oldest and was put in operation in 1925. In December of last year a similar large plant was installed at Ængelholm, others being now in course of erection at Teckomatorp and Hallsberg, all in Sweden. The last-mentioned will be the largest one of this type, a type which has proved very economical for medium sized stations where the traffic conditions permit the shunting operations to be handled with manual signalling and the local setting of the points.