

# Electric Interlocking Plant at the Car Depot of the Stockholm Tramways at Brännkyrka

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On 15th October, 1945, the Stockholm Tramways opened a new car depot, the Brännkyrka Depot, situated on and south of Hägersten Road between Södertälje Road and Tellusborg Road. It is designed as depot for tramcars on the three south-west suburban lines, as well as for the tramcars and buses serving the city.

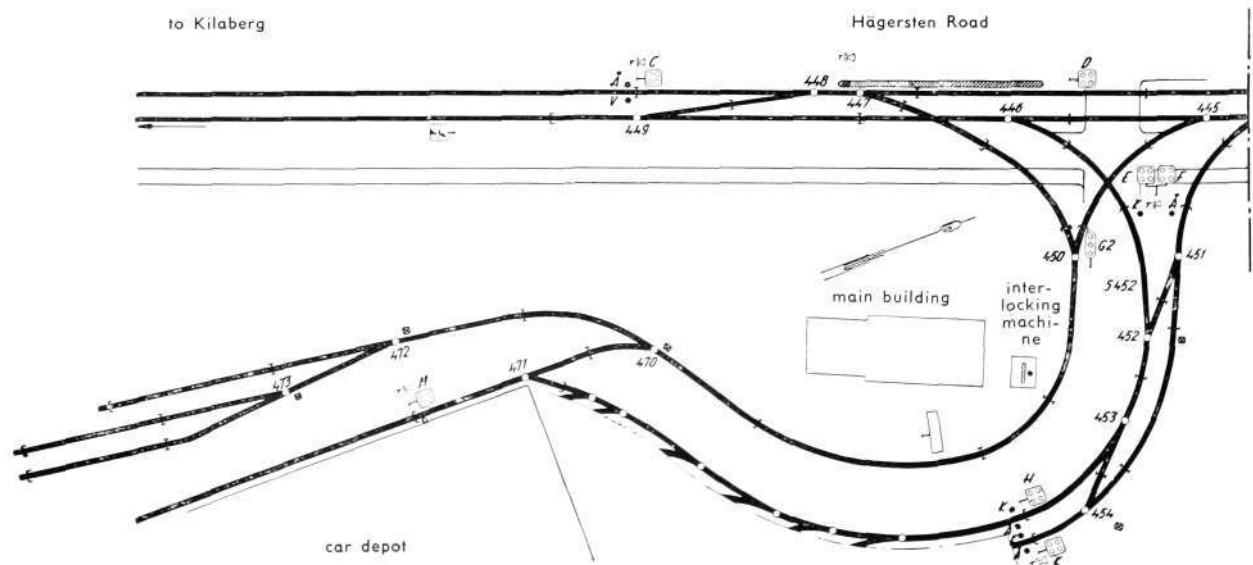
When running into and out of the Brännkyrka Depot the Tramway Company's vehicles must cross the fairly busy Hägersten Road and, as it was estimated that traffic at certain times of the day to and from the car depot would be very heavy, it was considered that an interlocking plant at the approaches to the depot would be economically justified. In fact, the only alternative to such a plant was to employ a number of signalmen to operate the points and to hold up the street traffic when necessary.

The build up and operation of the new interlocking plant is described in this article.

As early as 1944 the Tramway Company began in consultation with L M Ericssons Signalaktiebolag to plan an interlocking plant for the approaches to Brännkyrka Depot. However, as the first large interlocking plant of the Tramways Company — at the car depot in Alvik — was about to be put into use experience with the operation of that plant was first awaited. Meanwhile the conditions for the plant at Brännkyrka Depot were partly changed, owing to the track and point positions being altered and to the fact that a larger number of city cars of the most modern type (called »mustangs») began to be housed in the Brännkyrka Depot instead of the buses it had been intended to place there. The tram traffic to and from the depot, already before very heavy, was thus considerably augmented.

The programme for the plant was complete in principle by the beginning of 1947, when the material was purchased from Signalbolaget. The work of installation was executed during 1947 and the beginning of 1948, and the plant was put into operation on 19th April 1948.

Fig. 1  
Plan of the interlocking plant at Brännkyrka depot  
X 7520  
X 7521  
local switches  
telephone  
pedal or pressure contacts



## Description of the Plant

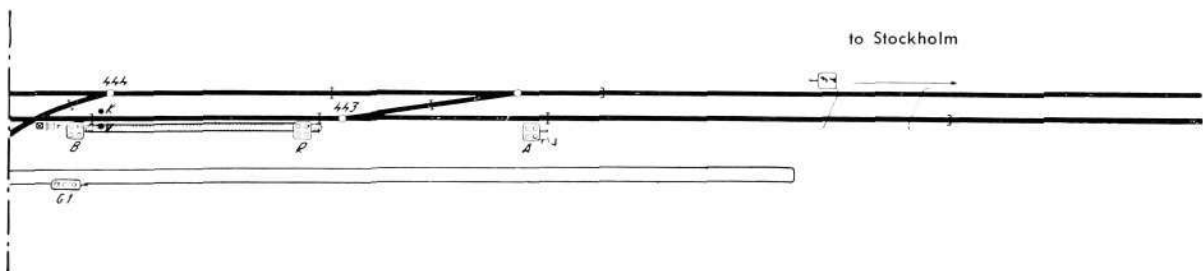
### Signals and Points

Fig. 1 shows a lay-out plan of the interlocking plant. It comprises 22 AC track circuits of conventional type, 2 street signals with red, yellow and green lights and 10 position light signals with four white lights. In addition there are 10 motor-driven points, impulses for which can be given either from the interlocking machine or from local switches (7 in number) at the various points or groups of points. Finally, there are 11 pedal contacts, operated with point iron by drivers when they wish to communicate with the interlocking machine attendant or themselves operate points or signals.

A tramset from Stockholm, after passing signals *A* and *R*, Fig. 2, which normally operate automatically but which may also be operated from the interlocking machine, comes to signal *B* and two pedal contacts by which the route can be selected. When the driver presses down one of the pedal contacts, impulse is transmitted either direct to the point lying immediately after signal *B* and to signal *B* or to the interlocking machine, in which case the interlocking attendant carries out the necessary operation. Permission for direct operation is given by a switch from the interlocking machine for the considerable parts of the day when traffic is such that most of tramsets proceed to the suburbs. To keep down as much as possible the work of the drivers and thus the loss of time at the stops, the signal *B* works automatically in such a way that when cars enter the track circuit preceding the signal this switches to clear for straight ahead track, naturally providing that no other tram movement is in the way. Any trams for the car depot, however, may at these times of the day operate point 445 and signal *B* by the pedal contact. After such a tram has entered the car depot area, point 445 is switched back automatically to straight ahead track.

The above relating to point 445 and signal *B* also applies to point 447 and signal *C* for trams from the suburbs. The signal *D* coming next, which is automatic but can also be operated from the interlocking machine, is employed to prevent trams for Stockholm at the stop from continuing when another tram is leaving the car depot on its way to Stockholm.

Tramsets when leaving Brännkyrka Depot are fully equipped as regards both material and crew before they come to either of the signals *H* or *K*. At these signals the required pedal contact is pressed, giving impulse either to the interlocking machine where the attendant performs the necessary operations



or direct to points and signals. When cars reach either of the signals *E* or *F*, Fig. 3, impulse may be given with the pedal contact there, on which the signals are operated either direct or via the interlocking machine. Authority for direct operation is required to be given from the interlocking machine. At times when many cars are leaving the car depot the tramdrivers do not need to transmit impulse at the signals *E* and *F*, as the interlocking machine

Fig. 2 X 6400  
Tramset on its way to the suburbs  
The set has just passed signal A and is opposite signal R.



attendant sets the signals to clear when the trams have passed either of the signals *H* or *K*.

Signal *G 1*, which alternates from green to red and vice versa over a 3 sec. yellow light, does not normally need to be operated separately as it changes automatically on operation of any of the signals concerned with tracks crossing Hägersten Road. The street signal *G 2* has not been employed up to now but has been normally kept unlit, for the reason that no street traffic proceeds to and from the car depot. The housing of buses at the car depot has not been carried out as planned.

Signal *M* and various points in the area are not of essential interest in the present connection and will therefore not be dealt with.

### The Interlocking Machine

The interlocking machine building, the location of which may be seen on Fig. 1, is combined with space for the caretaker and is built on three floors. The basement is used as relay room, the ground floor comprises the caretaker's lodge and the top floor is the operating room. The interlocking machine is a relay machine with press button operation. All the plant's relays are placed in the interlocking machine relay room, Fig. 4 and 5, and four 60-wire EDBL cables connect the relay room with the operating room.

In the operating room, Fig. 6, the interlocking machine is placed on a desk, on one shelf of which the fuses for the point engines are installed. The interlocking machine is built up of vertical panels of standard dimensions, which can easily be exchanged in case of alteration. The interlocking machine attendant can follow the movements of the tramsets and see the positions of points and signals on an illuminated track diagram, Fig. 7, behind the interlocking machine. The track diagram has been placed on the wall between the operating room and a small rest room for the interlocking machine staff. In this way more or less dead space behind the track diagram has been avoided. The diagram has also been made so that it can be opened from the back, Fig. 8, i. e. in the rest room, and thus attention to it can be given without disturbing the work of the interlocking machine attendant.

For each signal there are 3 control buttons on the interlocking machine, one for setting to clear, one for setting to danger and a sealed button for emergency opening of the route. For each point or group of points there are 2 control buttons for switching to plus or minus position. In addition there are switches by which switching over of the points by the devices for local switching placed



Fig. 3 X 4624  
The driver transmits impulse to the interlocking machine by means of the pedal contact

Fig. 4 X 6404  
Interior of the relay room  
Most of the relays are set up on wooden shelves.



alongside the various points or groups of points in the depot area can be made possible. There are separate switches for switching to direct operation from pedal contacts.

Indication on the track diagram of the tramset movements is done by one indication lamp for each track circuit. The track circuit lamp shines when the corresponding track circuit is free from tramsets and is out when the track circuit is occupied by a tramset. For point indication there are three lamps per set of points. One of the lamps is placed on the point tongue and shines when operation is handled from the interlocking machine and is extinguished when authority has been given for local operation in the car depot area. The other lamps indicate the position of the points. The signals as formed on the track diagram show corresponding signal pictures on the depot area. When one of the pedal contacts is actuated this is indicated on the track diagram by a light in the corresponding lamp, provided authority has not been given for direct operation of the corresponding signal and points. The lighting of the pedal contact lamp on the track diagram is accompanied by a buzzer signal to draw the attendant's attention to the fact. Finally the track diagram includes various instruments for measurement of current and voltage.

The interlocking machine attendant can easily reach from his place at the operating desk all the press buttons of the interlocking machine as well as a 20-line telephone switchboard, placed in the immediate vicinity of the operating apparatus. By means of the telephone switchboard the attendant can come into direct communication with most of the signals in the plant and also with the private branch exchange of the Brännkyrka depot.

## Special Problems

It may be considered that this signal plant is unnecessarily complicated. It may therefore be advisable to refer to the special problems which were and are associated with same.

Something will first be said about the tramway traffic to and from the car depot. It is characterized by great lack of uniformity. About 0430 o'clock cars begin to leave the car depot, and this keeps on for a little under two hours. In the next two or three hours there is generally no traffic to or from the depot. Later in the forenoon certain of the extra cars return to the depot and these leave again for the second time in the afternoon, to return after a further couple of hours. Around midnight the ordinary trams begin to run into the



Fig. 5 X 4625  
Interior of the relay room  
where JRG relays, transformers and fuses are mounted on a wall

car depot and all cars are in about 0100 o'clock. Thus as regards traffic to and from the car depot one may speak of 4 traffic peaks, of which the first and the last are incomparably the greatest. To give the reader an idea of the traffic density during the two heaviest traffic peaks, I shall cite a few examples from the time-table. Between 0503 and 0510 the time-table reads as follows:

|      |                             |      |   |   |           |      |   |   |   |   |           |
|------|-----------------------------|------|---|---|-----------|------|---|---|---|---|-----------|
| 0503 | from car depot to Stockholm | 0508 | » | » | »         | »    | » |   |   |   |           |
| 0504 | »                           | »    | » | » | »         | »    | » |   |   |   |           |
| 0506 | »                           | »    | » | » | »         | »    | » |   |   |   |           |
| 0506 | »                           | »    | » | » | Kilaberg  | 0509 | » | » | » | » | Kilaberg  |
| 0508 | »                           | »    | » | » | Stockholm | 0510 | » | » | » | » | Stockholm |

that is, 10 tramsets in 7 minutes. Altogether 52 tramsets drive out in the hour between 0500 and 0600. During this hour the capacity of the interlocking plant is utilized almost to 100 %. Unfortunately, all tramsets that are to drive to Stockholm («mustangs») come from the track at signal *H*, whereas most of the sets driving towards Kilaberg come to signal *K*. This crossing over, unfortunately necessary because of arrangements in the servicing hall, lying to the west of the marshalling hall, Fig. 1, is unsatisfactory from the signal point of view, as the capacity of the interlocking machine is decreased thereby.

At the other great traffic peak, concentrated entirely to the hour between 0000 and 0100 a total of 37 tramsets drive into the car depot and the extract below from the time-table gives an idea of the heaviest density. All tramsets come from Stockholm.

|      |      |      |      |      |
|------|------|------|------|------|
| time | 0025 | 0030 | 0033 | 0039 |
|      | 0026 | 0031 | 0035 | 0041 |
|      | 0028 | 0033 | 0037 | 0041 |
|      | 0029 | 0033 | 0037 | 0045 |

According to the above, therefore, 16 tramsets drive into the car depot in a period of 20 minutes. It should be noted that in respect of driving in times the time-table is misleading as demonstrating the traffic density, for traffic blocks in this period can easily be formed, so that a considerable number of cars approach the car depot at practically the same time.

During the two great traffic peaks to and from the car depot great demands are imposed on the interlocking machine attendant. Certainly a well-trained attendant can very well manage to operate the signals and points if he continuously prepares himself in the interval between the starting of the different tramsets for the next operation, but there is no appreciable interval.

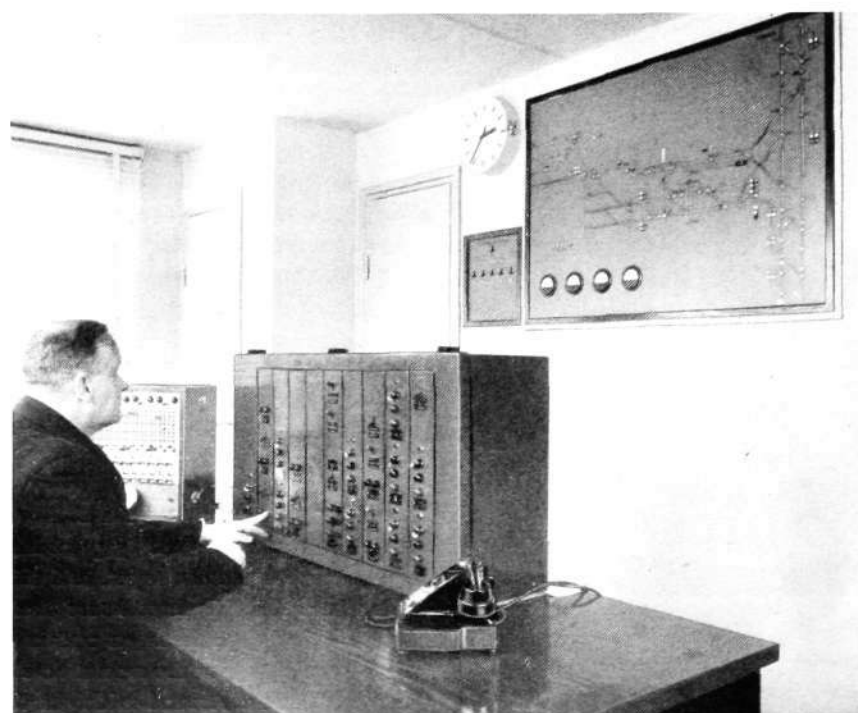


Fig. 6

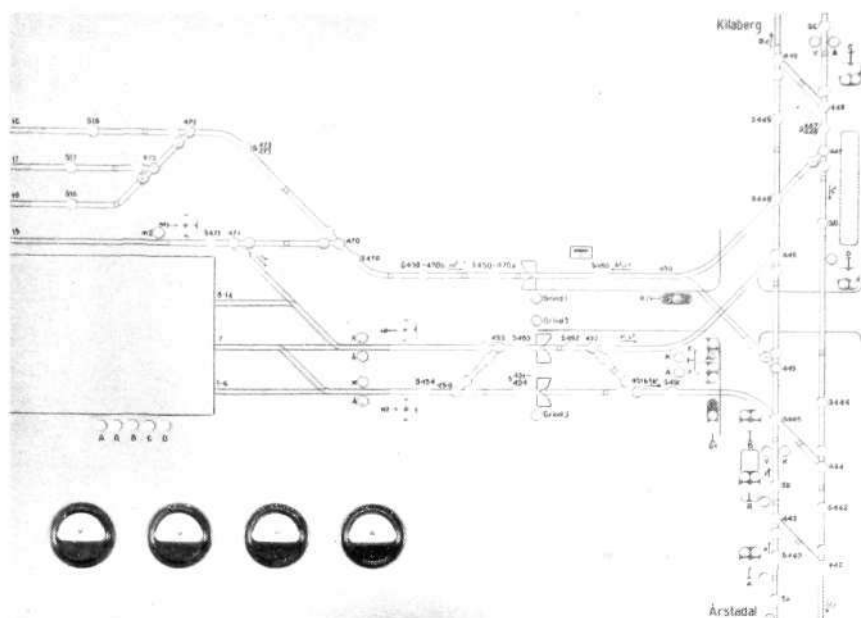
X 6404

Interior of operating room

left to right: telephone switchboard, control panel for connecting and disconnecting of heating arrangements in the electrically operated points, illuminated track diagram



Fig. 7  
On the illuminated track diagram the routes of the tramsets can be followed and the positions of the points can be seen



At the other times of the day, including the two smaller traffic peaks, the traffic to and from the depot is so small that it is not considered justified economically to have an attendant for the interlocking machine. It was for this reason that arrangements were made to enable the tramdrivers themselves when driving to and from the car depot to operate the signals and points they had to pass. Moreover at these times of the day it is no special inconvenience that the drivers must themselves carry out the operations.

The number and placement of the signals naturally had to be fixed according to the maximum traffic.

In their passage of Hågersten Road with its fairly heavy traffic the drivers must drive very cautiously despite the signal regulating. A street signal does not of course prevent motorcars or other vehicles from going past it and even if the street signals were always obeyed there is the possibility that a vehicle may stop on the tram tracks after having passed the signal. In such cases the Tramway Company always employs position light signals which can display unconditional stop and also permission to proceed. No real clear signal is given, as of course it is never possible to guarantee that the track is free from vehicles. In those parts of depot approaches not affected by the street traffic it is usual to employ coloured light signals. In the signal plant at the Brännkyrka Depot coloured lights should naturally have been employed in the signals *A* and *R*, but it has been considered undesirable to do this, out of consideration for the street traffic which when proceeding along Hågersten Road parallel with the tram tracks might mistake the significance of coloured light signals intended for trams. The circumstance that a more restrictive clear signal than necessary is used, does not involve any diminution of safety.

On close examination of the lay-out of the interlocking plant, Fig. 1, it will be seen that in principle there are no track circuits in the crossing of the track over Hågersten Road. Efforts have been made to avoid track circuits in the street because grooved rails are used there. It is usual to join two grooved rails in a track by track holders at intervals of about 2 metres. Naturally the track holders must be insulated if there are track circuits in the street and the Tramways Company has found by experience that the track holders constitute a troublesome source of fault. Another trouble with grooved rails is that the groove easily gets filled with gravel and sand, causing the risk that a single traction car which is raised and runs on the wheel flanges does not shunt the track circuit. The sand comes not only from sand knocked into the groove by automobiles but also from sand used by the tramdrivers when braking. Unfortun-

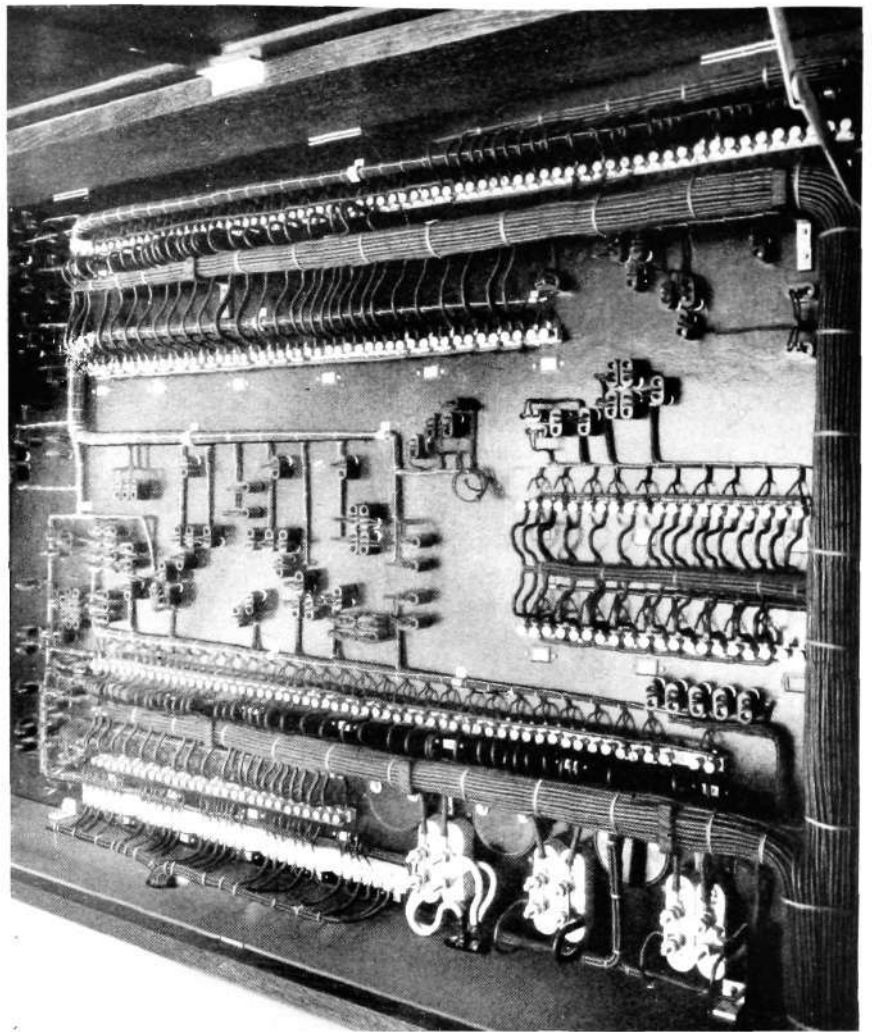


Fig. 8 X 6401  
The rear of the track diagram is easily accessible

ately it has not been possible to avoid some of the track circuits lying partly in streets and trouble has not been absent. The greatest trouble has been that the routes *e* and *f* (from the car depot to Kilaberg and Stockholm respectively) on some occasions have not been released, so that the street signals did not return to clear light. It would seem therefore necessary to replace the grooved rails by Vignoles rails and to have four rails per track laid on sleepers, so that two of them may be used as support rails. This method has already begun to be used in the Tramway Company's system at other street crossings where there must be track circuits and the results have been satisfactory.

### Other Equipment in the Interlocking Plant

The conclusion has been reached in the Tramways Company that the value of an interlocking plant is considerably lessened in heavy snowfalls, if the electrically operated points are not provided with heating arrangements. Consequently all the 10 electric points in the Brännkyrka area have been fitted with electrical heating arrangements. Connection and disconnection of the heating is done in the interlocking machine operating room.

As stated in the introduction the interlocking plant has been adopted chiefly as a means to ensure the safety of tram movements between the tracks for traffic and the area of the depot, which without the plant could only have been ensured with the aid of signalmen posted in the area.

The experience gained so far in operation shows that by means of the plant described the traffic can be handled rapidly and safely. In addition there is the saving in staff that has been made owing to replacement of the above-mentioned signalmen by a single interlocking machine attendant.