

Interlocking Plant at the Madrid Underground Railway

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In August 1936 the third line of the underground electric railway was opened in Madrid. Only lines I and II have coach depots, however, and it has consequently been necessary to arrange a junction line between line II and line III to transfer rolling stock from the new line to the depots.

To allow of transfer of trains from line III to the junction line and vice versa with complete safety despite the particularly dense traffic — one train passes every other minute — an interlocking plant has been installed at station Sol III, connected to another at Sol II station. The interlocking plant at Sol III has been made by Compañia Española Ericsson, which delivered and erected the material.

The control apparatus, mounted in the station master's office, comprises an illuminated track diagram on which are reproduced the signal indications, the position of the points, the state of the automatic block sections, etc. In addition there is on the diagram a series of two-way switches for setting the different train roads and for manual operation of points and signals. All relays are combined in a cabinet where they are protected and easily accessible for inspection and supervision. There are in the underground tunnel only the point machines and cabinets containing the junction boxes, track-circuit transformers, lighting transformers and fuses.

The system employed for the operating devices is such that the relations between the different devices are entirely electric. The point and operating switches are interdependent so that they can only be used for combining possible roads. All points and signals belonging to roads are afterwards operated by a single switch, which prevents opposing train roads being set. The signals are operated last and are normally at »stop», to be put over to »clear» only when the road has been laid out, locked and checked on the track diagram. When the signals have shown »clear» for a determined road and a train has been driven on to it the signals are returned to »stop» as the train proceeds through the different sections. When the last section of the road has

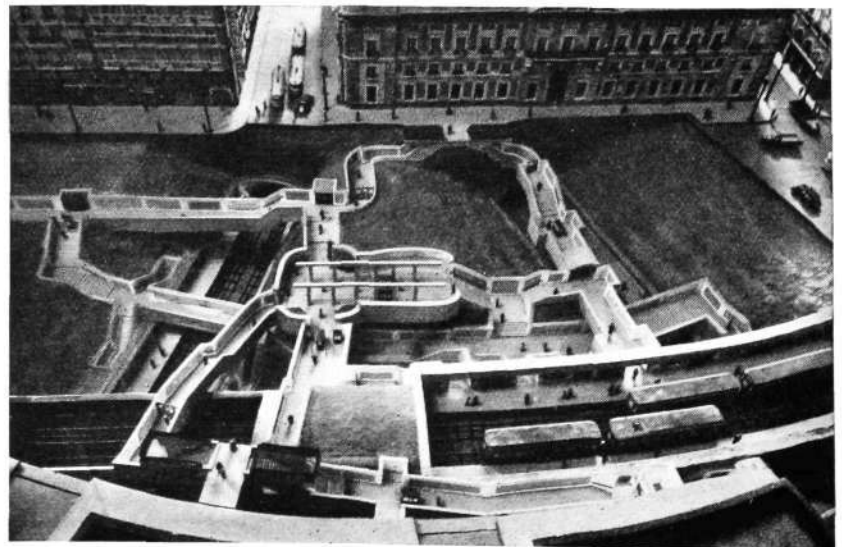


Fig. 1
Plan of Sol station
left line I, foreground line II, right line III

Fig. 2
Sol III station
left, on wall, control apparatus

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been passed the road is released and the corresponding points and signals return to normal positions.

If all the elements contributing to form a train road are in their right positions, *i.e.*, if opposing track relays are opened, the corresponding blocking relays closed, the cooperating operating devices in the Sol II plant blocked and corresponding relays closed, the relay of the desired road will be energised, when the corresponding switch is actuated, through the switch and then through its own contact as well as through the back contacts on the relays which operate the signals and make the road clear. The track relay closes when all the elements which make up the road are in the right position and these positions have been checked. The relay remains attracted until all the signals in the road have been set at «clear», that is when the road has been laid out, locked and checked.

The point machines are operated by double relays, which are mechanically locked in relation to each other and each of which corresponds to a position of the points. The relays are attracted through contacts on the locking relays belonging to the road to be laid out; the attraction of the relays occurs in addition through contacts on the track relays for the track section to which the points belong, this being to prevent changing of the points for another road when a vehicle is passing.

When these safety conditions have been fulfilled the road relay is attracted, whereupon the point machines set the points at the correct position. After that the checking of the position of the point tongues is done by attraction of a control relay corresponding to the point position and which breaks the current to the point machine. The control relays are DC relays provided with

Fig. 3
Control apparatus with illuminated track diagram

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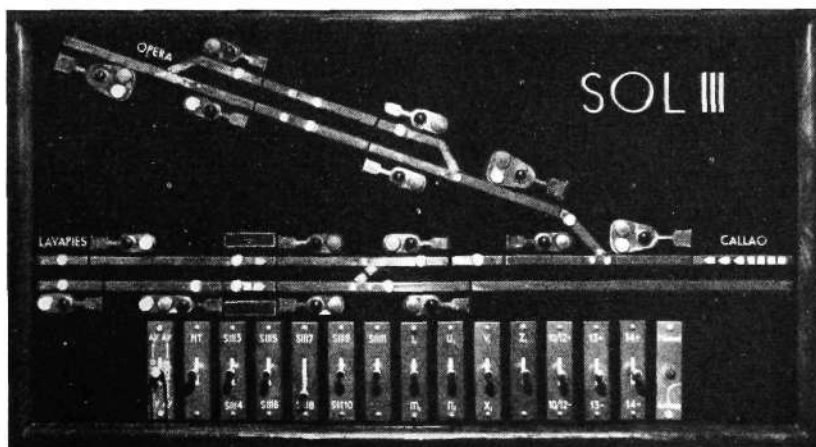
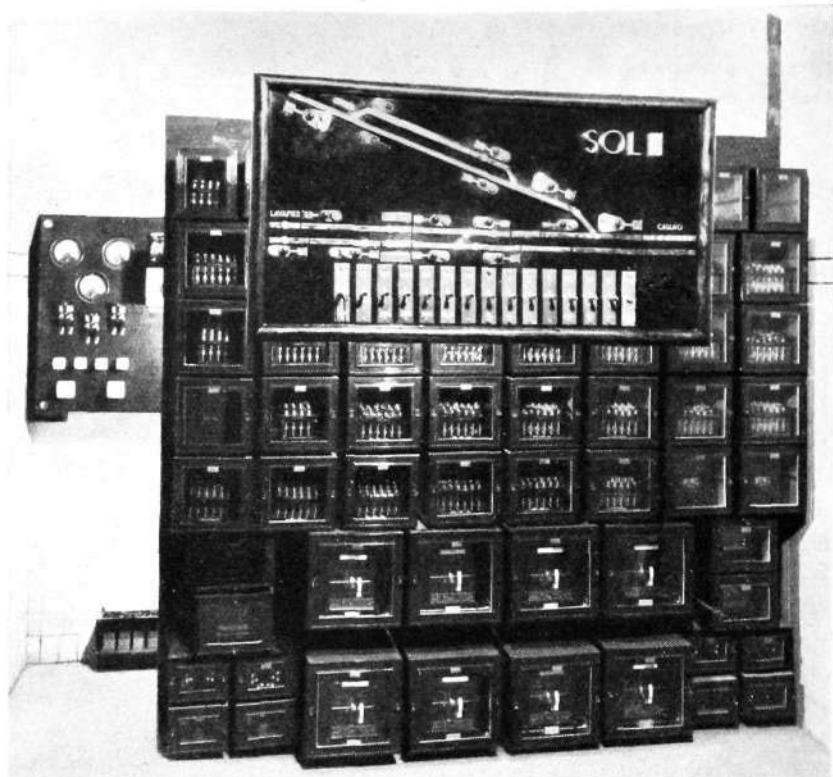


Fig. 4
Relay frame with control apparatus
and illuminated track diagram
background, power plant

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rectifiers so that they attract only for a determined current direction. The locking relays of the road normally receive current over a break contact on the road relay and over contacts of their own. When the circuit is broken through attraction of the road relay, current is fed over the back contacts on the point-control relays included in the road. When the point has taken up the position it should have for the road in question, the corresponding control relay attracts, whereupon the relay contacts break the current to the locking relay, which opens. As a result opposing train roads cannot be laid out and moreover no other movement of trains can take place on the track sections in which the points are, since the contacts of the locking relay break the circuits to the relays belonging to opposing roads and the operating relays for the points in question.

When all operations for laying the road have been carried out and the road is locked, the signals are set at «clear» which is done over contacts on the point-control relays, over contacts on the track relays included in the road, and further over front contacts on the road relay as well as over back contacts on the locking relay. When the signal relay has attracted, it obtains holding current over its own contact.

The signal-operating relay is repelled when any of the above conditions is no longer fulfilled or when a train comes into the corresponding block section or even by emergency release of a road already laid out. When a train comes into a section, the track relay falls and the corresponding signal is set at «stop». When the train has passed through all sections of the road and caused all signals to be set at «stop» the road locking relay is closed and remains closed. On this the current flows through the point-operating relay and the point machine returns the point to normal position. With this everything has returned to normal position and the different devices have the same positions as before the road was laid out.

By means of the interlocking plant now installed the execution of the different operations has been very much simplified, and the train dispatcher's work has been made much easier, since anybody can handle the plant in accordance with the information given on the illuminated track diagram. Moreover, no special operations are necessary to restore the points and signals to normal position, which constitutes a great advantage in comparison with the very cumbersome mechanical plants. In the time the interlocking plant has been in operation it has worked to complete satisfaction.

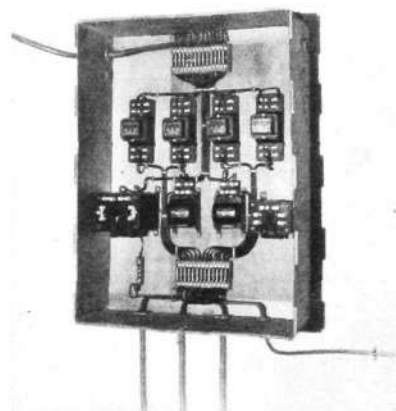


Fig. 5
Transformer cabinet

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