# ELECTRIC RAILWAY-SIGNALLING PLANT IN WARSAW

By S. BORKOWSKI,
engineer of the Railway Administration, Warsaw.

*In the summer of 1933 an electric interlocking plant on the Ericsson system, the first of its kind in Poland, was installed at the Warsaw-WCZ station; this was carried out in connection with the reconstruction of most of the interlocking plants at the Warsaw railway stations and with the putting in service of the intermediate railway line.*

Although the interlocking plant has only 21 points and 6 signals it has been equipped with electric apparatus designed to meet severe traffic conditions. The number of trains to be dealt with by this interlocking range in 24 hours is more than 300; in addition as most cases require the points to be thrown, it means that almost all points have to be thrown some 200 times in the 24 hours.

The interlocking machine has been installed in a two-story building placed between the tracks giving a view of all the points.

The upper story of the building houses: the interlocking machine, blocking apparatus and signalling relays. The lower story houses: a substation of the electricity works, cable inlets, distribution room and a room for the signal fitter on duty.

## Interlocking Machine.

The chief feature of the interlocking machine is that is not locked by mechanical means; all locking being carried out electrically.

The interlocking machine has 8 signal switches, 14 point switches and 2 reserve positions. On account of the use of electric interlocking, each signal switch operates a whole group of home signals for one direction or starting signals for another.

X 1366 **Fig. 1. Interior view of the interlocking plant in Warsaw—WCZ.**
From left to right: interlocking machine, blocking apparatus, relay box and track diagram.

Most of the point switches operate two points connected in series. The small number of signal switches, due to the use of electric interlocking of the points two by two, has allowed of the interlocking machine being made very small; the length is only 195 cm and the width including the switches is only 70 cm. In addition the interlocking machine has 17 road selectors, one for each road. These are of great importance in interlocking machines where mechanical interlocking is not used and where one signal switch operates a whole group of signals. This is particularly the case in master interlocking machines where the road selectors permit of testing whether all conditions for the indication of the signal corresponding to certain road have been fulfilled.

The *point switches* are made as latches and when in home position they are at an angle of 70° to the perpendicular. When the points are to be thrown the handle is turned 140°. Each switch operates a group of shaft contacts which switch on the current to the motors and also vertical contact drums for controlling and interlocking the points in question. In addition the horizontal shaft of each switch has two segments which cooperate with the locking devices operated

by the armatures of the group of electro-magnets placed on top of the segments.

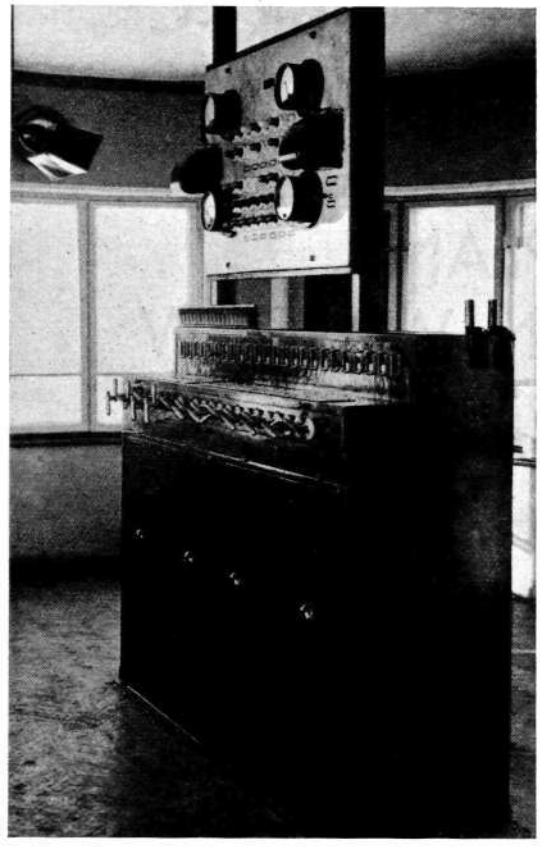
There are four such electro-magnets:

1 indicating magnet which in this case will be energized only when the position of the point switch and that of the points correspond. The armature of this electro-magnet operates the coloured disc in the supervisory window of the switch and the group of supervisory contacts. When the electro-magnet is energized a white disc appears in the window and the supervisory contacts are closed; when the electro-magnet is not energized a red disc appears in the window and the supervisory contacts are open;

1 point locking magnet, which in this case is energized only when the points may be thrown, *i.e.*, when they have not been locked previously by thrown signal switch. The armature of this electro-magnet operates the blue pointer in the supervisory window. A clear white window indicates that the points may be thrown; a vertical blue line indicates that the points are locked;

2 electro-magnets which lock the point switch in home and thrown position. The armatures of these electro-magnets have locks, which cooperate with the segments of the point-switches. The electro-magnets are energized over contacts on the signal switches by means of which the points in question are interlocked (these contacts are closed in the side positions of the signal switch). In addition this current is led over a contact, which is closed when the point switch is pulled forwards to be thrown. On account of this the electro-magnet is idle under normal conditions.

A *signal switch* operates a vertical shaft with contact drums and one segment fitted on the horizontal shaft of the switch. This segment cooperates with the lock which is operated by the armature of an electro-magnet placed on top of the switch. This electromagnet partly locks the signal switch in the side positions and in half-thrown position, *i.e.*, as soon as the point switches have been locked which cooperate with this signal. In addition the armature of this electro-magnet operates a coloured disc in the supervisory window of the signal switch. Should the signal switch be locked blue appears in the window. When the signal switch may be thrown, white is seen in the window. The signal switches can be turned 70° from the vertical to each side and can operate two groups of contrary signals. The points are interlocked by the signals by means of contacts on the vertical drums of the signal switches



X 1368 **Fig. 2. Interlocking machine with supervisory panel.**

which are closed only when the signal switch is in one of the end positions, and by means of supervisory contacts on these point switches which are closed only when the position of the switch and the points correspond. This kind of interlocking replaces altogether the mechanical interlocking of old types, and in addition it carries with it great advantages, for, the equipment being very flexible and simple in design, alterations and extensions are easy to carry out.

## Power Plant.

Since it is possible to feed the interlocking plant from two different electricity supply works, 220 V AC was chosen for the operation of the points and 110 V AC for the light signals. The two supply circuits feed the interlocking plant over automatic switches, which change over from one to the other. The switch is usually thrown to the circuit supplying the power at the lower price. When the power from this supply fails the switch changes over automatically to the other. When the voltage returns on the mains of the first

X 1373 **Fig. 3. Distribution panel of the power plant.**

supply the second is automatically disconnected and the first one is connected anew.

All electro-magnets and signal relays in the signal cabin are fed with 30 V DC, supplied by cuproxide rectifiers. Only the relays of insulated tracks are fed over small rectifiers, supplying 8 V DC.

All equipment for supplying electric power to the interlocking plant has been fitted on a common distribution panel; the equipment is composed of automatic switch, transformer which supplies 220 V for the motors and 110 V for the signals, disconnecting switches and fuses for the various instruments rectifiers and measuring instruments.

In addition there is a small distribution panel on top of the interlocking machine; this panel is fitted with voltmeter and ammeter for the point-operating current, and voltmeter and ammeter for the supervisory DC.

## Point Machines.

As all points in the interlocking range have point locks, the point machines have been made with one driving lever, operated by gear and worm wheels from a repulsion motor for 220 V AC.

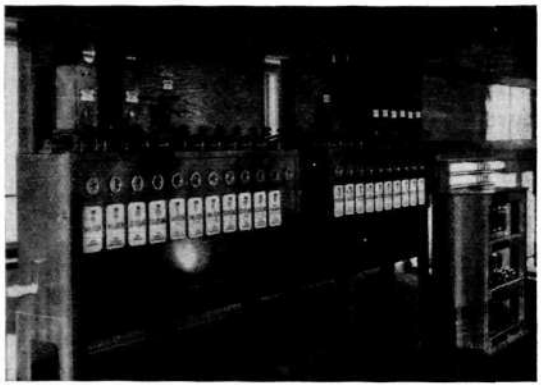
The movement is transferred by means of an adjustable friction clutch which allows elastic throwing of the points and permits them to be trailed. The trailing of points will cause no injury to the point machines, but only the burning of the fuse in the supervisory circuit of the points in question. All contacts in the point machines are knife contacts and operate in a satisfactory manner even during severe frost. All points which are faced by the trains have been provided with arrangements for checking the position of the tongues. In addition all point machines have separate crank arrangements enabling them to be thrown by hand.

## Signals.

All signals in the interlocking range are coloured daylight signals. To obtain uniformity the cases of the main and distant signals are of the same type and can be provided with three lamps, which is quite sufficient for forming the usual signal combinations.

All the home signals have three lamps, the central one being red and serving for the signal »stop», the top one being green for the signal »clear through on the main track» and the top green together with the bottom one also green for the signal »clear through on the side track».

The starting signals are either identical with the home signals or else they have only one green light and one red one. The distant signals have only two lamps: one for yellow and one for green light. The yellow light serves for indicating »caution» and the green light for indicating »clear». In addition all lamps have been provided with reserve lights of the same colour as the main lights. Although lamps of low intensity have been used (the main lamps consume 25 W, the reserve lamps 6 W) the signals are easy to make out particularly during slight fog or cloudy weather thanks to the application of double lens-systems, of which the inner lens is coloured and the outer colourless. In order to obtain a light as concentrated at one point as possible the lamps of the main lights are for only 12 V and have each two parallel wires, one of which has a higher resistance than the other, so as to serve as a reserve should the main wire burn off. In addition each lamp has a separate transformer which reduces the 110 V power supplied from the sig-



X 1367 **Fig. 4. Blocking apparatus.**
In the background, under the track diagram, relay box.

nal cabin to the 12 V required to operate the lamps.

Of special importance is the manner of connection of the lamps for red light.

The current for the lamps for red light is shunted by a contact on a special AC relay, the winding of which is connected in series with the lamp for green light. The red light will, consequently, go out only when this relay is energized, *i e.,* when green light actually lights. In case of faults or if both wires in the lamp for green have burnt off the signal will not be unlighted after the point switch has been thrown, but it will continue to show red light. All lamps of main and distant signals have been provided with coloured supervisory lamps, which are fitted on a special supervisory board on top of the interlocking machine; these lamps are placed in the same manner as on the signals. Small resistances are connected in parallel with the lamps, which in their turn are connected in series with the lamps of the signals.

This manner of connection ensures that the supervisory lamps will always light with the main lamps and in case a supervisory lamp does break down this will not affect the corresponding main lamp on the signal.

## Cables.

Since the points, signals and insulated tracks are concentrated at a few places, a small quantity of cables with several conductors has been used. having the necessary number of reserve wires; the various apparatus has been connected to these cables by means of distribution boxes. Only the points close to the signal cabin have been connected over separate cables. Only the short sections of one-conductor cable for contacts on insulated tracks have rubber insulation around the copper wire; all other cables have conductors with impregnated paper insulation.

The cables are drawn to the signal cabin where the multi-conductor cables terminate in terminal boxes with numbered terminals. The cables from single points are terminated separate boxes.

## Line and Station Blocking.

The interlocking machine cooperates with the master interlocking machine of the usual mechanical type, and consequently it must be connected over blocking apparatus.

In addition to the usual track blocking sections the blocking apparatus has entrance and departure blocking sections for line blocking and consent blocking sections in connection with the master interlocking machine. The entrance blocking sections have ordinary electric press-button locks. The departure blocking sections have also electric press-button locks, the function of which is to prevent a starting signal from being set at »clear» again, when a train has already entered the line and the starting signal has automatically returned to »stop» position.

Since the work of the interlocking machine chiefly consists in letting through the trains and there is very little shunting work, the points are not insulated.

For releasing the signal switches which are locked electrically in thrown position there are insulated tracks placed behind the last points of the road in question. For emergency release there are special emergency keys.

The insulated tracks of the starting roads serve also for the automatic restoring of the starting signals to »stop» position.

The above described plant, although installed under hasty conditions, is characterized by model workmanship and operates in an irreproachable manner under severe conditions, with the exception of small trouble due to the imperfect functioning of the point locks, caused by the movement of newly laid tracks.