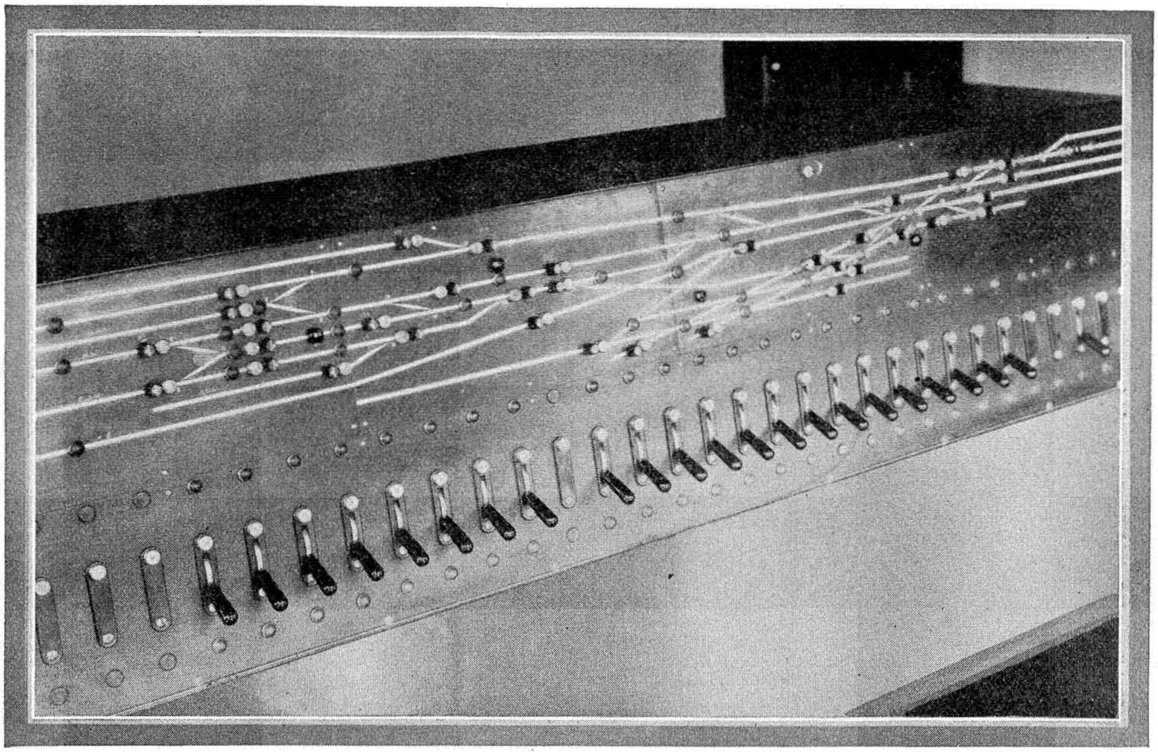

The machine is of the centralized control type

Big Four Installs Simplified Interlocking *With No Mechanical Locking*

Illuminated diagram includes signal levers and movable track sections repeating position of switches—All locking accomplished electrically

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SIMPLICITY and facility of operation are the features of a large electric interlocking plant recently installed by the Cleveland, Cincinnati, Chicago & St. Louis at Linndale, Ohio, six miles west of Cleveland. This new interlocking is located at the west end of the new electrified zone of the Cleveland Union Terminal. The locomotives for about one hundred New York Central Lines passenger trains are changed daily from steam to electric, or vice versa, at the Linndale plant. The track layout was, therefore, designed to facilitate changing locomotives as well as to expedite the movement of numerous freight trains which are handled by steam locomotives through this territory, but do not go through the Cleveland passenger terminal.

On account of the numerous train movements at this point, considerable study was given to the choice of a plant that would provide, with safety, the greatest flexibility and rapidity of manipulation and operation. Other features desired were simplicity of design, economy in first cost and maintenance, and adaptability to future track changes and additions.

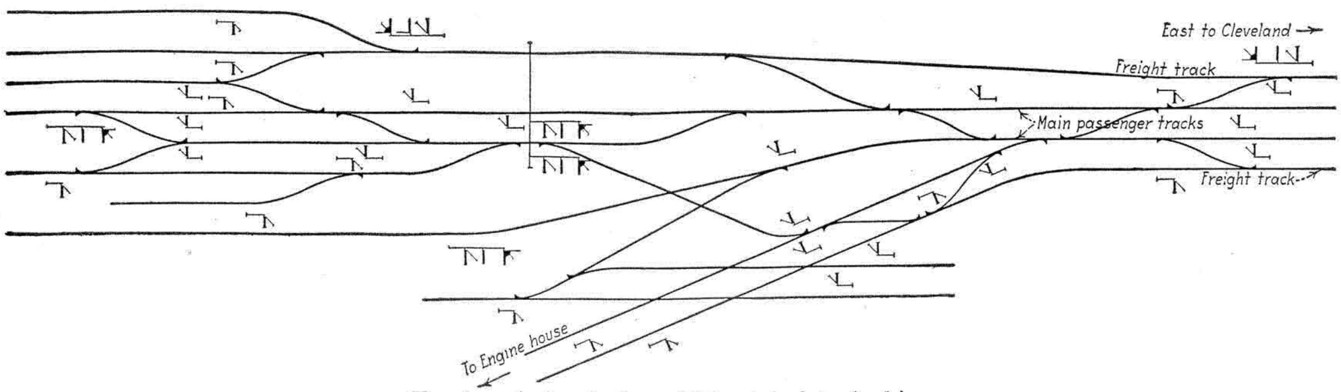
Reason for Using New Type Control

To accomplish these results in the best way, it was determined to use a machine of the centralized-control type, providing the simplest possible controlling devices for switches and signals and, at all times, giving the operator complete information as to all conditions affecting the operation of the plant.

The safety features of mechanical locking have been so surrounded by electrical protection, in the modern interlocking plant, that a machine of that type, with its resultant increase in size and other complications, only tends to retard the manipulation of the plant and affords no safety features not already covered by adequate electrical protection. That complete reliance can be placed on the electric circuits alone, has been demonstrated by the successful operation, over a period of years, of remotely-controlled switches and centralized traffic control systems. These principles were, therefore, considered to be equally applicable to short distance control.

Small Levers for Switches, Buttons for Signals

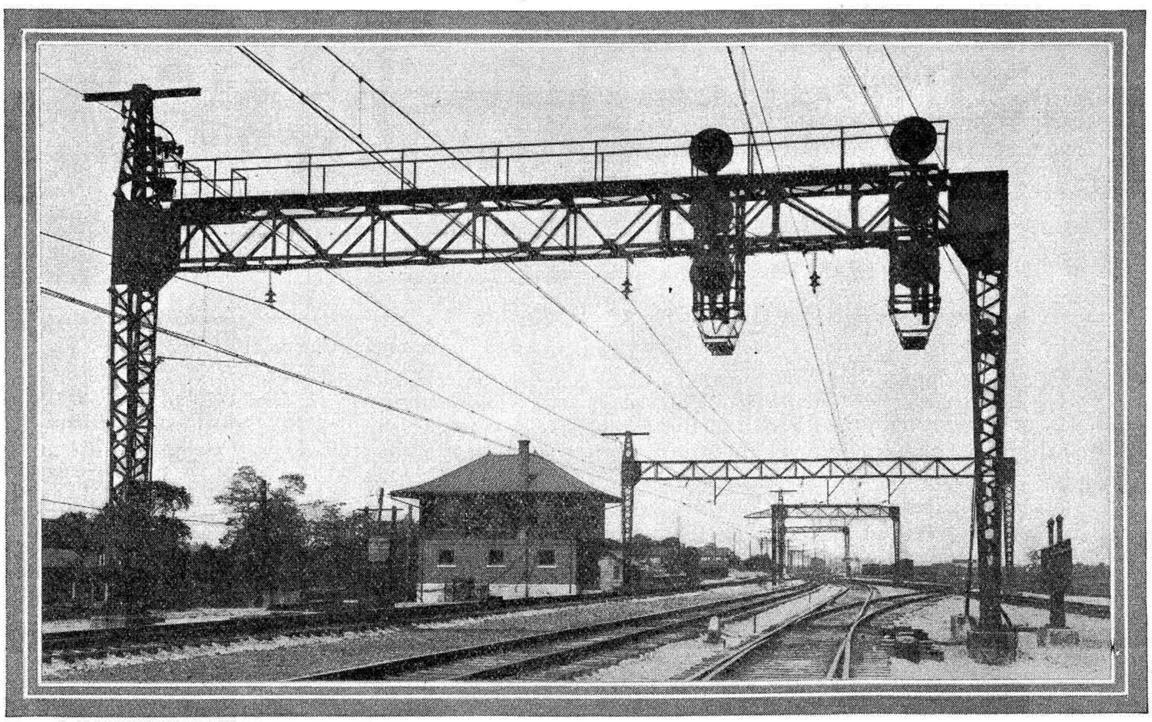
The machine is quite small, only 67 in. long, and the operator seated at the desk has all of the controlling switches within easy reach. The diagram before him reproduces the track layout. A lever directly below a switch or crossover on the diagram,



Track and signal plan of Linndale interlocking

operates the corresponding switch in the track, if conditions are safe for doing so. There are 23 levers controlling the 33 switches, 9 spares being provided for future additions. A light below each lever indicates when the switch is moving, and, after it is over and locked, the electrically-operated switch points on the track diagram move to the new position of the switch. A red light above the lever indicates to the operator that the switch can not be operated. A lever movement is entirely ineffective if made while the red light is burning, even though the route locking relay should subsequently pick up.

The signals are controlled by a number of buttons, each mounted at the location on the track diagram corresponding to the signal location on the track lay-



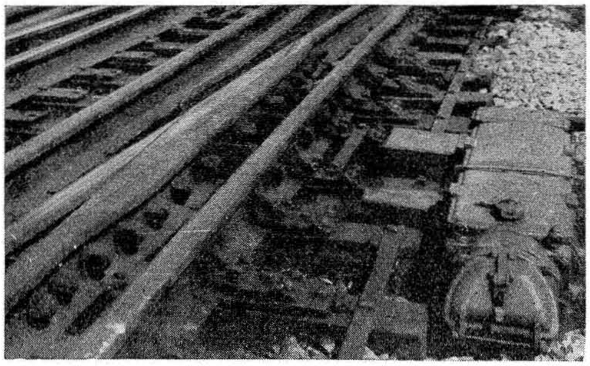
View looking east through the plant; tower at left

out on the ground. After the desired line-up of switches has been effected, a turn of the button clears the signal. A lighted arrow beside the button indicates when the signal has actually cleared. A total of 34 buttons control the 40 signals.

Color-light signals and 110-volt d-c. switch machines were used throughout the plant, which is protected by approach, detector, and release locking and SS control.

The elimination of mechanical locking and lever locks made it necessary to break the switch control circuits through the route-locking relays without sacrificing cross protection. It was further desired that a switch machine respond only to a lever movement that is made while the locking relays are energized, thus preventing the switch operating after the track circuit had cleared, the object being to prevent an improper switch movement during a momentary loss of train shunt. Another benefit derived from this type of control making a lever movement effective only at the time the switch can operate, is that the operator cannot fail to observe the indication.

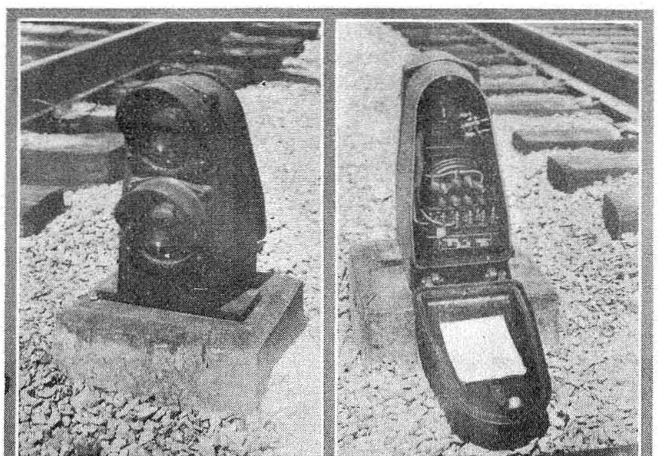
In addition to these features this switch control circuit embodies adequate cross protection. For each switch lever there is in the machine a small quick-acting relay which is completely checked. If it remains improperly energized or de-energized, no movement of the switch can occur. In addition, a standard slow-acting neutral d-c. relay located in the tower is used for each switch lever, which can be energized only when all of the desired route-locking relays are up. Two wires run directly from the polarized control element in the switch machine to the rugged pole-changing contacts on the switch lever. Negative 110 volts d-c. is applied constantly to one side of the pole-changer, while positive 110 volts d-c. is applied only for a duration of about one second, provided the lever movement takes place while the route-locking relays are up. The cross-protection value of this polarized circuit is further enhanced by the use of a high resistance winding in the switch-controlling device, together with an additional series resistance. Also, a separate cable is run to each switch or crossover, two wires being used to energize the polarized switch-repeating relay in the tower, from



The switch layouts are well braced

the pole-changer and point-detector contacts in the switch movement, using 110 volts d-c. Flexible single-conductor copper wire in flexible conduit, run between the terminals of the switch machine and a nearby concrete junction box, in which splices are made to the parkway cables.

The polarized control device in the switch machine is entirely enclosed and sealed, and is so designed and mounted as to maintain the polarity last received by it, and so as not to be affected by vibration. The switch will always follow the position of the polar



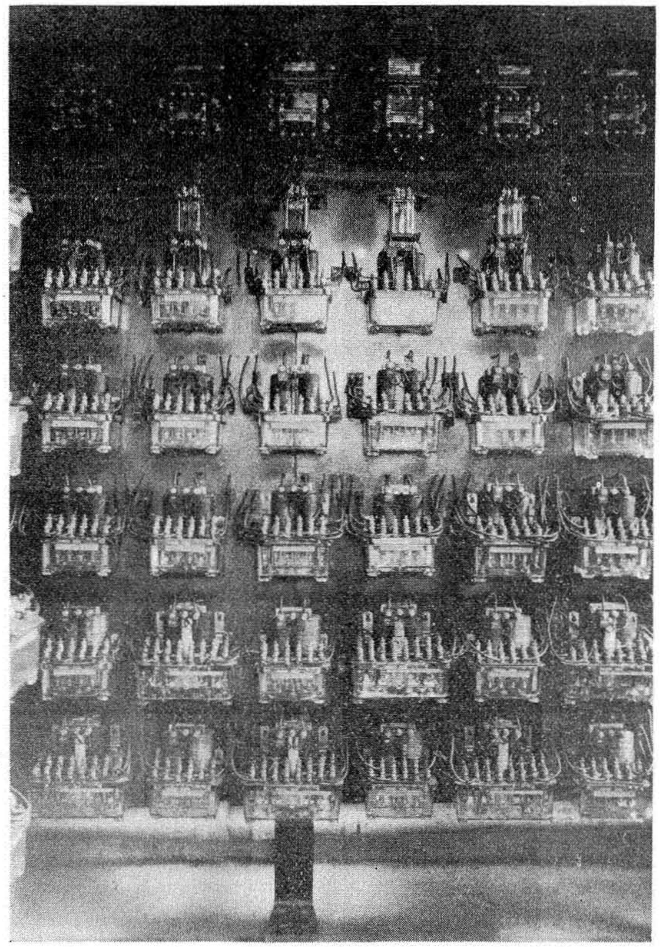
Front and rear views of special dwarf signal with housing for relay

element, receiving 110 volts d-c. energy from the bus wires. If switch points are obstructed or not in proper adjustment, the overload coils become energized, which cut off the operating current until the operator restores the lever to the original position. He may then repeat his effort to operate the switch. The switch mechanism is protected by a clutch in the motor drive until the overload device has time to operate. The operating current is broken by large carbon-to-carbon contacts, provided with a magnetic blow-out. A magnetic brake then functions to stop the motor rotation almost instantly.

Signal Control Circuits

The signal control circuit is of the usual network type, in which a signal can only be cleared when every switch in its route, both facing and trailing, is locked in the proper position. For this purpose, the contacts of the polarized switch-repeating relay were used. The customary switch lever contacts were omitted, in as much as a switch lever movement is rendered ineffective when a train is approaching a clear signal or while on the track circuit in the plant over which the signal governs.

The only other departure from ordinary practice was to break the signal control circuits over contacts of normally de-energized d-c. relays, which repeat the signal-operating buttons. This allowed the buttons to be quite compact and easily mounted on the track



In the tower the relays are mounted on Transite board

diagram, and reduced the number of wires between the machine and the relay case.

Each signal control HR relay circuit is a 110-volt a-c. neutral metallic circuit and is normally shunted by the back contacts of the signal button repeater relay. When the button is operated, the HR relay receives energy from the front contact of the button repeater relay, the appropriate switch-repeater relay contacts, and back contacts of the opposing button-repeater relays, all in series.

Signal indication locking is not standard practice on the Big Four where relay-controlled color-light signals are involved. Its equivalent, however, was obtained in this case, though merely incidental to another more important feature. Quite often, in the ordinary plant, the route-locking stick relays receive energy through normal signal lever contacts. Thus, operating a signal lever drops the stick. This practice was not possible in this installation, in as much as nothing prevents turning a signal button at a time when certain switch repeating relay contacts, or other conditions, might prevent the actual clearing of the signal. In addition to the usual selections, an automatic thermal relay contact, or clockwork time release contact is used in every case to delay the pickup of all route-locking stick relays, unless the train passes over the circuit, or the approach relay is energized. To avoid unnecessary delay, these stick relays are de-energized only by the actual picking-up of the signal control HR relay. For this purpose a neutral metallic circuit of 110 volts a-c. is used, which, together with the signal HR circuit, required a four conductor No. 12 parkway cable from the tower to each signal. The wiring of the route-locking stick relays is such that the switches behind a train are released as the track circuits are cleared, providing, of course, that the signal has been restored to its normal position.

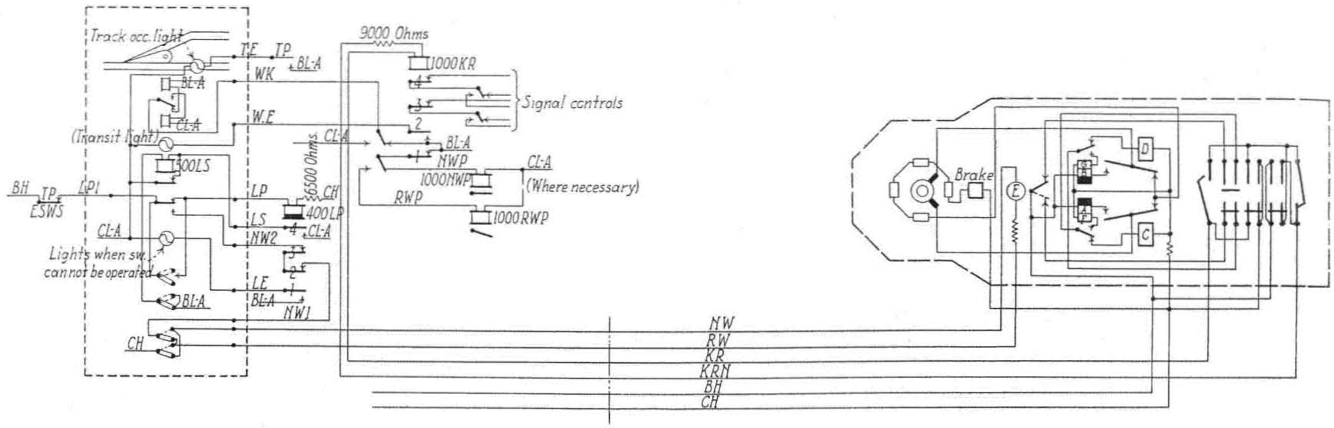


Diagram of switch control and locking circuit showing at left circuit in tower and at right connections at switch machine

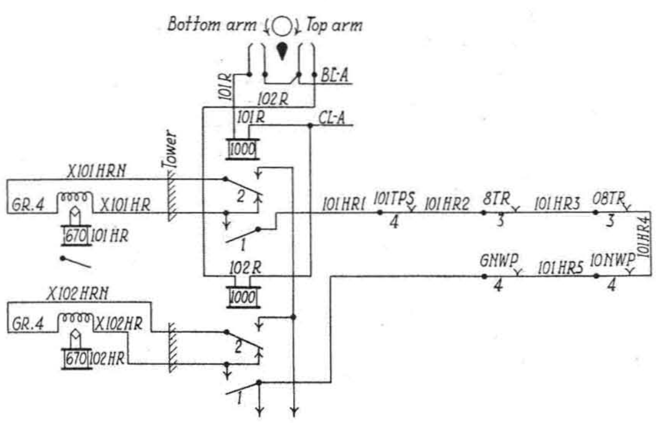


Diagram of typical signal control circuit

Special Dwarf Signal

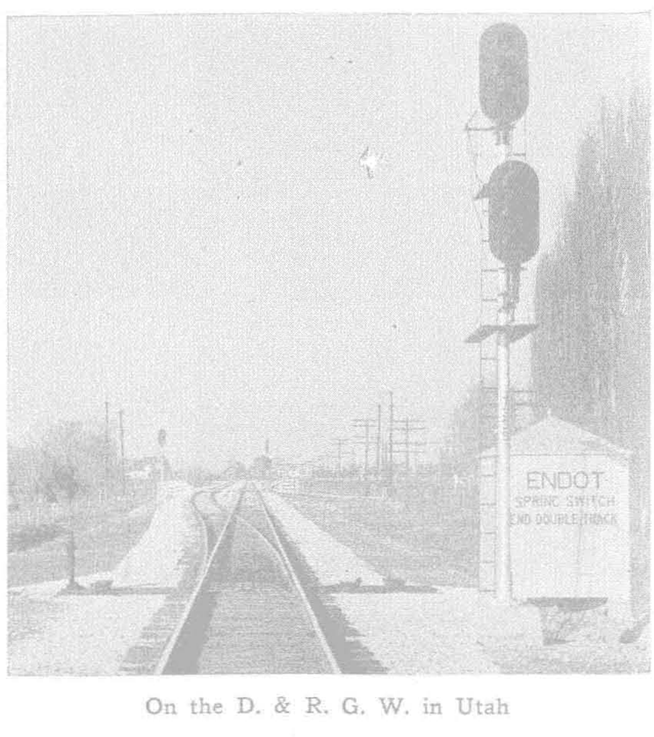
The dwarf-signal cases are large enough to house the control relay. The only other housing required outside of the tower itself are the wood relay cases used for the HR control relays of the high signals and the standby lighting equipment. The signals are lighted normally by 10 volts a-c. If the a-c. power should fail, a power-off relay cuts in a local 10-volt storage battery.

The tower relays, rectifiers, track transformers and other small equipment are wall-mounted on vertical panels constructed of Johns-Manville Transite Board, a fireproof insulating material. All tower wiring is No. 14 solid copper with 3/64-in. A.R.A. insulation. The wires run directly from one instrument to another, or to the terminal board, where the parkway cables from the outside functions enter the tower.

Track circuits are operated by alternating current to avoid foreign current influence from the 3,000 volts d-c. used for propulsion. Convenience and economy were effected by bringing all rail connections into the tower with twin conductor No. 9 parkway cable, locating the transformer, fuses and impedances for each track circuit directly above the track relay for that circuit.

All approach, distant-control, and other line relays are a-c. Certain signal control HR relays and tower route-locking stick relays are d-c., the control circuit being 110 volts a-c. with a step-down transformer and dry-plate rectifier at the relay.

The signal and interlocking material for this installation was manufactured by the General Railway Signal Company, the construction work being done by the Big Four railway forces.



On the D. & R. G. W. in Utah