

Remote Control by Code

THE READING has installed code system control between Jenkintown, Pa., and Bethayres, a distance of 3.5 miles, as remote control of the signals for governing movements over a crossing at the latter point. Three control wires extend between Jenkintown and Bethayres, where the single-track non-electrified Newtown branch crosses the electrified portion of the Reading's New York to Philadelphia main line at grade. Bethayres is 14.5 miles from Philadelphia and 75.5 miles from New York. Approximately 59 main-line passenger and 6 main-line freight trains are operated over this crossing daily. The daily traffic on the Newtown branch over the crossing consists of 12 passenger trains and 2 freight trains.

Prior to the installation of the coded remote control, crossing signals and derails at Bethayres were controlled by an eight-lever, Style-A mechanical interlocking machine located in a two-story frame tower at the intersection, and manned 24 hours a day. The home signals on the Newtown branch were lower-quadrant semaphore type, while the main line

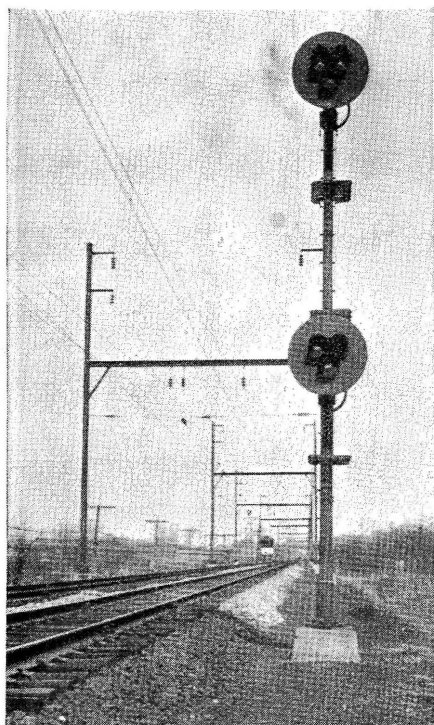
signals were color-light type, installed when this section of the main line was electrified in 1931.

The Bethayres layout is now controlled from "KI" Tower, 3.5 miles west of Bethayres, at Jenkintown, where the control machine is mounted in the second story of the tower, next to a P-5 electro-mechanical machine controlling the facilities for the junction of the Bethlehem branch and the New York branch at this point. The control machine consists of a sheet-steel cabinet made up of two 4-in. wide end caps, a 10-in. wide master unit, and one 10-in. wide application unit, the component units being approximately 57 in. high and 22 in. deep. The master unit is placed to the left of the application unit, and a desk shelf is attached to the front of these two units. No automatic train recorder was provided. The machine is a Size-8 General Railway Signal Type-F, Class-M, duplex coded centralized traffic control machine, having a capacity of 16 control stations, each having four controls, where a control is considered as the capacity required to afford complete control of

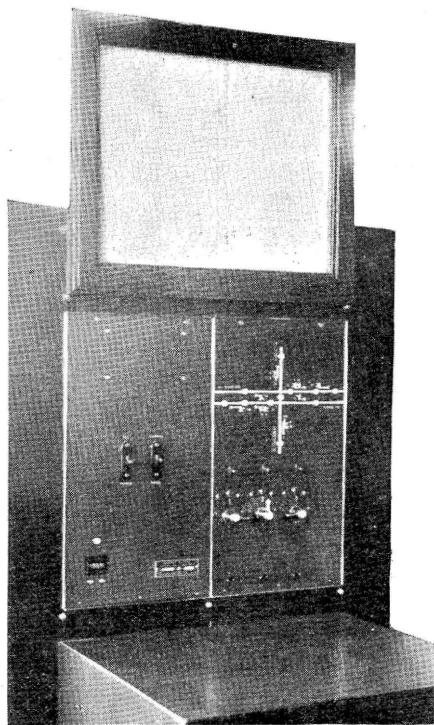
C. T. C. equipment is utilized by the Reading at Jenkintown, Pa., to control signals at Bethayres crossing of a single-track branch and double-track main line

a two-position field function or device, and 16 indication stations, each having 11 indications, where an indication is the capacity required to indicate fully the positions of a two-position fixed function or device.

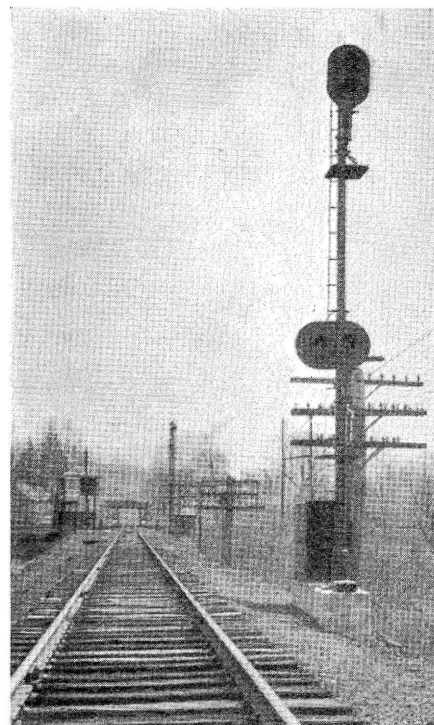
The application unit carries a 10-in. control panel which has a capacity of four sets of switch and signal levers and start buttons, and on which the track diagram is shown, with normally-lighted white track occupancy indicator lights inserted. The machine is equipped with three, three-position signal levers, and three indication lights are provided for each lever, red for controlled signals at stop, and a green light for left signal and right signal displayed, respectively. A signal lever is set for "proceed" by turn-



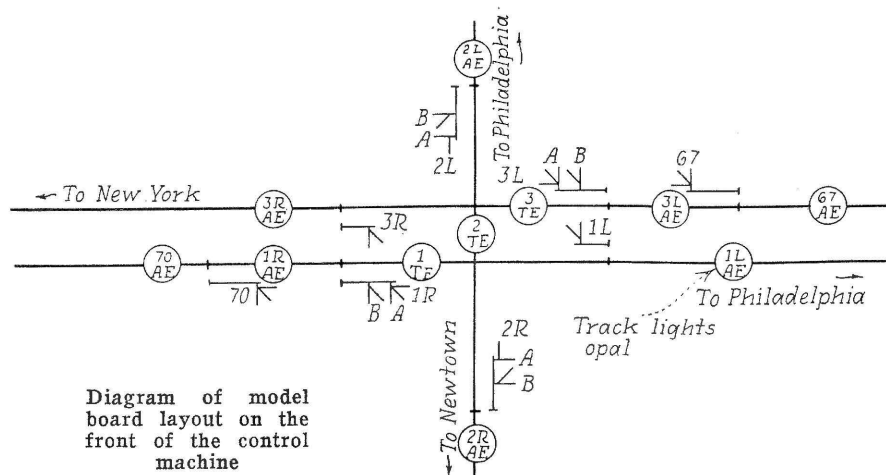
Main line signal 3 L



The control machine at Jenkintown



Newtown branch signal 2R



ing the lever 90 deg. from the center position. The push-buttons, controlling transmission of controls for each signal lever, are placed at the bottom of the panel below the respective levers. All associated application relays are housed in this unit. The relays are individually quickly-detachable, and are mounted in a sliding cabinet which can be pulled out like a drawer from the back of the machine for inspection or service.

The master unit, at the left of the application unit, houses the control office stepper and the registration relays, also mounted in a sliding cabinet

which may be pulled out from the rear of the machine. On the panel of the master unit are mounted a key switch for the maintainer call and re-check features, a key switch for the station suppression and cancellation features, a cycle light and a cycle counter. The 4-in. wide end-cap at the left, next to the master unit, houses the power and test panel which carries terminals for power and line wires, a volt-meter, an ammeter, and various switches for controlling, adjusting and testing the power and line circuits. It also carries a hand-step switch and code repeating lights for stepping the system by hand and checking code operation in detail.

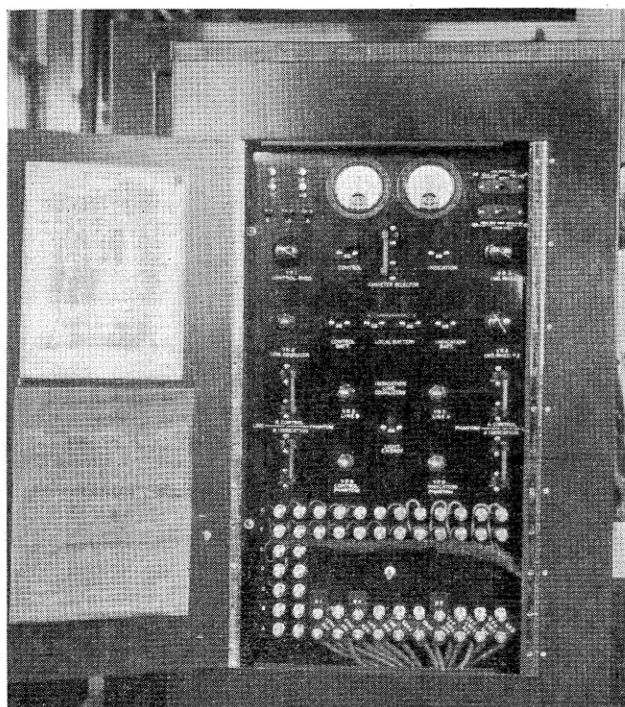
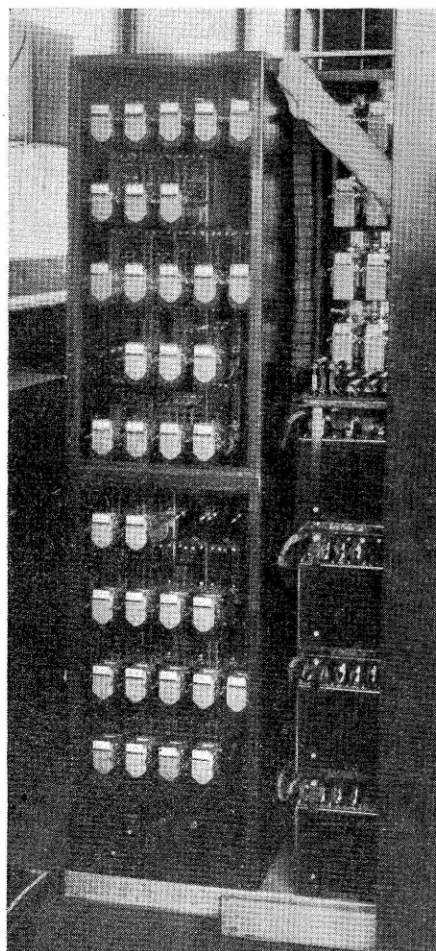
Operation of Code System

The Type-F system, used in this installation, employs two line circuits; one, the control circuit, and the other, the indication circuit. The control

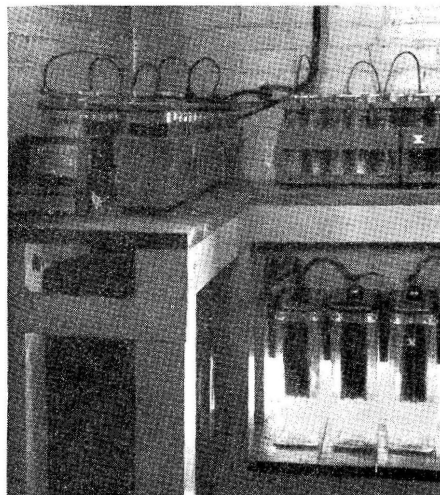
circuit transmits controls from the control office to the field location, and also operates the step relays of the control office and field code equipment in synchronism. The indication circuit transmits indications from the field location to the control office, and carries the starting impulse that automatically starts the system whenever a change in field conditions takes place.

Controls are obtained by the use of polarized current in the control line circuit. The control office unit applies positive or negative current to the control line during each "ON" half-step of the cycle in accordance with the code required to select the desired field station and to deliver the controls the operator desires to be executed at that field station. Station selection elements of the control codes were set up, through the medium of permanent code connections, when the control machine was wired, while the function-control elements of a control code are set up, through the medium of control-lever-selected connections, by positioning the signal levers on the control machine. The combination of the connections to the busses determine which code elements are to be positive and which are to be negative.

When the function-control portion of the code has been set up by positioning the control levers as desired, the complete code is released by pressing the corresponding start button on the operating panel below the levers. The operation of a start button picks up the corresponding start or change relay, and the system steps through a complete cycle. In case two or more



Extreme left—The C.T.C. relays are housed in a sliding cabinet which may be pulled out for inspection. Left—Power and line adjusting and testing equipment on the side of the machine.



Machine and line battery on balcony of Jenkintown tower

start buttons are pressed simultaneously or in rapid succession, the codes will be stored and released automatically, one at a time in a definite order arbitrarily fixed by the local circuit connections.

The first several elements of the control code select the station by dropping the "SO" relay at all field locations, except the one at which the code connections match the code being transmitted.

During the remainder of the control cycle, the elements of the code are devoted to the control of the various functions at the selected station. This is accomplished by means of "application relays" which are operated by the field stepper unit in accordance with the control code and which apply the controls to the various function relays.

Indication Codes

Indications are obtained by the use of uni-directional current in the indication line circuit. The field unit CLOSES or OPENS the indication line circuit during each half-step period of the cycle in accordance with the code required to identify the calling field station and to deliver the indications that should appear on the control panel. Station identification or registration elements of the indication codes were set up, through the medium of permanent code connections on the field units, when the field units were wired; while the function indication elements are set up, through the medium of function-relay-selected code connections on the field units, by the operation of the function relays.

When the function-indication portion of the code is changed by the movement of any function, the complete code is released automatically by the operation of the start or change

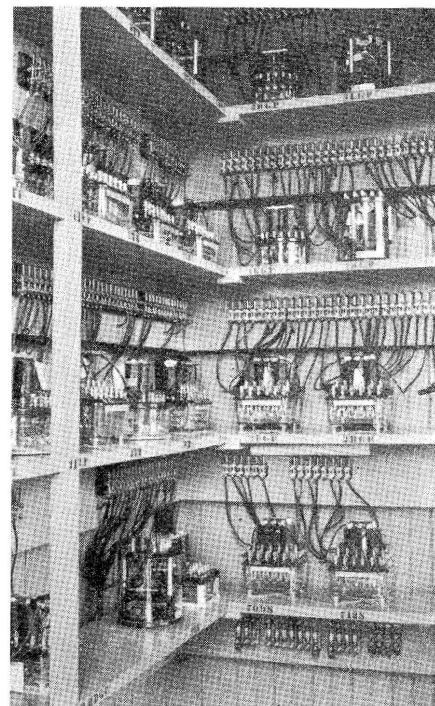
relay which, also, is actuated by the movement of the function. Since the location at Bethayres has three "stations," the priority of the stations within the location is fixed arbitrarily by the local circuit connections. The stored indication codes are released automatically one at a time in the order of the station superiorities. The first several elements of the code identify the calling field station by selectively picking up "registration" relays, in the control office, which finally pick up the "station" relay that represents the calling field station. During the remainder of the indication cycle, the elements of the code are devoted to the operation of the indication relays which control the indicator lights, annunciator bell, etc., in accordance with the indication code received from the field station.

The closed or open condition of the indication circuit during each period, as described above, in no way interferes with the choice of polarity for the control circuit current that may be applied by the control office for each ON period; therefore, it in no way interferes with transmitting controls simultaneously with indications. Hence, the system affords "duplex" operation, that is, controls and indications may be transmitted on the same cycle to and from the same or different field locations. During a "duplex" cycle, the control code determines the polarity of the control circuit for each ON period, while the code from the field indication station determines the "closed" or "open" condition of the indication circuit during each "off" and "on" period in the cycle.

Placing the cancellation switch on the master panel in the "cancel" position will cancel all control codes that have not been transmitted. When it is considered necessary to verify the indications from the field location, the recheck switch on the master panel is placed in the "recheck" position, and the start button for the location to be checked is pressed. When the buzzer in the control machine indicates that the control has been effected, the recheck switch may be returned to its normal position. A field station that continues to send indications due to some failure or abnormal condition at the location can be suppressed by placing the station suppression switch on the master panel in the "suppress" position and holding it there until the buzzer sounds.

Power Supply and Construction

Three separate batteries with rectifiers and control equipment are located on a balcony just below the second floor of the tower at Jenkintown.



Relays at Bethayres tower

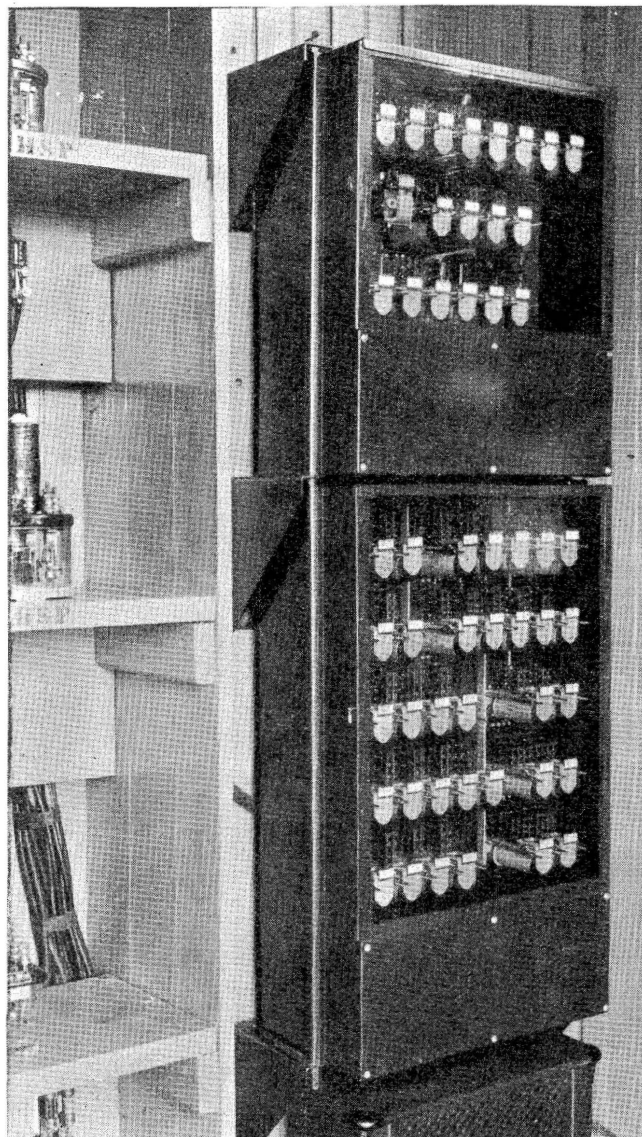
The battery for the control circuit consists of 30 Exide BTM-2 cells of 6 a.h. capacity, while 30 BTM-2 cells of 6 a.h. capacity are provided for the indication circuit. Power for the machine equipment is supplied by 12, 120-a.h. EMGS-7 cells. The line circuits are carried in No. 16 wires, three conductors of a steel armored telephone cable being used.

Equipment at Bethayres

Color-light, three-indication, red, yellow, green, top units are used on signals 1R and 3L on the main line, while two-indication, red, yellow, units are provided for the bottom units. Standard, two-block signaling is used, the lower yellow, under a red on the top, being a "calling-on" signal. The reverse movement dwarf signals on the main line are two-indication, purple, yellow, color-light signals. On the Newtown branch home signals, two-indication, green, red, units are used on the top, while two-indication, red-yellow, units constitute the bottom units. Westbound Newtown branch signal 2L and eastbound signal 2R are color-light type, two-position signals. The single-track Newtown branch, outside of interlocking limits, is signaled with two-position automatics, and the double-track New York branch with three-position automatics.

The major portion of the control equipment for the Bethayres remote layout is housed in the ground floor of the old tower, the upper floor being

(Continued on page 584)



C.T.C. equipment at Bethayres—field stepping unit mounted above the field application unit

from 25 to 100 cycle and transmitted at 4,400 volt, 100 cycle, single-phase on No. 2 copper line wires to Bethayres, supplying signal locations either side of Bethayres. At Bethayres it is transformed to 110 volts. Line circuits to the signals are in No. 10 hard-drawn, double-braid, weather-proofed, insulated line wires. Cable is used between the tower and pole line terminal boxes, Kerite wire jumpers being used from the terminal boxes to the cross arms. The instrument cases previously in service, of wood construction, were used to house the equipment at signal locations.

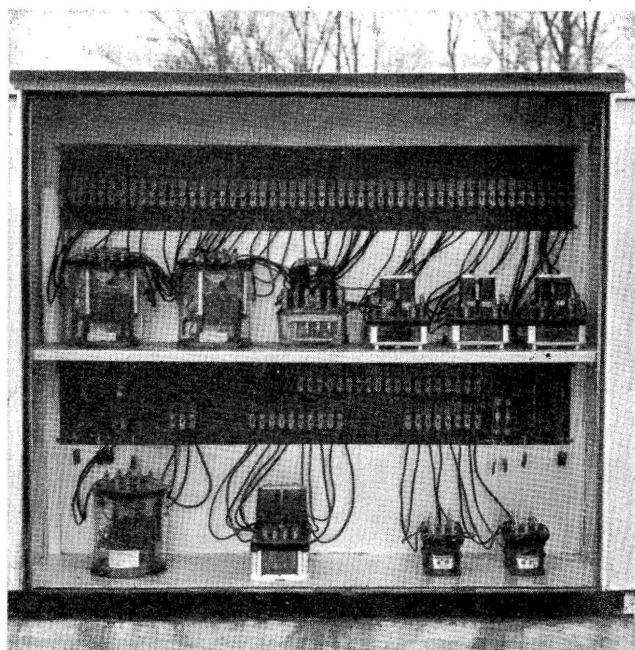
The approaches on the Newtown branch are equipped with double-rail, end-fed neutral d-c. track circuits, using three Edison 1,000-a.h. primary cells in parallel, in concrete battery tubs, and 4-ohm track relays. The section of the Newtown branch within interlocking limits is equipped with a double-rail end-fed, 100-cycle, a-c. track circuit with a 500-v.a. trans-

(Continued from page 575)

boarded up. Wood shelving was provided with the relays shelf-mounted, and Racor multiple unit terminals were mounted on backboards placed two inches from the tower walls. Entering cables fan out to terminals under the bottom shelf. Jumpers of No. 12 flame-resisting flexible wire are used between the cable terminal board and relay terminals, No. 12 flex with soldered Bee eye terminals being used for relay leads. A total of 59 relays of various types, manufactured by both the Union Switch & Signal Company and the General Railway Signal Company, are housed in the tower. DT-10 time element relays were used in the time-locking circuits, four-minute setting being used for the main line and two-minute for the Newtown branch signals.

The C.T.C. equipment at Bethayres is mounted on the tower wall, in one corner, next to the relay shelving, and consists of a field stepper unit mounted above a field application unit. These units are provided with A.A.R.

Relay location on the branch at signal 2R



terminals on terminal boards to which the field wires and code jumpers are connected permanently. All of the relays are of the detachable type.

Plant Battery

The plant battery consists of 12 cells of Exide 40-a.h. Type DMGO-5 battery floated on copper-oxide Type RPQ-21 rectifiers. The signal operating and indication circuits are fed from 10 80-a.h. EMGS-5 cells floated on a copper-oxide Type RP-10 rectifier. Power is obtained from an electric traction substation at Wayne Junction, near Philadelphia, at which point power frequency is changed

former feed and a two-position Model-13 vane track relay. The main line track circuits are 100-cycle, a-c. end-fed circuits with 500-v.a. track transformers, No. 1554 reactors, and centrifugal frequency relays. Impedance bonds on these tracks are of 100-amp. capacity. The track leads are single and double conductor No. 9 parkway cable attached to Union two-way and Racor No. 316 bootleg outlets. Small welded head-of-the-rail type bonds are used on the electrified track.

This installation was made by the Philadelphia division signal department forces under the direct supervision of the signal engineer's office.