

A-c. primary system track circuits and a-c. floating line supply and stand-by used for three-position color-light signals on the double-track between Upper Sandusky and Toledo.



New color-light automatic block signal on the C. & O.—near Fostoria, Ohio.

New Automatics on the C. & O.

THE CHESAPEAKE & OHIO has recently completed an installation of automatic block signaling on 51 miles of double track on the Toledo subdivision of the Hocking division, between Upper Sandusky and Walbridge, Toledo, Ohio. In addition to 4 passenger trains daily, this division handles 34 freight trains daily, the majority of which handle coal, moving north to the docks at Toledo, and empty coal cars moving south.

Prior to the recent installation of three-indication automatic signaling, trains were operated over the double-track line in this territory under manual block system rules. Normally, absolute manual blocking was in effect for all passenger trains, and permissive blocking was permitted when freight trains only were involved. No distant signals were in service to warn enginemen of their approach to block station home signals. During certain seasons of the year dense fogs are prevalent in the territory so that the

indications of the oil-lighted semaphore manual block signals, formerly in service, were often difficult to see. Therefore, during stormy weather absolute blocking of freight trains, as well as passenger trains, was in effect. Since the manual blocks were from 4 to 12 miles in length, considerable delay was experienced during bad weather.

Reasons for the Installation of Automatics

The installation of automatic block signaling was considered advisable on the basis of the decreased total train hours and reduced total running time to be obtained by the provision of shorter blocks which would allow for closer spacing of trains, as well as additional safety. Whereas the manual blocks were 4 to 12 miles long, the automatic blocks average about 9,000 ft. in length. Furthermore, the new automatic blocks afford much

better indications so as to be seen more readily by the enginemen. An installation of automatics on the same division, adjoining the new installation, between Valley Crossing, near Columbus, Ohio, and Upper Sandusky, a distance of 71 miles has been in service approximately six years.

A total of 58 Style R2 signals, providing red, yellow, and green indications was installed on 51 miles of double-track line. Straight two-block signaling without overlap is provided for the normal direction of traffic on each of the two tracks. The average block length is approximately 9,000 ft., trains being operated, in general, under a maximum speed restriction of 70 m.p.h. At the majority of the locations the signals on each track are placed opposite each other.

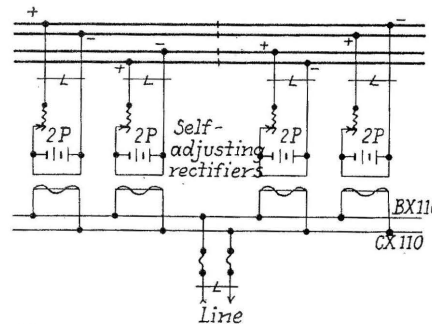
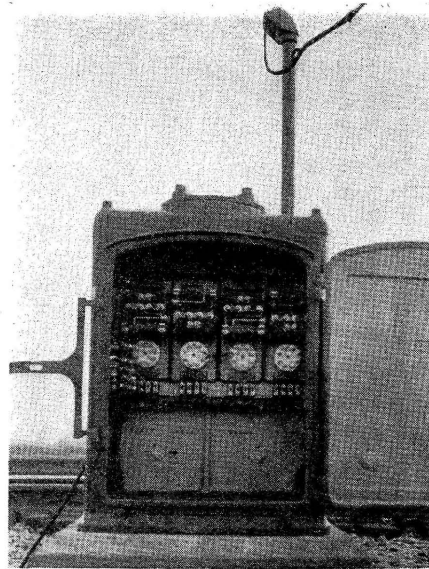
Six existing highway crossing flasher signal installations were incorporated in the new signaling design. Although no new interlockings were installed, modifications were made to

the circuits of existing interlocking plants located at Upper Sandusky and Cummings, Ohio. An interesting feature of the installation was that, although the work was in progress during a period when rain might be expected, not an hour's time was lost due to rain. The automatic system was designed in the office of the superintendent of telegraph and signals at Richmond, Va., and was installed with system signal forces. The work was started on May 15, 1936, and was completed on September 22, 1936.

The signals are controlled by polar line circuits, using retained-neutral polar line relays. Each line circuit is normally fed from a set of 5 cells of 90 a.h. lead-type storage cells which also serves as a stand-by supply for the signal lamps. Each of these batteries is on floating charge through a dry plate rectifier. Double-filament lamps are used in the signal heads, the primary filament being rated at 10 volt, 18 watt, while the secondary filament is rated at 10 volt, 3.5 watt.

Track Circuits on A-C. Primary

The track circuits are of the d-c. neutral type, and with but few exceptions two track circuits are used in each block with the two track feeds being located in the center of the block. In the majority of instances,



Above—cut-section housing and wiring diagram
Below—typical instrument case at signal location

2-ohm neutral track relays were used. A total of 142 neutral track relays and 65 retained-neutral polar line relays were placed in service on this installation.

Each track circuit is fed by a self-adjusting rectifier in multiple with two 500-a.h. primary cells connected in series. Each track rectifier is adjusted so that it normally carries the major portion of the track circuit load, the two primary cells in series being allowed to furnish only approximately 10 m.a., this being considered sufficiently high to keep the cells active. On a normal track circuit, the entrance of a train onto the circuit, with the resulting train shunt load, causes the rectifier to automatically adjust itself so that the rectifier, and not the battery, supplies the increased load. Thus, the two primary cells supply only approximately 10 m.a. at all times and are kept in good condition as a reserve source of track circuit energy in case of power failure. It is estimated that the cells, with this circuit and rectifier arrangement, will have a life of from three to five years. It will be noted that the track cells are connected in series rather than in multiple. This was done in order to obtain a more effective train shunt value by the use of more resistance in series with the energy supply.

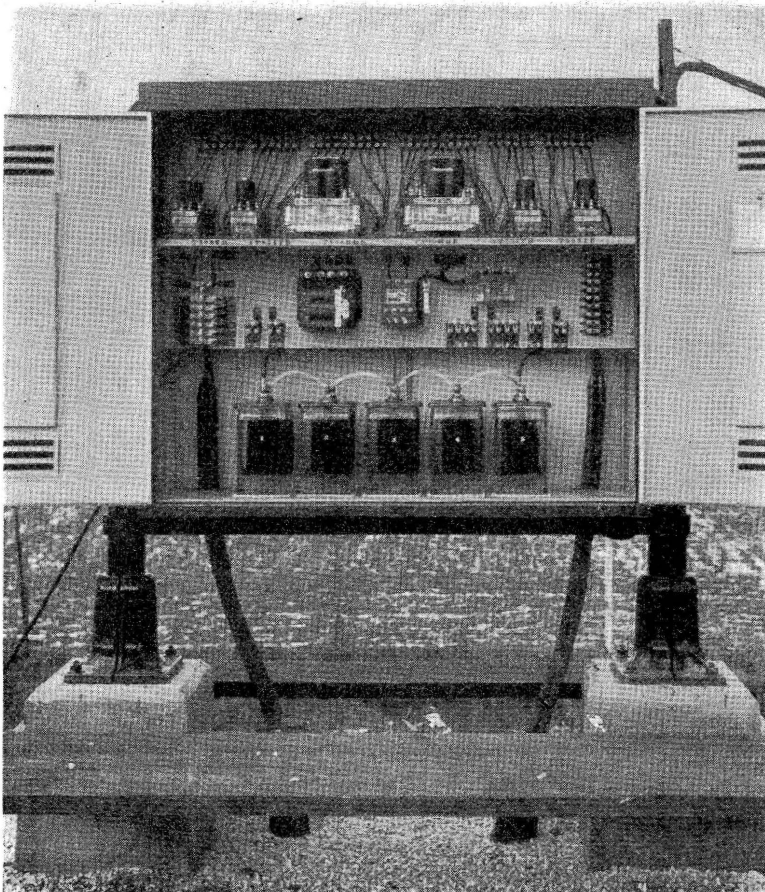
A rotary type switch circuit controller is connected to each turnout switch, this device being wired to shunt the track circuit when the switch point is opened, and is adjusted to $\frac{1}{4}$ in. for facing-point switches and $\frac{3}{8}$ in. for trailing-point switches.

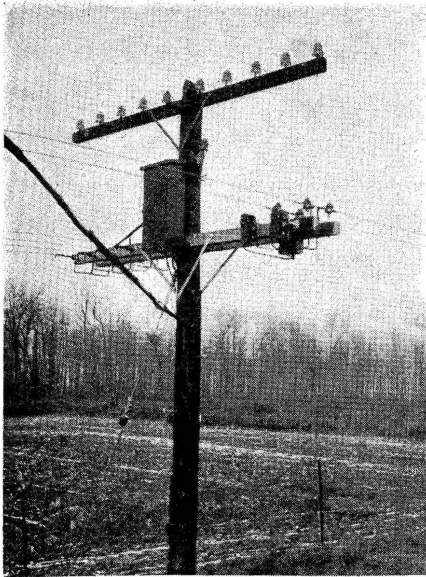
Details of Construction

Track leads are run in No. 9 AWG steel taped cables from the instrument case to a horizontal trunking outlet placed under each rail. Two No. 9 AWG flexible, rubber and braid covered wires are soldered to each cable lead in the trunking. One flexible wire is then brought up on each side of the rail and fastened to the web of the rail with a driven plug type rail terminal. A keeper wire extending through the web of the rail, about a foot away from the point of termination of the flexible jumpers, is wrapped around both jumpers to keep them in place. Two galvanized iron bond wires with $\frac{3}{8}$ -in. duplex channel pins were used for rail bonding.

Sheet-Metal Housings Used

At each signal location there is a sheet-metal instrument case, either an 8-way or a 12-way capacity case being used as required. The relays are shelf-mounted on the upper shelf, while the





Apparatus mounted on pole at signal location

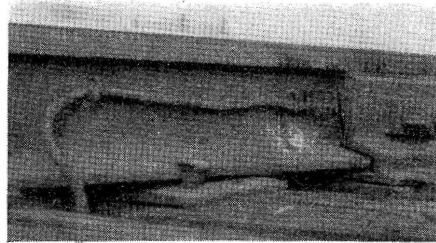
rectifiers and transformers are mounted on a panel board in the lower compartment in which the five cells of storage battery are placed. Each shelf on which relays are placed is covered with a strip of rubber matting to eliminate vibration and prevent movement of the relays. Cables entering the instrument cases are carried to the wiring space behind the panel boards where the wires are fanned out, inserted through individual holes, and run to their respective terminals. The ends of the terminal bolts to which 110-volt a-c. wires are attached are painted with red paint to facilitate identification. Another maintenance feature is provided in the connections to each battery bus, where the battery lead, the rectifier lead from the power-off relay, and the load lead are all broken through terminals before being connected to the battery bus. With this arrangement, various meter readings may be made easily without disconnecting the energy feeds.

Resistance units of 10-amp. capacity in each light circuit are mounted in the signal head and an extra resistor of 10-amp. capacity is mounted in the instrument case at each location to provide an adjustment for all light circuits simultaneously, if and when it is needed due to line voltage variation.

At center feed locations the track battery is located in a 10-cell capacity battery well, while the rectifiers and track resistors are mounted in an instrument case. An interesting feature of this installation is that all instrument cases face east and all lightning arrester housings are on the south side of the telegraph poles to which they are fastened. On previous installations in this area, instrument cases had been

placed, in general, so that the case doors always opened away from the track. It was discovered, however, that due to prevailing winds from the north and west, doors on cases facing in these directions became badly weather-beaten and warped, and that during snowstorms a workman opening the case doors was usually faced with the problem of snow blowing into the instrument case. In order to protect the housings and their contents, all housings were placed so that entrance is obtained from the geographical east or south. In the case of lightning arrester housings, the backs of the boxes are protected during bad weather, and the sun's rays are used most effectively to dry off the front.

In order to preserve the track cable leads into the instrument cases, the cable was brought up through a piece of 4-in. tile, approximately 24 in. in length, extending about 12 in. above the ground level. The tile was filled with sand and sealed with compound. Cut stone ballast, to a depth of about three inches, was placed around each instrument case, each center feed



Typical rail connection

housing, each battery well, and each signal base to provide good drainage and a neat appearance.

Power Supply and Line Wires

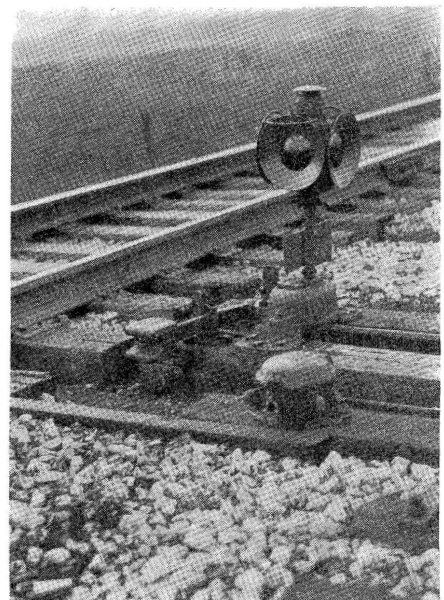
Power supply of 440-volt, 60-cycle current was provided by running two No. 6 AWG solid double-braided weatherproof copper wires. These were placed on the ends of 10-pin arms mounted on the existing pole line. Signal line wires, No. 10 AWG, solid double-braided weatherproof, copper-covered steel, were run on the same arms. At the signal locations, new creosoted pine poles were set. Transformers, stepping down the line voltage from 440 to 110, together with 10-amp. primary fuse cutouts, 440-volt lightning arresters, and the housings for the signal circuit lightning arresters, were mounted on these poles. The signal wire lead-ins to the instrument cases are in aerial cable, the 110-volt line being carried in two No. 12 AWG rubber covered taped and braided wires. Power is obtained

at 440 volt, 60 cycle, at three different locations from commercial sources. Connections made at Carey and Longley feed 10 miles either way, while a connection at the east end of Walbridge Yard feeds 10 miles south.

The construction methods on this project were featured by centralized assembly methods for all materials and concentration of gangs on certain phases of the work. The relay cases were pre-wired by signal department forces, and all signals were assembled, including the heads and ladders, at Fostoria. The foundations were poured in place, using sheet-metal forms.

Four distinct gangs were used in the actual construction. The first gang went through and completed all the bonding. The second gang, a concrete crew, worked on successive stretches of territory, placing foundation forms, track leads, and steel taped cables, mixing and pouring concrete, and removing forms. A third gang worked exclusively on line changes, placing crossarms, and stringing line wire. The fourth gang wired the instrument cases and assembled the signals at the central location, Fostoria, and then placed the instrument cases and signals on their respective foundations, using a crane placed between flat cars of a special work train. This same gang installed the battery and completed the wiring. The number of men in each gang varied as it was necessary to transfer them from one gang to the other throughout the progress of the work.

A similar installation is now in progress on 91 miles of the Chesapeake & Ohio Northern subdivision of the Cincinnati division, extending from Limeville, Ky., to Parsons Yard, Columbus, Ohio.



Rotary type switch circuit controller