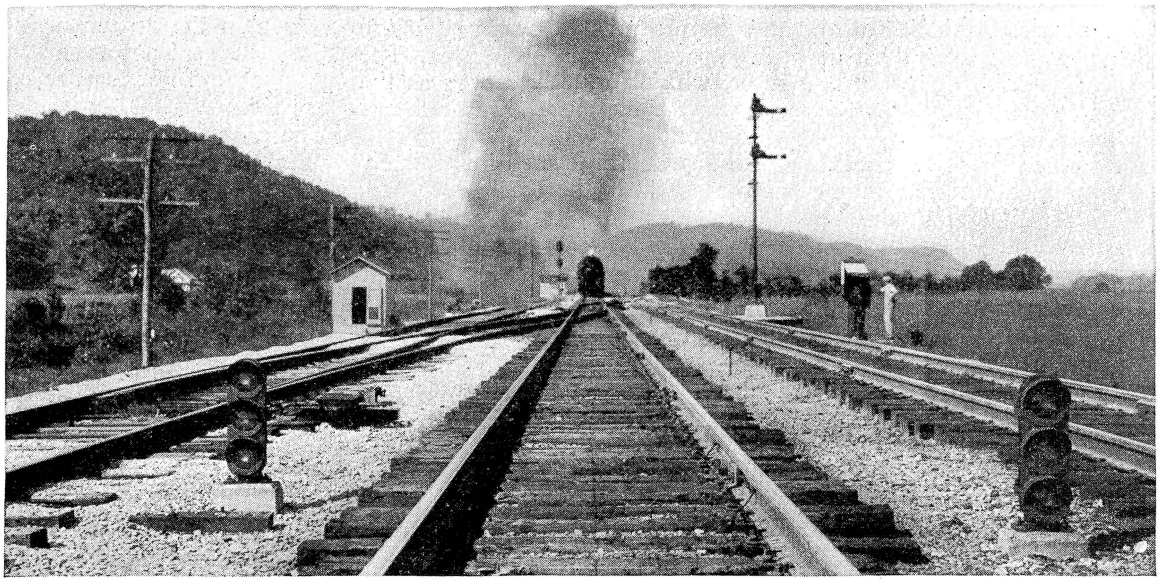


Eastbound train approaching Edgington—Three-aspect dwarfs in foreground

C. & O. Remote Control

Outlying mechanical interlocking near Limeville, Ky. replaced by power switches and signals controlled from tower four miles away

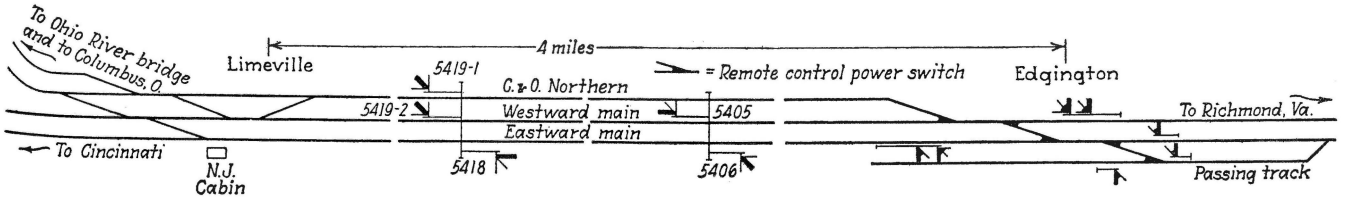
At Edgington, Ky., four miles east of Limeville, the Chesapeake & Ohio has replaced a 24-lever mechanical interlocking with power switch machines and signals, which are remotely controlled by a C.T.C. type machine in the tower of the interlocking at Limeville, at which point a double-track line diverges from the Richmond-Cincinnati main line to cross the Ohio river, and extend northward to Columbus and Toledo, Ohio. From Limeville a third main track extends eastward to Edgington; westbound trains destined for the Columbus line are diverted to this third track at Edgington.

This section of third main permits northern subdivision freight trains to leave the main line quickly, especially when interchange movements are to be made or when helper engines are to be attached to assist trains up the grade leading to the bridge over the river. The track layout at Edgington includes a trailing-point crossover between the two main tracks, a facing-point cross-over from the eastward main track to a passing track, and a facing-point turnout from the westward main track to the third track, designated as track No. 1.

A study of operating conditions between Russell terminal and Limeville, revealed that the Edgington interlocking station, which was originally built in 1911, was no longer essential. It was, therefore, decided to remove the old mechanical plant, install power switch machines and signals and control the layout by means of centralized control type of equipment, operated from a C.T.C. machine in the existing interlocking tower at Limeville. At the same time obsolete and worn out two-position automatic semaphore signals, for a distance of seven miles east to Riverton, Ky., were replaced with three-position automatic color-light signals, properly spaced to provide adequate braking distance.

Traffic Handled and Interchange Moves

The daily traffic through Edgington includes 10 passenger trains, 10 manifest freight trains, 2 local freight trains and about 28 dead freight trains, totaling about 50 trains daily. As mentioned previously, westbound freight trains for Columbus diverge from the main line at Edgington. In addition, Edgington is a point of interchange. For example, eastbound trains from Stevens yard, a short distance east of Cincinnati, with loads destined for the lake ports via Columbus, are routed by means of the power switches into the eastward siding at Edgington, and the loaded cars are



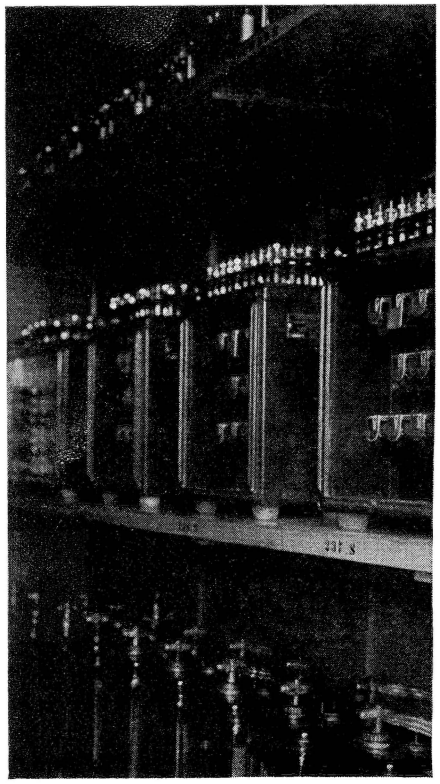
left in the siding to be picked up by westbound northern subdivision trains. Likewise, eastbound trains from Columbus, with cars destined to Cincinnati and the west, leave them on the eastward siding at Edgington, to be picked up by westbound trains for movement over the Cincinnati division. Approximately 100 loaded and 100 empty cars are thus interchanged daily at Edgington, during the nine months of the year.

As many of the movements in picking up or setting out cars block one or both of the through main tracks, they must be handled without delay. The operator at Limeville is, of course, fully informed in advance as to the moves to be made at Edgington, and he co-ordinates the operation of the Edgington layout with that of the Limeville plant as though it were all one interlocking. Operations are thus facilitated by centralizing the control of the entire area under the direction of one man who can co-ordinate the movements. Although telephones are provided at Edgington, a large proportion of the movements are made without the trainmen talking to the operator at Limeville. If the operator desires to call trainmen to the telephone he sounds a large electric horn.

Equipment Required for the Change

The major items of equipment installed at Edgington to replace the mechanical plant included five electric switch machines, five interlocking color-light dwarf signals and two two-arm interlocking home signals, one of which is a standard color-light type and the other a two-arm semaphore of comparatively modern design. The latter, which formerly served as the westward home signal, was retained in service.

All signals are located immediately to the right of the track governed, standard two-arm high signals being provided for all through train movements in the normal direction of traffic. Color-light dwarf signals with three aspects are used to control low-speed movements through the crossovers to the main tracks with the normal direction of traffic.



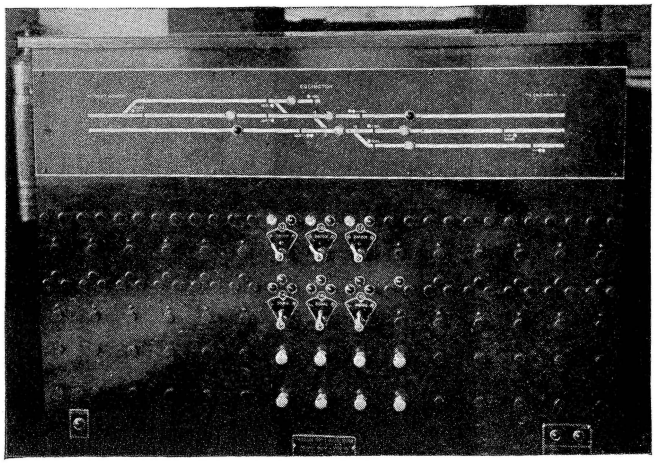
Code equipment and battery in instrument house

The control machine in the tower at Limeville, for the control of the switches and signals at Edgington, has three two-position levers for the control of the switches and three three-position levers for the control of signals. These levers, together with an illuminated track diagram, are mounted in a standard 30-in. sheet-metal cabinet which affords space for extensions of the C.T.C. system in either direction. The time code system of control is used, all functions being controlled and indications returned by codes transmitted over a single-line circuit of two wires.

Aside from the C.T.C. machine, no other equipment was added in the tower at Limeville except the code-line and code-operating batteries and their rectifiers. The code equipment at the instrument house at Edgington consists of one line-coding unit and three storage units.

Switch Layouts

Each power switch is operated by a Type-M2 switch machine equipped for operation on 24 volts d-c. Each machine is equipped with a point detector and Chesapeake & Ohio standard switch fittings and braces are used throughout. Each switch adjuster is equipped with two coil springs, as shown in the accompanying illustration. The springs are made of spring steel of 5/16-in. square section and are formed with 1¾ inside diameter. The purpose of the springs is to reduce the wear and strain on parts when the switch operates, as well as to compensate for binding in the switch machine due to normal irregularities in alinement and fitting of switch points. This spring arrangement is, therefore, a decided benefit in preventing switch failure and reducing maintenance costs. Extended tests on the Chesapeake & Ohio have shown that they are especially valuable on remotely-controlled layouts where the maintainer is not on duty to make frequent observation of the switches during extreme changes of temperature.



The C.T.C. type control machine

Details of Apparatus

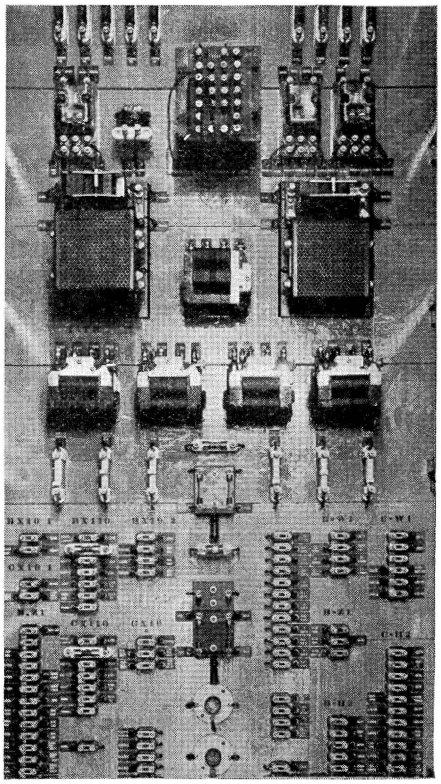
At Edgington an 8-ft. by 11-ft. building is provided to house the batteries, relays, rectifiers and coding apparatus. This house is of frame construction, using 2-in. by 4-in. studdings and 1-in. by 8-in. shiplap siding and roof. The outside walls and roof are covered with heavy gage corrugated galvanized sheet iron. The foundation and floor are in one piece, made of concrete poured in place.

In order to allow space for a man to get behind the relay racks in the house, those on the rear and two sides are set out 20 in. from the wall. The racks are built up solid from the floor to the ceiling, of 1-in. boards bolted to ½-in. by 2-in. by 2-in. angle-iron uprights. All incoming cables and wires are brought into this outer compartment and the wires are run through small holes to bakelite-based terminals, which are mounted on the

rear wall of the relay rack. The interior wiring is No. 16 flexible with 1/32-in. insulation wall and single braid. Distributing wires from the terminals to the various instruments are run back through the wall, thence on messenger wires in the wire way to a point where they again pass through holes to the binding posts on the instruments. In this way all the wiring runs are out of sight, and yet there is adequate space behind the racks to install or inspect the wiring. All terminals, arresters, limiting resistances, fuses, etc. are mounted on the rear wall of the terminal rack.

A 5-ohm adjustable resistor is used for each track circuit and a 3.5-ohm adjustable resistor is used for each signal lamp circuit. All battery connections to the code units are fused with 10-amp. fuses. All signal line control circuits are protected by series line choke coil type arresters and the track relays are protected by shunt type arresters with the center tap grounded. These arresters are connected to grounds used exclusively for this purpose, being separate from the ground for the arresters on the 440-volt circuits.

The lightning protection for the code line is of special interest. At Limeville and Edgington the following combination is used: Neon-argon arresters are connected in series and are located in a box on the line pole. No. 60 AP arresters with carbon blocks are connected across the line and are located in the instrument house at Edgington and in the tower at Limeville. This arrangement of arresters has proved very successful in preventing failures of the code line which might otherwise be caused by lightning.



Interior of instrument house

Each signal pole-line ground rod is numbered to the nearest even hundredth of a mile, each ground for the 440-volt signal power line is numbered to the nearest odd hundredth and each shunt arrester ground to the next nearest odd hundredth. This numbering of the ground rods facilitates testing and maintaining records of ground tests.

Relay Assignments

The track relays are of the DN-11 type using 4-ohm relays for short detector sections and 2-ohm relays for normal length circuits. The line control relays for the three-position automatic signals are the DP-21 retained-neutral polarized type rated at 400 ohms and DN-11 500-ohm relays are used for the control of other signals. The code-repeater stick relays are also 500 ohm and as their holding circuits are energized from the 16-volt code-operating battery fixed 500-ohm resistance units are inserted in series to reduce the voltage across the coils of the relays. Type DP-14 500-ohm relays with special front contacts are used to control the motor circuits of the switch machines.

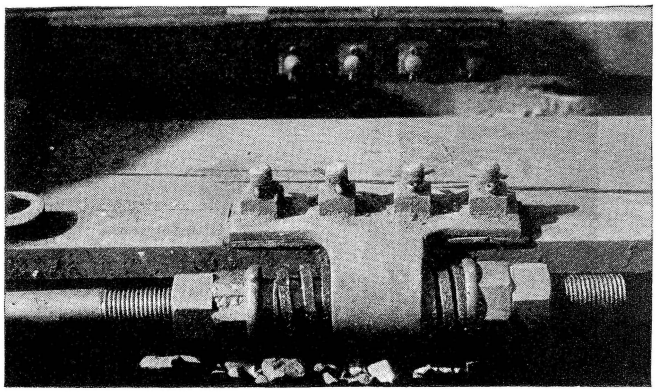
An ANL-2 relay is connected in series with the red lamp in the top unit of each two-unit, color-light home signal, so that if the filament burns out the red lamp in the bottom unit is lighted automatically. Approach and time locking is accomplished by the use of TH-10 thermal relays.

For testing or changing out code apparatus the code line equipment at Edgington can be by-passed by reversing a knife switch which cuts off the line coding unit and inserts a resistance of 20 ohms in series with the line.

The 110-volt electric horn at Edgington, used for calling trainmen or maintainers to the telephone, is controlled by the coding system. A stick circuit utilizing a thermal relay provides for approximately a nine-second blast of the horn and an indication that the horn has sounded is provided on the control machine at Limeville.

Pole Line and Power Supply System

The signal wires in this territory are carried on a 10-pin crossarm mounted below the crossarms which carry the communication line circuits on the pole line. The signal line wires are all protected with double-braid weather-proof covering, the signal control wires being No. 10 AWG copper-covered steel, the two code wires No. 8 AWG, hard-drawn copper and the 440-volt a-c. distribution circuit No. 6 AWG, hard-drawn copper. Porcelain insulators are used for the 440-volt line, brown type pyrex glass insulators for the code circuit and hemingray glass insulators for the signal control circuits.



Special springs on switch adjuster

The a-c. power for this territory is distributed at 440 volts single phase, this circuit being marked on the end of each crossarm with 2-in. aluminum markers. At each signal location a 440/100-volt line transformer is mounted on the crossarm and each transformer layout is protected by pellet type arresters and fused cut-outs. The line taps are made with solderless clamp type connectors. The machine at Limeville is equipped with an indication lamp to show when power is cut off the a-c. line.

All the signals are normally a-c. lighted and the power line also furnishes current for operating the rectifiers which charge the various sets of storage battery. At Edgington a set of 13 cells of 168-a.h. capacity lead battery is used for the operation of the switch machines, 8 of these cells being used also for code-operating battery.

(Continued on page 173)

the current flow is sufficiently strong to pick up the relay, one leak being on the relay control line circuit.

Elimination of the possibility of these false indications is of greater value than the cure. In order to prevent such false indications the common wire should be cut at regular intervals, where wiring conditions will permit, thus restricting false current flow through the ground to certain limits. Meter readings should be taken, ground to common, after every electrical storm, and at least once each week, under normal conditions, by all maintainers.

If, in testing for grounds, a maintainer on the Omaha railroad observes a current large enough to appear dangerous, with the possibility of an operating relay being falsely energized, he either clears the ground or checks it to the limits of his district, notifying the supervisor. The supervisor, in turn, notifies other maintainers having charge of apparatus within the same common span and they immediately check and clear. By this cooperation, dangerous grounds are short lived and the possibility of falsely energized relays is reduced to a minimum. If necessary, a high voltage or milliampere ground can be traced for 20 miles in one half day, without disconnecting a single circuit, by following the method described below.

Starting at any point in a common span, connect a meter to ground and common, and place an instant short circuit across the terminals of the line relay which receives energy from the east. If there is no deflection on the meter, all battery east is free from grounds. When the ground is toward the west the shunting of battery feeding from that direction changes the balance of current flow, and reduces the positive ground reading on the meter.

In making such a test, if there is no deflection on the meter for either direction, I know that I have arrived at the source of battery on which the ground is acting. At this point, I start to disconnect the various circuits, feeding out, until I locate the one causing the trouble. Then, by the use of a meter and magneto, I check to the point of trouble.

The above outline shows my method of locating a simple ground. Testing as above, if I arrive at a point where I get a deflection with both directions, after having received a deflection in only one direction, I know that I am between two grounds and the last location at which I received a one-way test is near one of them.

C. T. C. on C. & O.

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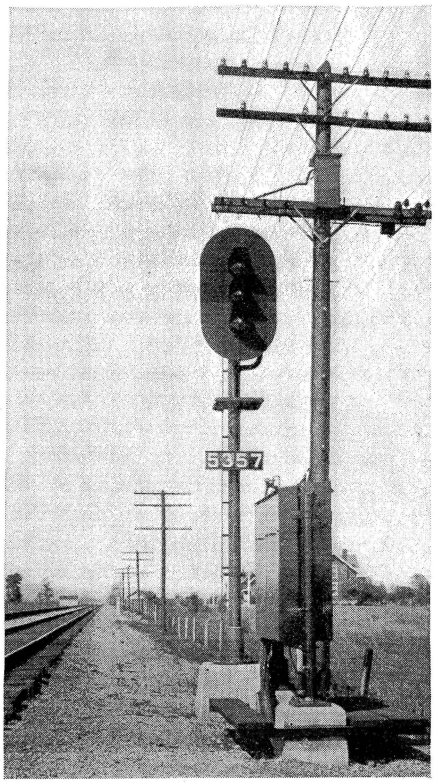
Five cells of 224-a.h. capacity lead type battery are used to feed local control relays and to act as a stand-by for the signal lamps. A set of seven cells of 8 a.h. capacity type BTM lead battery, located at Limeville, is used



Automatic signal location

to feed the code line. Each track circuit is operated by a type B4H nickel-iron storage cell. Each battery is on floating charge through a dry-plate rectifier.

Underground Wiring

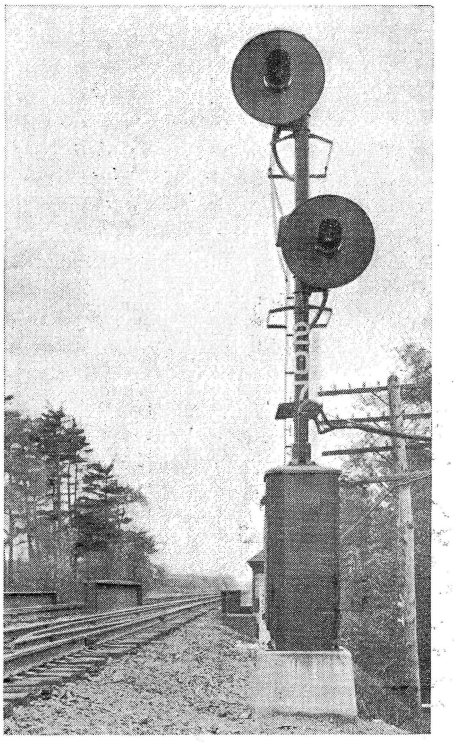
The wiring from the instrument house to the switches is run in underground cable made up with steel tape, jute, etc., run to a cast-iron terminal box near each switch. Flexible conductors extend from the terminals in this box through flexible metal conduit to the switch machine to prevent breakage of wire eyes due to vibration.

The underground cable entrance to the relay cases is protected at the ground line by a section of vitrified clay tile, the voids being filled with sand and sealed at the top with pothead compound. The No. 9 steel-taped underground cable for the track connections is brought up at the rail through a wooden riser box in which the cable wire is joined to a No. 9 flexible wire which extends to a rail terminal in the web of the rail.

As previously mentioned, the old two-position semaphore signals between Edgington and Riverton were replaced with three-position color-light signals. At each of the signal locations the instruments and battery are housed in a sheet-metal case, supported at each end by a 4-in. post set on a concrete foundation. The case has two doors at the front opening to the instrument compartments. At the rear, two removable panels, normally held by set screws, afford access to a wiring space, all wires being brought in and distributed through individual holes to horizontal rows of terminals mounted on the face of the terminal board.

A special feature of the control for these automatic block signals is the use of DP-21 type retained-neutral polarized relays which eliminate undesirable momentary flashes of the color-light signals from red to green to yellow or from yellow to red to green, which would otherwise occur when a change in line polarity takes place in the clearing of signals for the movement of following trains under various operating conditions. The voltage at the lamp in the signals is maintained at a maximum of 9 volts; this is accomplished by using individual variable resistance units mounted in the signal head. The lamps are rated at 10 volts, 18 watts.

This entire installation was planned and installed by the signal forces of the Chesapeake & Ohio.



Multiple-aspect color-light automatic signal on the Boston & Maine