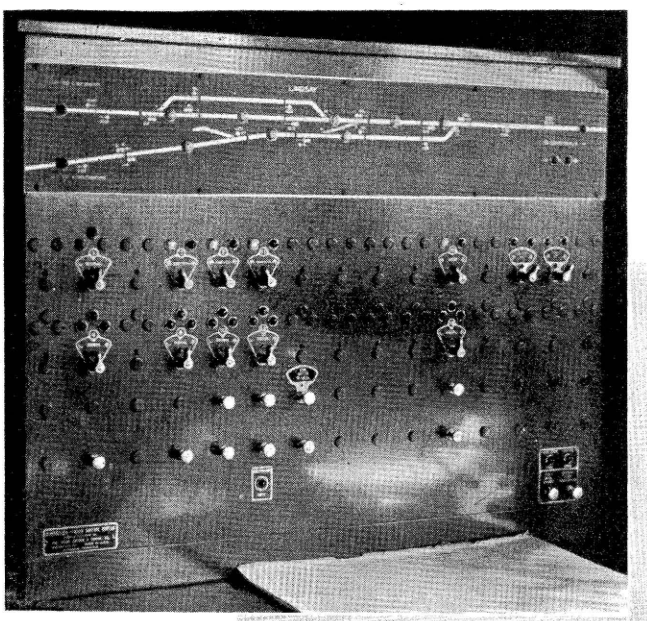
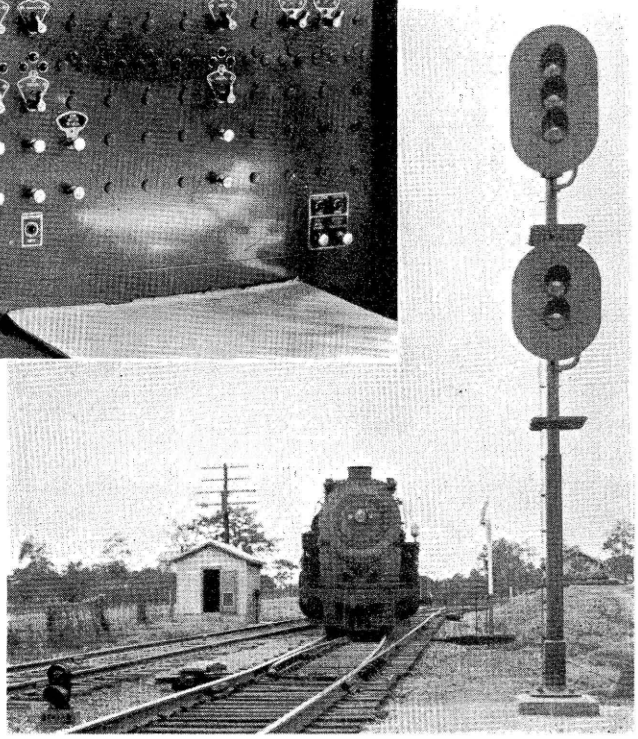
Junction Layout at Lindsay, Va., and train operation in either direction between Lindsay and Gordonsville, Va., controlled from one machine





Above — The control machine in the office at Gordonsville. Right — An eastbound train on the crossover No. 9 with signal 12L in the foreground

Centralized Traffic Control

On the Chesapeake & Ohio

At Lindsay, Va., 80 miles west of Richmond, Va., on the main line of the Chesapeake & Ohio, there is a junction with a single-track branch line extending 29 miles south to Strathmore, Va., to connect with the James River line of the C. & O. Trains making movements between the main line and the branch ordinarily use crossover No. 9, as shown on the plan. The extension from the branch line from crossover No. 9 eastward to connect with the main line at switch No. 15 is used as an interchange track. West of the junction, a passing track, with both switches connected to the main line, extends along the north side. Prior to these improvements, the crossover and the three single switches were operated by switch stands which were handled by train crews.

Volume of Traffic

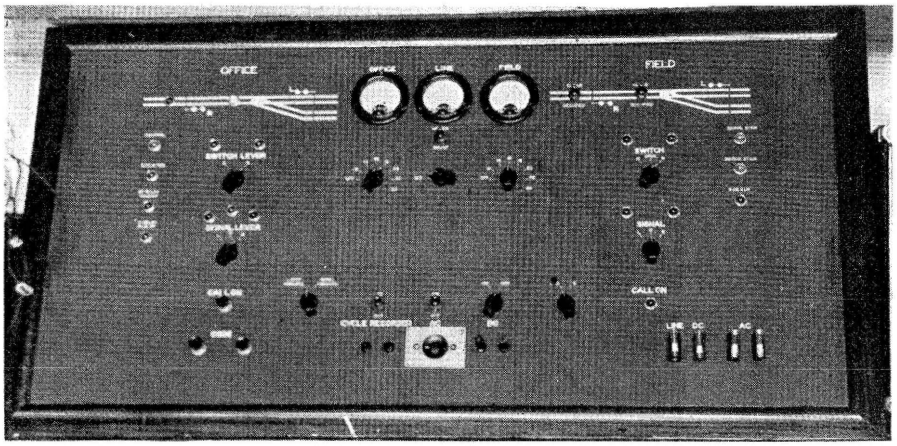
The daily traffic on the main line through Lindsay includes 12 passenger trains, about 8 freight trains, and a local freight which operates in one direction one day and the opposite direction the next day. The branch line handles one mixed train in each direction daily and from four to six extra freight trains daily. All trains moving to or from the branch line also use the main line between Lindsay and Gordonsville. Therefore, a total of from 27 to 29 train movements are handled on this section of line daily.

A freight train from the branch line, when arriving at Lindsay, sets off on the interchange track those cars which are to move westward, and then the train proceeds eastward through Gordonsville. A westbound main-line train picks up the westbound cars from the interchange track. Likewise, eastbound main-line trains may set off cars on the interchange track to be picked up by trains going to the branch line. In addition to the movements to and from the branch line and the interchange of switching, the main-line passing track is used by a considerable number of trains, this being the regular meeting point of certain passenger trains.

In order to facilitate train movements by eliminating delays occasioned by handling the switches by hand, a complete system of power switch machines and interlocked signals was installed.

Signals and Switches

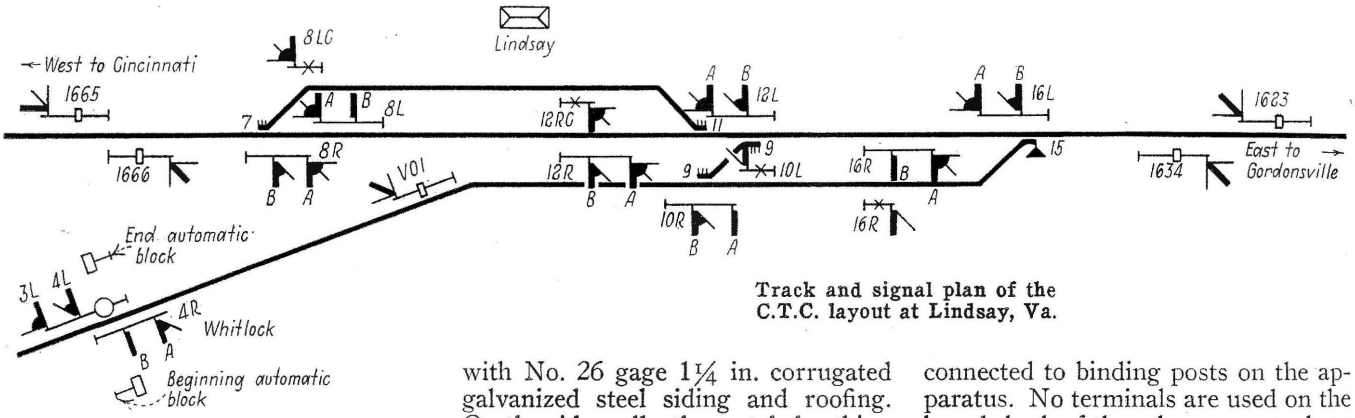
A power switch machine was installed at each end of crossover No. 9 and also at the two passing track switches No. 7 and 11. Switch No. 15 at the east end of the interchange track, is used only when eastbound trains are setting out cars. Therefore, a power switch machine was not installed. However, as this switch is in centralized traffic control territory it was equipped with an electric switch lock. Color-light signals were installed as shown on the plan, a special feature being that signal No. 3L-4L on the branch line is a manual block signal governing a manual block extending 27 miles to Strathmore, Va. Signal VO1 is a distant signal for Signal 3L-4L. The top unit of Signal 3L displays a clear manual block aspect



The inclined panel of the code testing set includes meters, keys, buttons and indication lamps the same as on the control machine at Gordonsville

and the lower unit, 4L, displays a permissive aspect. Signal VO1 displays a clear aspect only when 3L displays clear aspect.

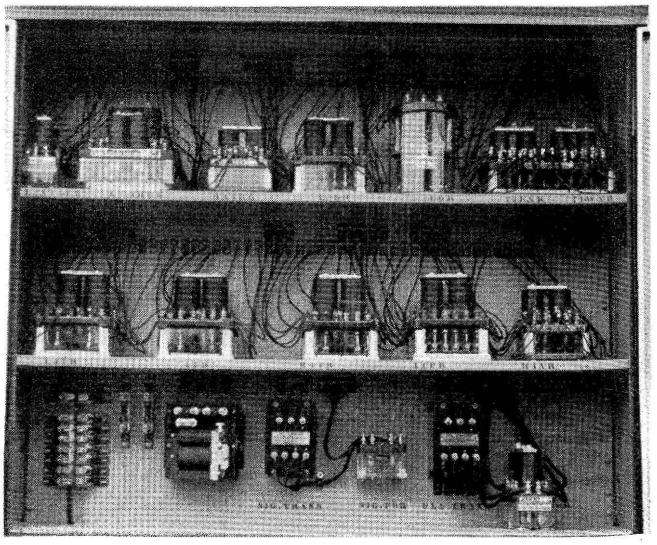
The five miles of single track main line between the west end of Lindsay passing siding and Gordonsville is operated under a centralized traffic control system, all train movements being directed by interlocking signal indications which supersede time-table superiority and eliminate the use of train orders. Eastward Signal 16R at Lindsay, when displaying clear or approach aspect conveys authority for eastward trains to proceed to Gordonsville, and a westward signal at Gordonsville conveys similar authority for westward trains. The signals, power switches, and electric switch lock at Lindsay are controlled from a centralized traffic control type machine in the interlocking station at Gordonsville, the controls and indications being handled by a two-wire time code system.



Track and signal plan of the C.T.C. layout at Lindsay, Va.

Housing of Equipment

At each of the three locations on the Lindsay layout where considerable apparatus is required, a small building is provided for housing the relays, coding equipment, rectifiers, and batteries. The house near crossover No. 9, shown in one of the views, is 9 ft. by 12 ft. outside dimensions. The foundation and floor are constructed of concrete poured in place, with the floor sloping toward a drain outlet at the center. The building is of frame construction using 2 in. by 4 in. studdings with 1 in. by 12 in. sheathing, applied diagonally. The building is covered with No. 26 gage 1¼ in. corrugated galvanized steel siding and roofing. On the side walls, the metal sheathing extends at least one inch below the wooden framework, thus improving the fire protection. The door frame and the door are made of sheet metal. Instrument shelves extend lengthwise on the two sides of the interior, and a terminal board is located near the rear, facing the door. The back walls of the shelving and terminal board are spaced 20 in. from the outside walls of the building, thus allowing space for a man to work when installing the wiring. Incoming underground cables are brought up through fiber ducts in the concrete foundation, and incoming aerial cables pass through a large sized metal conduit in the rear wall near the roof. All incoming cables extend to terminals or arresters on the rear terminal board, and from there, wires extend back through individual holes in the board and around in the wiring space, out through individual holes direct to the terminal posts on the instruments. All cross wiring between relays and other apparatus is directly connected to binding posts on the apparatus. No terminals are used on the boards back of the relays except where bus connections are required, and then not more than two wires are connected to a single terminal post although several two-post terminals are connected by bus straps. A fiber identification tag attached to each wire is held in place against the rear board by a



Typical outdoor instrument case showing relays and method of wiring

small wire brad. Number 16 flexible wire with 1/32-in. insulation wall and single braid, is used for all control circuit wiring inside the house. The wires in the wiring space behind the shelves and terminal board are supported by enameled bridle rings. This type of construction facilitates the installation of the wiring and also saves time when making tests or wiring changes. Each relay, code instrument, switch, rectifier, transformer, and battery is identified by numerals and letters stenciled on the edge of the shelving or front of the terminal boards.

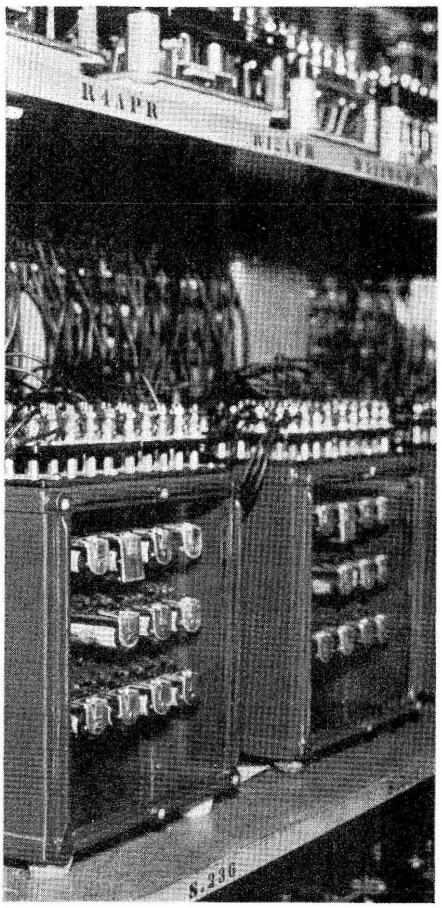
In order to provide enough contacts for circuits through the switch repeater relays, a neutral relay with eight front contacts was used to repeat each position of the power switches. Retained-neutral polarized relays are used for signal controls so as to eliminate a red flash when three-position signals change from yellow to green. A light-out relay is connected in series with the lamp bulb in the top unit of each two-unit signal so that if both lamp filaments fail, the relay will be de-energized and prevent the display of any aspect other than red in the lower unit, which arrangement prevents the display of a more favorable aspect than intended, in case of lamp filament failures. The lamps used in the signals are rated at 10 volts and have main and secondary filaments rated at 18 and 3.5 watts respectively. The maintainer ordinarily detects the failure of a main filament and replaces the lamp before the secondary filament fails. Each switch battery consists of 13 cells of 112-a.h. lead-type storage battery which is split into two sets of 5 and 8 cells, the 8-cell set being used to operate the code equipment. A set of five cells of lead-type battery, rated at various capacities, depending on the number of signal lights, is used to operate the local control circuits and serve as a stand-by for signal lighting in case of a-c. power interruption at each relay house and outlying signal location. One cell of nickel iron type storage battery is used to feed each track circuit. All storage batteries are on floating charge from copper oxide rectifiers.

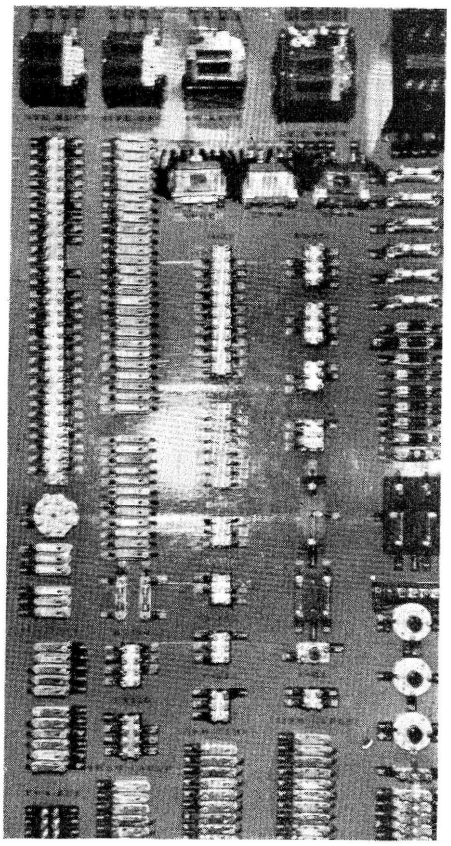
Details of Switch Layouts

The rail through Lindsay is 110 lb R.E., and the turnouts are No. 10, requiring a speed restriction of 15 m.p.h when making diverging movements. Each switch is operated by a low-voltage d-c. electric switch machine. Regular lock rods and point detectors are used. With 25 volts at the motor, switches will operate in about 12 sec.

The switch layouts including plates, adjustable rail braces, switch rods, etc., are constructed according to C. & O. standard for all main-line switches, the only addition at interlocked switches being the installation of adjustable rail braces on the tie ahead of the points. When installing a power switch machine, the signal department is responsible for ordering and installing the two ties on which the machine is mounted, and, thereafter, the signal supervisors are responsible for checking the condition of these ties and having them replaced when necessary. Switch ties for new

Left—Coding equipment in the instrument house at Lindsay. Below—All terminals, arresters, etc., are on one board



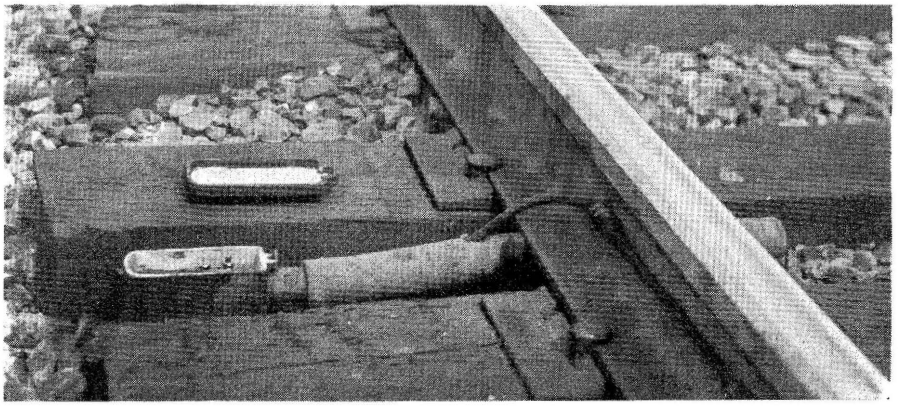


installations or replacements where power machines are used are ordered according to plans and specifications, and are framed before being treated in the creosoting plant. The bolt heads, threads, and nuts used for mounting switch machines, tie plates, rail braces, etc., as well as anchor bolts on signals and instrument cases, are treated with an application of No-Ox-Id when being assembled, after which a coating of Lastic cement compound is applied, thus excluding moisture and preventing corrosion.

Special Signal Hood on Dwarfs

A feature of the two-aspect color-light dwarf signals is that a special sheet-metal hood extends 10 in. from

(Continued on page 611)



Wires from the bootleg outlet junction box run in a section of air hose to the rail

case. At each of the K. C. S. home signal locations, and at the K. C. S. and T. & P. distant signal locations, five cells of Exide DMGO-7 80-a.h. storage battery are in service and on floating charge from a Type BX132 rectifier, for signal operation. At each location where a base-of-the-mast case is in service the battery is located on one side of the case, or in a separate case or battery box.

Each track circuit is fed by two cells of Edison 500-a.h. primary battery in multiple, with a Type BBY automatic rectifier across the circuit. The a-c. side of this rectifier is rated at 115 volts, 60 cycles, and the d-c. side at 1 volt, 1.4 amp.

A 110-volt, a-c. power circuit extends to all signal locations throughout the plant, except the T. & P. home signals, and at all these locations, the incoming 110-volt circuit is broken through an automatic circuit breaker provided to protect apparatus from short circuits, etc. These breakers serve as a breaker and entrance switch. This provides some degree of safety as the 110-volt wires are not exposed as in the case of an open knife switch. The 110-volt terminal post on transformers, etc., has an insulated nut for further protection against contract with the 110-volt.

This installation was made by the Kansas City Southern, under the direction of C. F. Grundy, signal engineer. The major items of signaling equipment were furnished by the General Railway Signal Company.

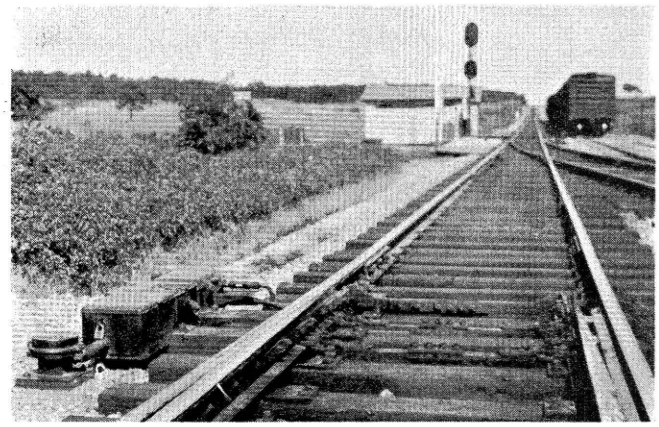
C.T.C. On the C. & O.

(Continued from page 655)

the face of the housing, the purpose being to improve the aspect and prevent sunlight from entering the lens to cause interference with the color of the red aspect. Spread-light lenses are used in all units with the corrugations set at an angle of about five degrees from horizontal, thereby providing a vertical spread, slightly favoring the track side, which results in the aspect being seen more readily by enginemen. An auxiliary light deflecting prism is used to improve the close-up indication.

New Type Bootleg Outlet

A new type of bootleg rail outlet construction, which was developed on the Chesapeake & Ohio, and which is being tested extensively, was used throughout the Lindsay installation. A malleable iron riser about 18 in. long and 2 in. in diameter has a spread foot at the bottom and a terminal box at the top as shown in one of the illustrations. The single-conductor No. 9 underground cable is brought up through this riser, and the wire is attached to one of the posts of a bakelite base terminal in the box. The space inside the riser is filled with sand, a metal wedge being driven down alongside the cable so that no strain can be brought on the conductor at the terminal. Sealing compound is then poured around the cable. From the right end of the box, as shown in the view, a section about 1¼ in. in diameter extends for 4 in. with a raised collar on the outside near the end. A section of discarded air hose is forced over the collar and around the projection on the box. Two stranded No. 9 insulated conductors equipped with wire eyelets extend from one post on the terminal in the box, out into the hose, and up through small holes in the top of the hose to a plug-type terminal driven in the web of the rail, one wire going to each side of the rail. A piece of cotton waste, saturated with sealing compound, is pushed into the open end of the hose. The bootleg outlet is located in the second tie space from the insulated joint so that the joint may be properly tamped. The length of wire along the web of the rail is supported in loops of short pieces of insulated wire which pass through ⅜-in. holes in the rail web.



View looking east from Lindsay with power switch No. 11 in foreground

Code Testing Equipment

A complete testing set for checking and testing the code control equipment is provided in the maintainers' headquarters. The panel on which the testing equipment is mounted is made of insulating material 3/16 in. thick, 18 in. high, and 36 in. long, being mounted on an inclined plane in a finished wooden case. Illuminated track diagrams at the upper left and right show typical office and field layouts. At both the office and field ends switch and signal levers, as well as indication lamps, are provided to duplicate a panel of the control machine. At the field end, toggle switches may be operated to duplicate the effect of occupied or unoccupied track sections, while 8-way gang switches are used for varying the operating voltage on either the office or field code equipment. Indication lamps are provided to repeat certain operations of the code equipment such as control, indication, ST relay hold-up, D relay pick-up, signal stick, switch stick, etc. Three meters are mounted in the panel; a voltmeter with an 0-50-volt scale connected to the field circuit, a similar meter connected to the office circuit, and an 0-300 millimeter that is connected in the line circuit. An adjustable rheostat is provided for varying the current in the line circuit. Three code-type relays are mounted in the board, being known as (ST) starting, (F) first group selecting, and (G) second group selecting relays. A cycle recorder instrument is provided for measuring the length of the various open and closed line impulses.

Wiring connections from the test panel extend to plug terminal plates which fit on the terminals of the office and field coding units. With this complete arrangement of apparatus, the coding equipment used on the installation can be checked and tested.

The power operation of the switches at Lindsay and the centralized traffic control operation has been effective in saving considerable train time. Trains which have cars to set off or pick up save from 12 to 20 min. Also considerable time is saved when making meets between main-line through trains. In case one train or the other is running late, the meeting point can be changed between Lindsay and Gordonsville depending on up-to-the-minute circumstances, and thus the centralized traffic control has been effective in relieving congestion of trains in this territory.

The installation explained above was planned and installed by signal forces of the Chesapeake & Ohio, under the direction of the superintendent telegraph and signals.