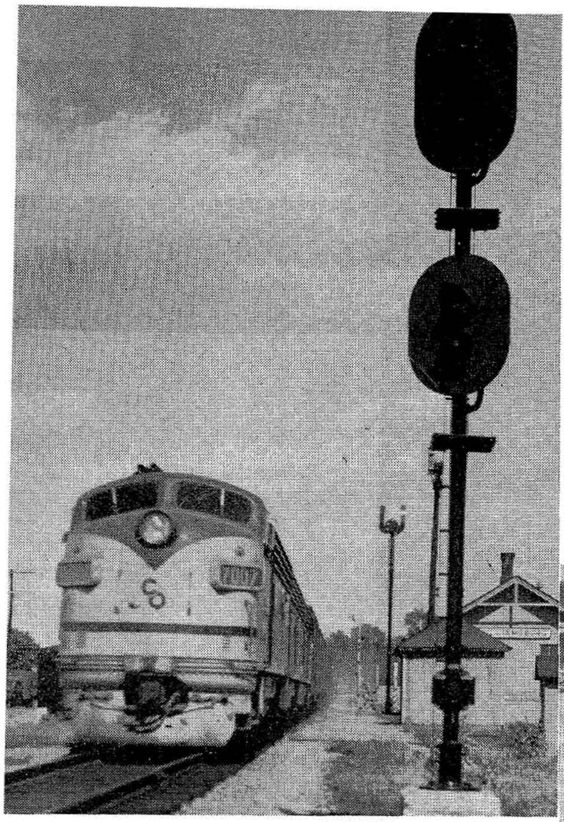
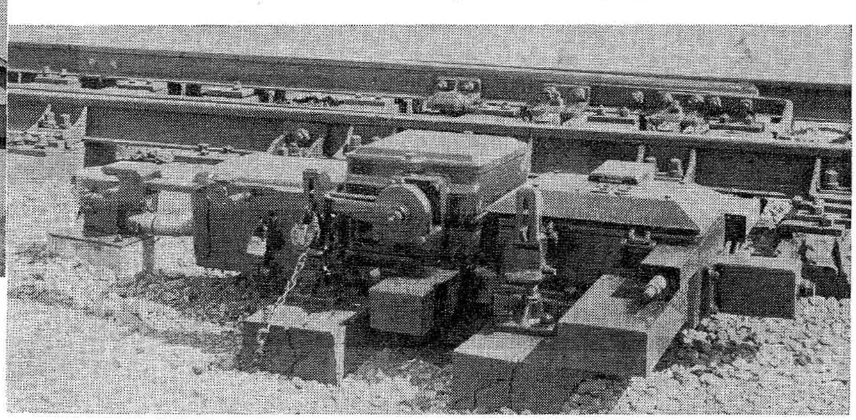


C. T. C. Replaces Manual Block On Single Track



As compared with previous manual block operation, the new signal system improves safety, saves train time, increases track capacity and reduces operating expenses

MODERN CENTRALIZED traffic control, to authorize train movements by signal indications, has been installed to replace manual block operation on 155 miles of busy single track line on the Chicago division of the Chesapeake and Ohio between Cheviot, Ohio (Cincinnati), and Peru, Ind. The benefits derived from the new CTC are improved safety, saved train time, increased track capacity and reduced operating expenses.

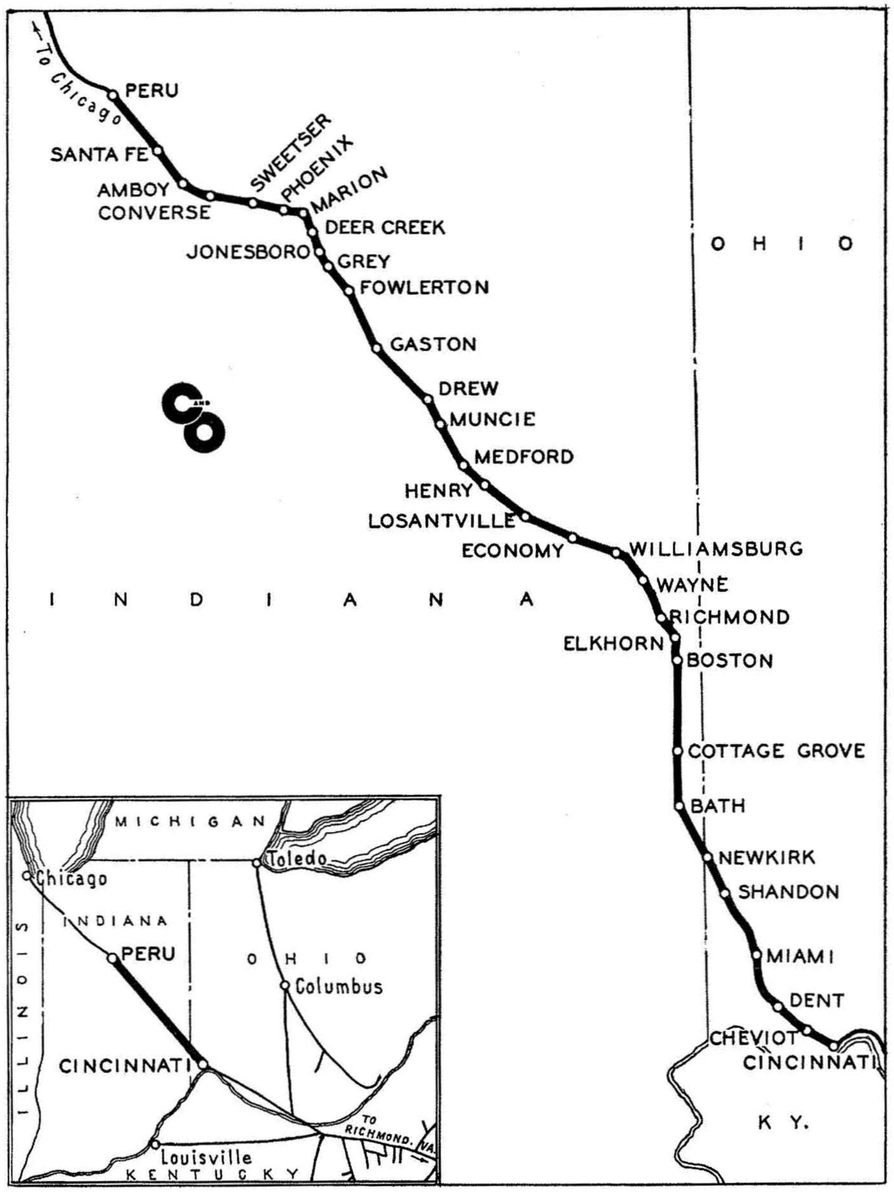
This line between Cincinnati and Chicago was built originally as the Cincinnati, Muncie, and Richmond Railroad, later changed to the Chicago, Cincinnati and Louisville Railroad, which was acquired years later by the Chesapeake and Ohio as a connection into Chicago, being known now as the Chicago division of the C&O. No passenger trains are operated on this division, the traffic including 10 scheduled freight trains and several extra trains, as well as a local freight westward one day and eastward the next, except on Sunday. Thus, the total ranges from 11 to 15 or more trains daily in the summer. More trains, consisting primarily of loaded coal cars northbound, are handled in the months from November to April, during the season when the Great Lakes are closed. Thus, in the winter, the traffic may increase to a total of 30 to 35 trains daily.

Although there is one section of tangent track about 8.5 mi. long west of Amboy, the major portion of the Cheviot-Peru territory is through rolling hilly country, with numerous curves, many of which range up to 5 or 6 deg., with a few 7 deg. and one 7 deg. 30 min. None of the curves necessitates reductions below the maximum permissible speed of 50 m.p.h.

The ruling grade eastbound is about 6 mi. of 1.09 per cent through Dent. The ruling grade westbound is 6.5 mi. of 0.96 per cent, just east of Newkirk. On the remainder of the territory, the grades are rolling, and, for the most part, are short, and less than 1 per cent. The through freight trains are operated by diesel-electric locomotives. The tonnage rating is 4,800 tons westbound and 4,500 tons eastward, between Cheviot and Peru.

Manual Block Delayed Trains

Previously, no automatic block signaling was in service on this division. Train movements were authorized by absolute manual block. The block stations were located 6 to 10 mi. apart, but only certain ones were open continuously. Block stations were in service 24 hours daily at Peru, at YD Cabin (Cincinnati) and at 13 intermediate locations. Eight other offices were open eight hours during the day except Saturday and Sunday. No more offices could be opened because competent operators, who would work in outlying locations, were not available. In fact, some of the offices scheduled to be open continuously were closed some of the time when operators could not be secured. When an intermediate office was closed, the absolute block was from open office to open office, with no provision for following moves. "Blind" siding moves were not permitted. This method of operation resulted in numerous delays, especially when there was a shortage of operators. Therefore, as a means of improving safety and saving train time, a decision was made to install some form of track circuit controlled signaling. Centralized traffic control was chosen with power switches at the passing sidings. These power switches, as well as signals at these sidings, are controlled by the dispatcher at Peru. By signal indication, he directs and authorizes train movements, thus dispensing with manual block, as well as train orders. If conventional automatic block had been chosen, some system of authorizing train movements, such as train orders, would have been required. About 60 mi., between Cheviot and Richmond, has been in service for about seven months. The first 100-mi. stretch was completed to Muncie in September, 1952, and completion of the entire project is contemplated early in 1953. According to division operating officers, the CTC is accomplishing all the benefits anticipated in saving train time, especially during the winter season, when coal traffic increases.



Fewer and Longer Sidings

As part of the overall program of improvements, 15 sidings were lengthened to capacities ranging from 80 to 143 cars. These 15 sidings, together with 7 other long sidings, or a total of 22, were equipped with power switches, and CTC controlled signals. Seven previous sidings, at Fernald, Peoria, Kitchell, Muncie, Janney, Deer Creek, and Converse were abandoned as passing sidings, being converted to storage tracks, the main track switches being equipped with electric locks. Thus, the number of sidings for use in passing trains was reduced from 29 to 22.

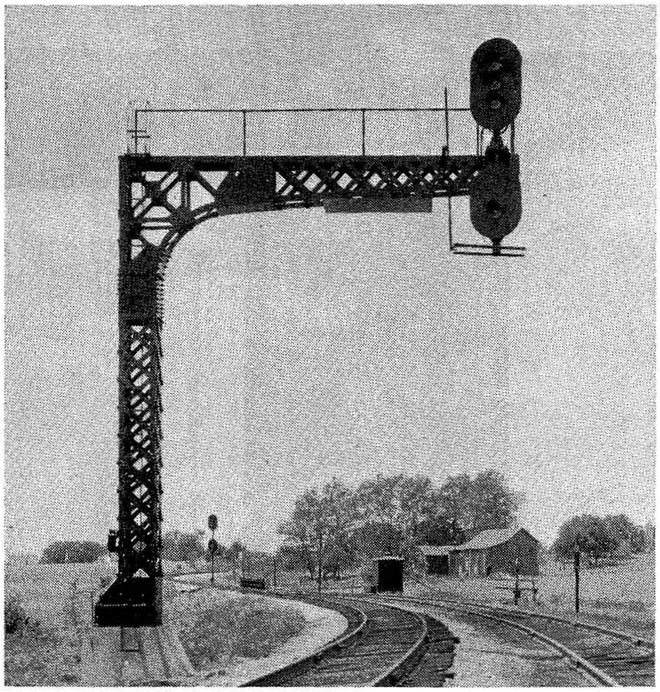
Complete Information on Control Machine

The machine which controls the CTC on the 155 mi. between Cheviot (Cincinnati) and Peru, is located in the dispatcher's office in an office building in the business section of Peru, four city blocks from the railroad. This machine is made up of several panel sections, arranged in a "U" shape, totaling 22½ ft. in length.

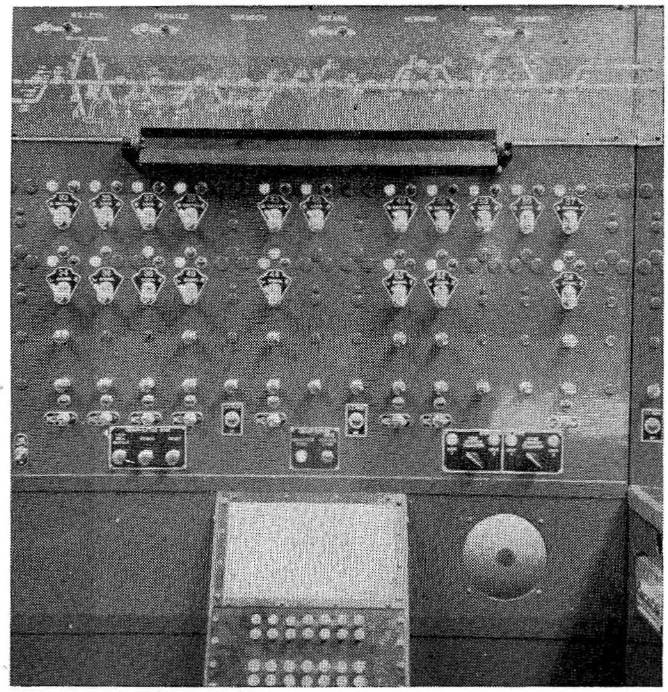
The track diagram is equipped with normally dark, white track occupancy lights for both main track and passing sidings. Where there is more than one automatic block section betwen passing sidings, a track occupancy light is provided for the "clearing out" or first automatic block section leaving each siding to indicate when the leaving signal at the end of the passing siding may be cleared for a following movement. Where necessary, a third track occupancy light is provided to indicate track conditions between these two "clearing out" sections. Track occupancy lights on the passing sidings are considered essential to provide indication on the machine when the siding is occupied so as to improve the operation of these train movements.

Normally dark traffic direction lights are also provided on the track diagram for each section between meeting or holding points, using a green light in an arrow for eastward movements (superior timetable direction) and an amber light in an arrow for westward movements. These lamps are lighted when a route is established by clearing the entering signal and are held lighted as long as the section is occupied. Such an arrangement prevents "losing" a train within the limits of the controlled section and permits more efficient operation of the control machine both in closing up following moves and making closer meets.

Normally burning indication lights are provided above each switch and signal lever to indicate the position of the controlled function in the field. A white light above the normal (left) position of a switch lever indicates the switch is in normal position and properly locked up, while a red light above the reverse (right) position of a switch lever indicates the switch is in reverse position and properly locked. Where signals are not provided to govern movements through electrically locked switches in the reverse position, the red indication lamp is omitted. A red light above the normal (center) position of a signal lever indicates that the controlled signals are in stop position, while an amber light above the left or right position of a single lever indicates that the corresponding signal displays an indication less restrictive than Stop. All lights out on a signal lever indicate that time locking is in operation. Additional lights are provided on the machine for each control point to indicate "AC power off," "Maintainer Call Signal On," and at beginning and end of carrier sections, to indicate whether the section is operating on the "normal" or "stand-by" unit.



Cantilever locates main-line signal properly



Dispatcher's machine includes traffic-direction arrows and lamps

At locations such as Cottage Grove, where switching conditions make it necessary, special "call-on" controls are provided either to permit a train to make a following movement into an occupied block or to make a back-up movement against part of the train left on the main track. Where such moves are provided, in addition to properly positioning the signal lever, the "call-on" button located below the signal lever must be held depressed while the control code is being transmitted. Under these conditions, the signal involved displays a "Restricting" aspect.

The electric locks on hand-throw switches are lever controlled in the switching blocks at Richmond, and at other places such as Kitchell where provisions have been made for trains to clear main track. Where such provisions are not necessary, outlying electric locks are not lever controlled but rather have local automatic controls, in conformity with Signal Section, A.A.R., requisites, Part 211.

The CTC machine includes an automatic train graph, which records the movement of all trains. The pens are of the three-position type, so that when the detector track circuit at a power switch is occupied with the switch normal, the pen moves to the left; if the switch is in the reverse position, the pen moves to the right. Thus, the graph indicates whether the train holds the main track or takes siding.

Carrier for CTC Code Line

The distance from the control office at Peru to the remote end of the CTC at Cheviot is 153 mi. The CTC code line circuit is on two No. 8 weatherproof Copperweld line wires. Conventional d.c. codes are used on the first 39.2 miles east from Peru to Fowlerton. Carrier sections are 40.4 miles between Fowlerton and Economy, 35.0 miles between Economy and Cottage Grove, and 38.4 miles between Cottage Grove and Cheviot.

Outgoing control codes are at 29.7 kc, 25 kc and 21 kc for the respective sections, and the incoming indication codes are at 16.5 kc, 12.8 kc, and 11 kc. Duplicate carrier equipment is in use in the dispatcher's office at Peru and at the various field locations so that if one set fails the other can be cut into service, with an automatic cutover provided at the receiving end in case of a line break.

Colorlight Signals

The signals on this project are the colorlight type, using 10-volt primary-secondary filament lamps rated at 18 plus 3.5 watts. Where the approach to a signal is on a curve requiring a spreadlite lens, 10-volt primary-secondary filament lamps rated at 30 plus 6 watts are used. The dispatcher-controlled signals are continuously lighted, and all other signals are approach lighted. At all signals with two colorlight heads mounted on the same mast, a light-out relay is connected in series with the filament of the lamps in the top "arm," the control circuits for the lamp in the lower "arm" being cut over contacts of the light-out relay when energized. Thus, if both lamp filaments in one of the lamps in the top "arm" burns out, the light-out relay will be de-energized, thereby preventing the display of an aspect more favorable than intended.

At the passing sidings, the arrangement of signals is conventional as illustrated in Fig. 2, showing the

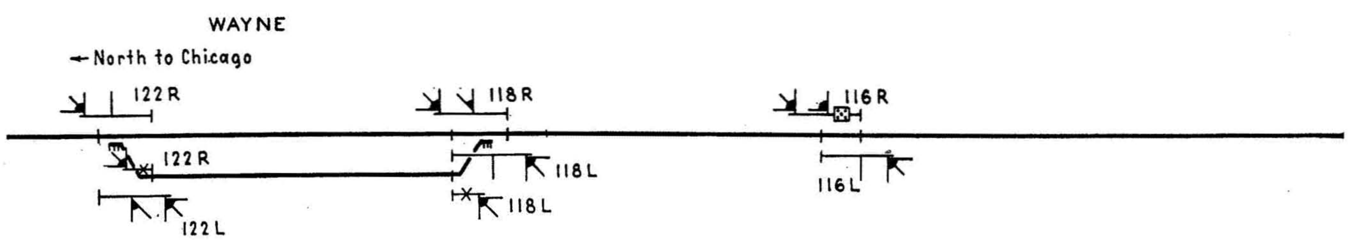
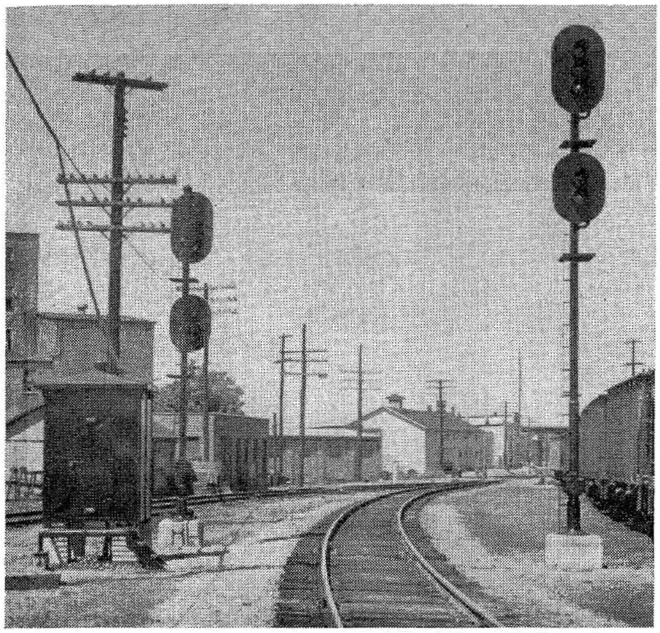
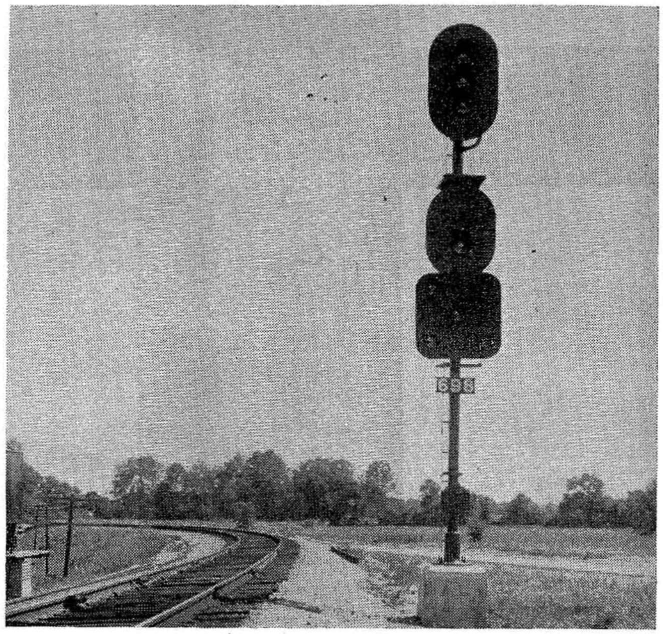


Fig. 2—Track and signal plan of territory between Wayne and Elkhorn



Switching signals 106R and 104L at Richmond



Special approach aspect to enter siding

layout at Wayne. All signals are located to the immediate right of the track governed. At Wayne, the east end of the siding was thrown over to 19-ft. centers with the main track to allow clearance for eastward main track signal 118LA. At locations where it was not practicable to throw the siding over, cantilever masts were installed, such as shown in the picture made at the west end of Elkhorn, to place the signals to the right of the track governed.

Leave-siding dwarf signals display three aspects the same as high signals. The leave-siding dwarfs, which are on the field side, such as signal 118L, are mounted on top of a 4-in. pipe mast 5 ft. high, so as to place it in better view of the engineman, especially when there is deep snow on the ground. Such a signal is shown in one of the pictures.

Special Aspect Used on Approach

The signals display standard Signal Section A.A.R. aspects and, in addition, the Chesapeake and Ohio has a special aspect used on "approach" signals as advance information that an approaching train is to take siding. One of the accompanying pictures shows intermediate signal 698, which is the eastward signal in approach to station-entering home signal 122L at the west end of Wayne passing siding. Signal 698 has a standard RYG colorlight signal unit at the top of the mast; below that is a single green lamp unit; and below that is a square background with five amber lamp units.

When the power switch at the west end of Wayne is reversed and entering signal 122L is cleared for a train to enter, signal 698 displays Approach aspect with all the five lamps in the special lower unit lighted. Thus, the display of this special take-siding aspect is definite information to the engineman that his train is to enter the siding.

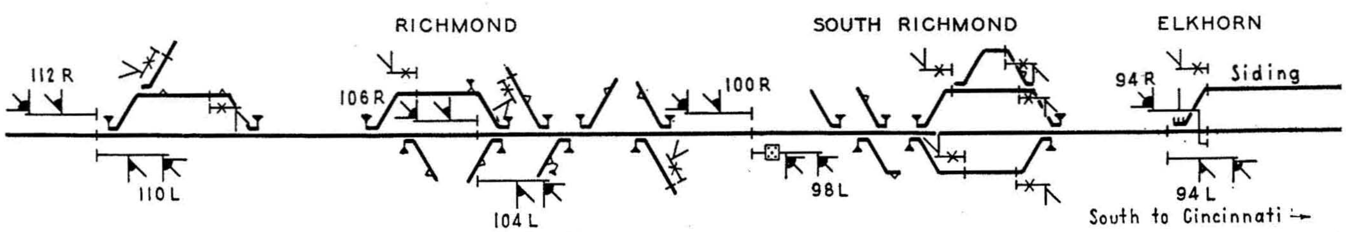
The top unit on signal 698 ordinarily displays three aspects; namely, Stop, Approach, and Clear. The second colorlight unit has only a green lamp, which is normally dark. This green lamp is lighted in combination with a yellow in the top unit to display an Approach-Medium aspect when the west switch at Wayne is normal, signal 118L is displaying Stop, and signal 122L is displaying Approach.

This Approach-Medium aspect is provided for on all approach signals on this CTC project, thereby indicating to enginemen that they are to hold the main track for a meet with an opposing train that is to take siding. The Chesapeake and Ohio considers that this practice has special merit from the standpoint of facilitating train movements approaching meeting points, as well as safety.

In some instances, the distance on the main track betwen signals at the ends of sidings is not long enough for braking distance which would have necessitated the use of Approach-Medium on signals such as 698. However, for reasons stated above, the Chesapeake and Ohio provides the Approach-Medium on all such signals, including layouts where there is sufficient braking distance on the main track between signals at the ends of a siding.

Special Switching Blocks at Richmond

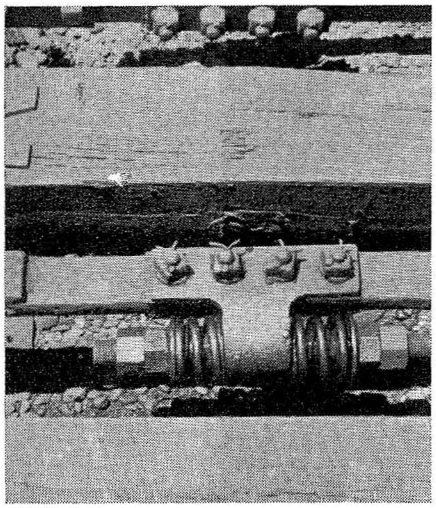
A total of 20 industry spurs with hand-throw main track switches with electric locks are located in the Richmond area in the 6 mi. between sidings at Wayne and Elkhorn. A switch engine and crew are kept busy all day setting out and picking up cars at these spurs. In order to permit this switch engine crew to work as much as possible without delaying through trains, the siding-to-siding block between Wayne and Elkhorn is cut into four switching blocks by three double locations of lever-con-



showing special aspect on signal 116R and the switching blocks in Richmond area

trolled absolute signals; 110L and 112R is one pair, 104L and 106R is the second pair, and 98L and 100R is the third pair.

For example, the conductor of the switching crew advises by telephone that he has about an hour's switching to be done in the switching block between 104L and 100R, known as the Richmond Block. He is given definite time limits within which he may occupy this block and, by use of a special push-turn controller, in addition to the signal lever, a restricting aspect is displayed to admit his engine to the block. The signals automatically restore to Stop when switch engine enters the block. After the block is occupied, the switch lever may be operated to release the electric locks on the switches. All nine of the electric locks in this center area are controlled by lever 101. Neither of the signals to enter this



Springs on operating rod

switching block, 104L and 100R, can be cleared again until the switch engine and cars clear the main track and turnouts to clearance point, and all switches and derails are normal and locked. Throughout the period while this special control is in effect, a green indication lamp is flashing above the pushturn lever on the dispatcher's control panel.

In the meantime, eastward signal 118L at Wayne, for example, can be cleared to keep an eastward through freight moving on down toward signal 104L. Then, when the switch engine and cars are all in the clear and switches locked, the conductor of the crew reports in the clear and eastward signal 104L can be cleared to keep the through train moving.

The levers for control of the special signals, such as 104L, are the push-to-turn type, thus requiring special attention by the dispatcher so that he will be reminded that he is setting up a special condition that will require further attention and cooperation by the switching crew to avoid delay to a through train. The track occupancy lights on the track diagram indicate where the switch engine is working, and if that crew does not clear the main track within authorized time limits, a control code can be sent out to blow a loud sounding electric horn. This warns the crew to get in the clear, and for the conductor to call on the phone.

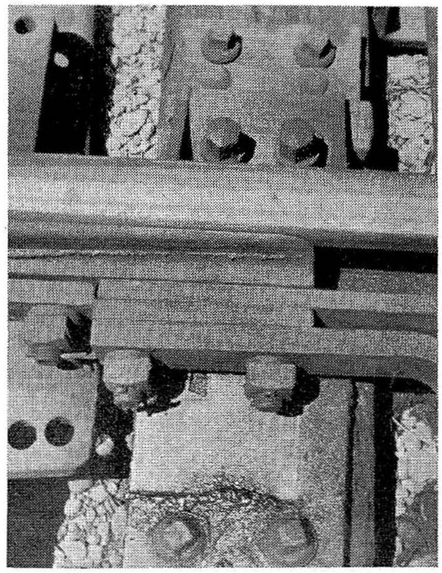
Power Switch Layouts

The power switches are operated by a most modern type of dual-control low voltage d.c. electric switch machine rates at 20 volts. With 20 volts at the motor, such a machine operates a switch in about 16 sec. with a current ranging from 4.5 amp. to 6 amp. When installing these switch machines, the ties are notched out about 2 in., which is just enough to get the top of the machine outside of the standard clearance diagram. Each switch is equipped with a pair of roller bearings for improving its operation. A frost cover, a special Chesapeake and Ohio feature, is applied on top of the controller compartment of the machine, as shown in one of the pictures. This cover, made of sheet metal 1/16 in. thick, is attached by special studs which space the cover 1 in. from the top of the conventional cast-iron cover. The extra cover shades the regular cover, and the open space betwen allows circulation of air, with the result frost does not form on the contacts in the controller.

Another special feature of power switches on the Chesapeake and Ohio is the use of coil springs on the operating rod; one pair at either side of the switch adjustment bracket. The purpose of the springs, one pair for normal and one pair for reverse, is to provide a cushion so that the mechanism can complete its full-stroke operation without producing excessive strain on the switch point or connecting rods under slightly varying conditions of adjustment.

The spring on each side of the adjustment bracket really consists of two coils, one inside the other. The outside diameter of the inside coil is 2-5/16 in. and the inside diameter of the outside coil is 2-3/8 in. The cross section of the inside spring is 5/16 in. in diameter, and the cross section of the outside spring is 7/16 in. in diameter. The nuts are adjusted to hold the springs within approximately 1/4 in. of being fully compressed, so that if one of the springs should break, less than 1/4 in. slack would occur. None of the springs purchased under the present specification have broken, and many have been in service for several years.

A new Chesapeake and Ohio practice, as shown in one of the pictures, is to place a 3/4 in. plate between the foot of the head rod and the point lug for the switch circuit controller connecting rod. This extra spacer plate is for the purpose of allowing for 3/4 in. bend, if a switch is trailed through while locked up, thus bend-



Spacer between rod and point lug

ing the head rod, before starting to bend the point lug so that the point detection and latch-out feature will remain effective to detect this condition. Where, in accordance with conventional practice, no space is provided between the front rod and point lug such protection can be defeated.

Electric Locks on Hand-Throw Switches

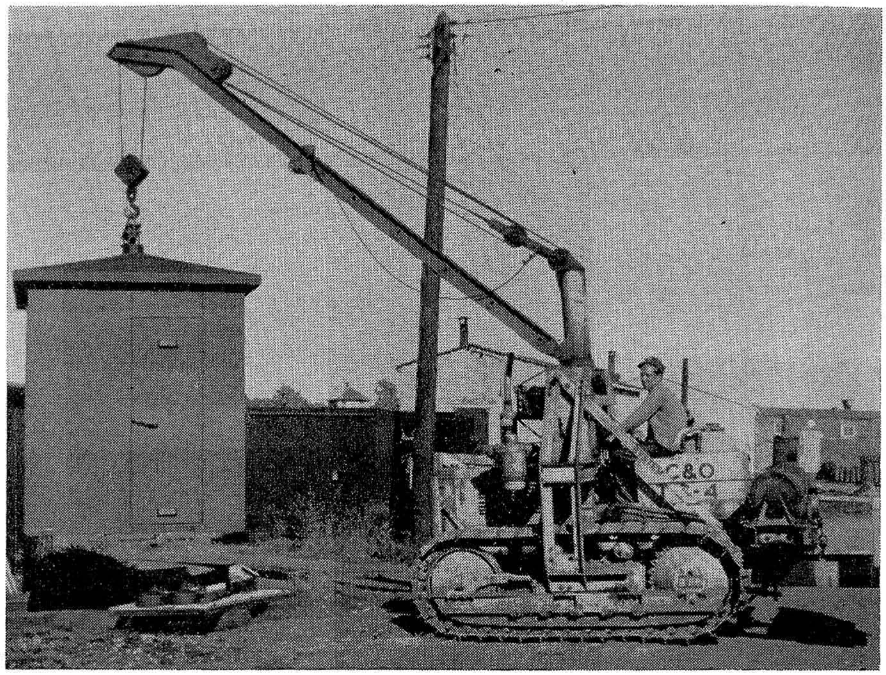
At each of the main track switches leading to industry spurs and house tracks, the old switch stand was replaced by a hand-operated switch-and-lock movement, which has an electric lock to lock the operating lever in the normal position. A block-type derail is located at the clearance point on the turnout. Where practicable this derail is pipe-connected to and operated by the switch-and-lock movement at the switch mentioned above. At other locations the derail is operated by a separate switch stand which has an electric lock to lock the lever in the normal position.

On tracks where it is necessary for trains to clear the main track there is a dwarf signal at clearance point to control the movements to the main track. Such a signal normally displays the red aspect for Stop. When, with proper authority, the switch is reversed and derail thrown, the signal displays an aspect which indicates the block condition to permit re-entry to the main track.

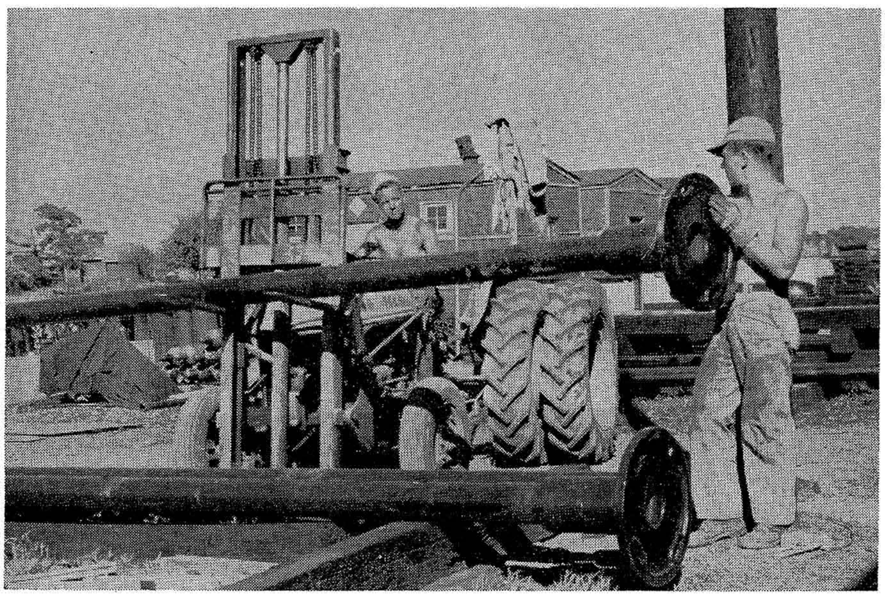
Construction Well Organized

This centralized traffic control installation was made by railroad forces using four field crews and one headquarters crew. On the average, each crew included about 12 men, a foreman and a cook. Outfit cars, including kitchen, dining and sleeping cars with shower baths were furnished for each crew. The railroad paid the cook's wages. The cook bought the food and men paid for it, in proportion to the number of meals they ate at the car each month.

The headquarters crew was stationed at Losantville. Part of a passenger station and two sheet-metal buildings, 20 ft. by 40 ft., were made available for work space and for the storage of relays and other apparatus. Existing house tracks were available for unloading and loading material cars. All signal materials were shipped to Losantville, where they were processed and assembled.



Crawler crane picks up house



Fork-lift truck handles masts

Houses Wired at Headquarters

A part of the preliminary work consisted of preparation of diagrams of the terminals, wiring and equipment to go into each case or house. Tags were then made on stencil machines for complete wiring of a relay housing. These tags are black, and the stenciled letters are filled with white ink and then sprayed with a coat of plastic.

For each house, there is a terminal board on the real wall. This board, made of plywood, is ¾ in. thick and 36 in. wide by 81 in. high. It is laid on a table, where it is drilled, and all arresters, terminals, test switches, resistance units, rectifiers, transformers and tags are applied. Each identification tag is placed with its hole over the ⅝ in. wire hole through the board and held in place flat against the board by a No. 18 wire brad. These brads are driven by a hand-operated brad driver, which drives the brad with one push of the handle. The board, when completed as explained above, is then installed in an empty sheet-metal house. A signalman and a helper install the wiring, complete with relays and batteries, in place on the shelves. The wire in all cases and houses is No. 16 or No. 14 insulated, and compression type terminals are used.

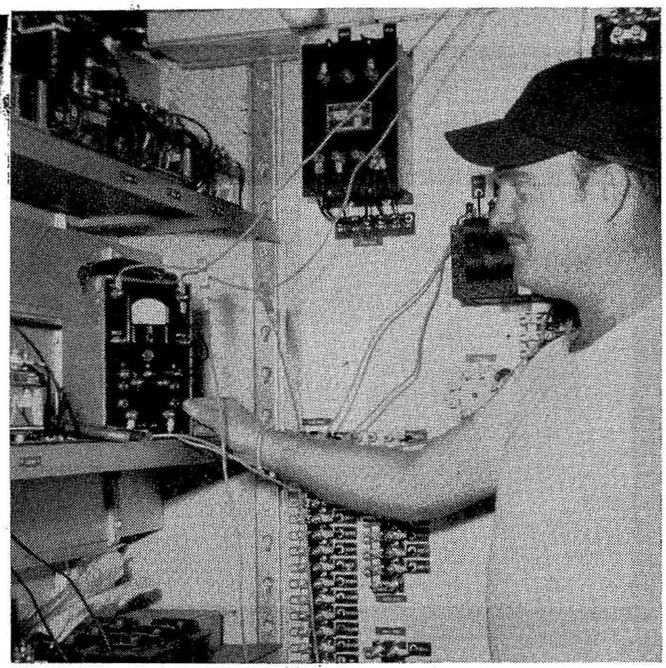
When completed, the circuits and equipment are given a detailed operating check, this being done by means of a special test set which, in effect, duplicates the operation of a typical track layout in the field from a typical section of the control machine. When all the wiring and tests are complete, corrugated paper is used as packing, and the relays are bound down by metal straps. Batteries are held in place by special wood crates and blocks. When the houses for several ends of sidings are thus completed, a crawler mounted power crane, as shown in the pictures, is used to pick up the houses and set them on flat cars. Then the crawler is run up an incline and onto one of the flat cars. These cars are placed in the local freight train which is stopped long enough at each location for the crawler crane to be used to set the houses.

In addition to the crawler mounted crane, the crew at Losantville has a tractor-mounted power fork lift truck which is used to pick up boxes, signal masts and various other heavy items to unload, store, or load them back on cars being sent to field crews. Materials other than the instrument houses are loaded into so-called "tramp" cars at Losantville and are billed to the headquarters of the other four crews.

Field Crews

Each of the four crews had men and equipment to perform all types of signaling construction in the field.

Terminal board work done in shop



Wiring is tested in houses

In rotation each crew was assigned a section of 25 to 30 mi., including perhaps three power sidings, and performed all the construction from beginning to completion. They set the foundations, erected the signals, buried the cables, and placed the switch machines, hand-throw switch mechanisms, and electric locks, made up line drop cables, connected all incoming cables at houses, signals, switches, etc., and tested circuits and equipment.

Each of these crews, of about 12 men each, lived in cars as discussed above. Materials other than houses, were shipped in cars from Losantville to the temporary crew headquarters, and the crews hauled the materials out to the field locations. Most of this hauling was done in 1-½ ton highway trucks. In some instances, where the track was not accessible from a highway, track motor cars were used from the nearest road crossing to the signal or switch location. Jeeps and automobiles were used by the men in going from one location to another or to and from the cars.

Concrete Foundations

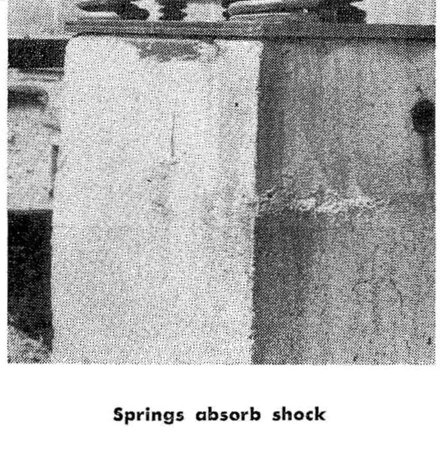
Some of the foundations are the one-piece pedestal type precast concrete. The remainder are the sectional type precast concrete. For a signal foundation a bottom slab 6 in. thick and 32 in. square is used as a foundation in the bottom of the hole. Four rods, 1 in. in diameter, extend up through the bottom slab, these bolts being cut to length to extend up through the top slab. The walls of the foundation are built up using conventional 8 in. by 8 in. by 16 in. concrete building blocks. For a one-arm signal, six tiers of blocks are used, or for a two-arm signal, 9 tiers. More tiers are used where ground is soft or on a fill. The top slab is 6 in. thick. The long bolts, which come up through from the bottom slab, extend through the top slab and serve as anchor bolts for the cast-iron base casting. For relay case and instrument house foundations, the slabs are 6 in. thick by 16 or 24 in. square, and the bolts are ¾ in.

Springs Under Houses

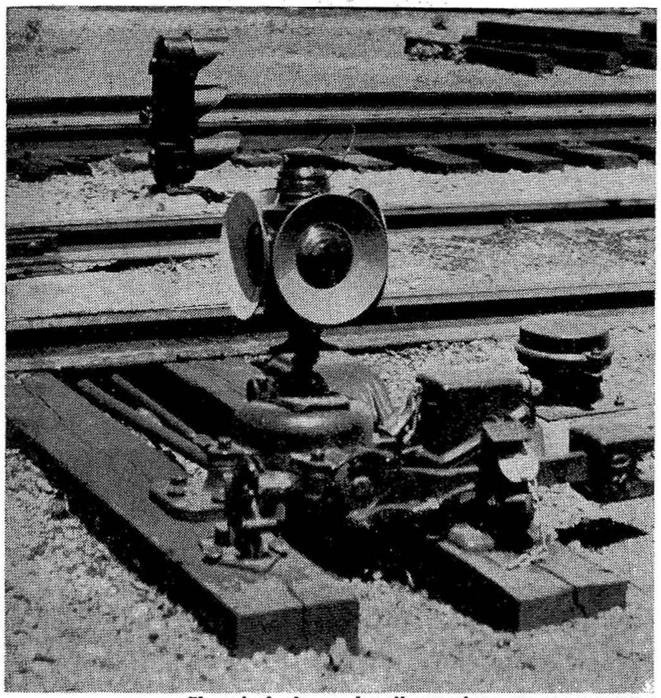
At the field stations such as at power switch layouts, the relays, coding equipment and batteries are in sheet metal houses on concrete piers. At some locations, the ground conditions are such that passing trains cause excessive vibrations in these houses. Therefore, the Chesapeake and Ohio signal forces designed and made special coil springs which were mounted on ½ in. base plates and placed between the piers and the houses as shown in one of the pictures. These spring supports have successfully eliminated serious vibration at such locations.

At intermediate signals, the relays, rectifiers and storage batteries are in sheet metal cases. The wires and cables enter a wiring space at the rear which is made accessible by removing sheet-metal panels, held in place by stud bolts. The case is supported at each end by a section of 4-in. pipe mast in a cast-iron base on a concrete foundation. A platform of metal grating is provided both front and rear, so that a man can easily reach all the wiring and equipment.

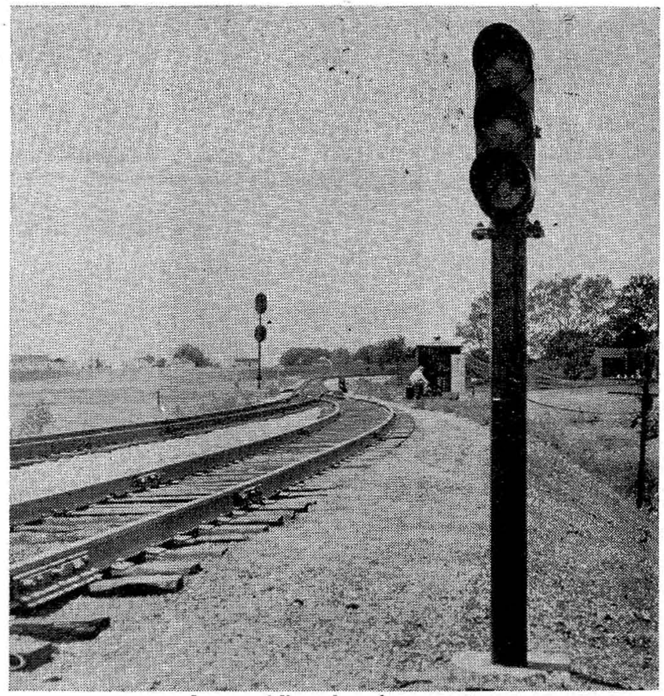
At each power switch, a set of 13 cells of 110-a.h. lead storage battery operates the switch motor. Eight of these cells also feed the line code equipment. Five lead cells of 240-a.h. capacity feed the signal line circuits, and are standby power for the signal lamps if the a.c. fails. At each intermediate signal a set of five cells of 150-a.h. lead battery feeds the line circuits and acts as a standby for lamps. Each d.c. section of the code line is fed by special code line power packs which are installed in duplicate with provision for a manual cut-over in case of failure of



Springs absorb shock



Electric lock on derail stand



Leave-siding dwarf on mast

one of the units, and a set of 8 cells of 450 a.h. battery feeds the local office circuits. Each track circuit is fed by one cell of 75 a.h. nickel-iron storage battery.

Pole Line Modernized

Preliminary to the CTC construction, the pole line in this 155 mi. was reconstructed using new creosote pine poles. Except at crossings, these are 25-ft. poles, about 6 in. in diameter at the top. A new 10-pin crossarm was added for the signal line wires.

The CTC code line circuit is carried on two No. 8 Copperweld line wires and is sectionalized at one end of each passing siding for testing purposes. Two No. 6 hard drawn copper line wires are used throughout for a 440-volt power distribution system with a local power supply at approximately 10-mi. intervals. Each supply point normally feeds about five mi. in each direction, but distribution lines are sectionalized so that in event of a power interruption on one section it can be fed from the power supply on the adjacent sections. Open line wire circuits are all two-wire circuits except for a few non-vital circuits with No. 10 Copperweld line wire being used throughout. All open line wires have double braid weatherproof covering.

Where the number of circuits required is more than the capacity of a single crossarm, asbestos braid covered aerial cable is used for all circuits except the power distribution and the code line circuit. Aerial cables are supported by a ⅜-in. stranded Copperweld messenger to which they are attached by stainless steel spinning wire. The No. 14 spinning wire is wrapped around the cable and messenger by a special spinning machine designed for this purpose. The advantages of this practice are: (1) No need for men to "ride" the messenger to apply cable hangers and (2) less abrasion or cable cutting with rings.

Pole type step-down transformers, rated at 460/115 volts, are used at each location to provide 110 volts in the relay housing. The capacity of these transformers is dependent on the load to be handled with 500-v.a. transformers used at ends of passing sidings and 75, 150 or 250 v.a. transformers used at intermediate locations. Rectifiers for battery charging are operated from 110-volt supply in relay housings while lamp circuits are fed from a suitable capacity 115/14 volt case type transformer located in relay housing.

New Type Bond

The rails bonds used on this CTC project are ¼-in. stranded phosphor bronze applied behind the angle bar and bonded into the web of the rail. These bonds are equipped with a plug terminal designed so that it can be pushed through behind the angle bar without difficulty, and are provided in lengths 7 in. longer than the angle bar for which they were designed.

Ditch Digger

Wherever practicable to do so, a power-operated trench digging machine was used to dig trenches for the buried cables. This machine is of the bucket-belt type, and digs a ditch 6-in. wide and as much as 48-in. deep. It is mounted on and operated by a crawler type roadway machine. Only one of these machines was available, so cable installation was scheduled so that it could be transferred from one crew to another.

The buried cables from a house to a switch include a nine-conductor No. 9 for motor controls, and a five-conductor No. 14 for switch-position circuits. If the distance is more than 200 ft., No. 6 is used instead of No. 9 for motor controls. This cable terminates in a junction box about 15 in. from the switch machine, and single-conductor No. 14 flexible insulated wires go through flexible metal conduit to the machine. The track connections are in a four-conductor No. 9 cable from the house to a junction box near the track, or No. 6 if the distance is more than 150 ft. From this box single-conductor No. 9 runs to a terminal on a riser post which consists of 2-in. angle iron 18-in. long, set vertically. From the terminal on this riser, ¼ in. stranded conductor, with neoprene covering runs to a ⅝-in. plug in the rail.

The buried cable from a house to a signal is either a six-conductor or eight-conductor No. 6. This cable terminates in a cast-iron case at the base of the mast, and flexible single-conductors run up inside the mast and out to the signal.

This CTC project was planned and constructed by signal forces on the Chesapeake and Ohio.