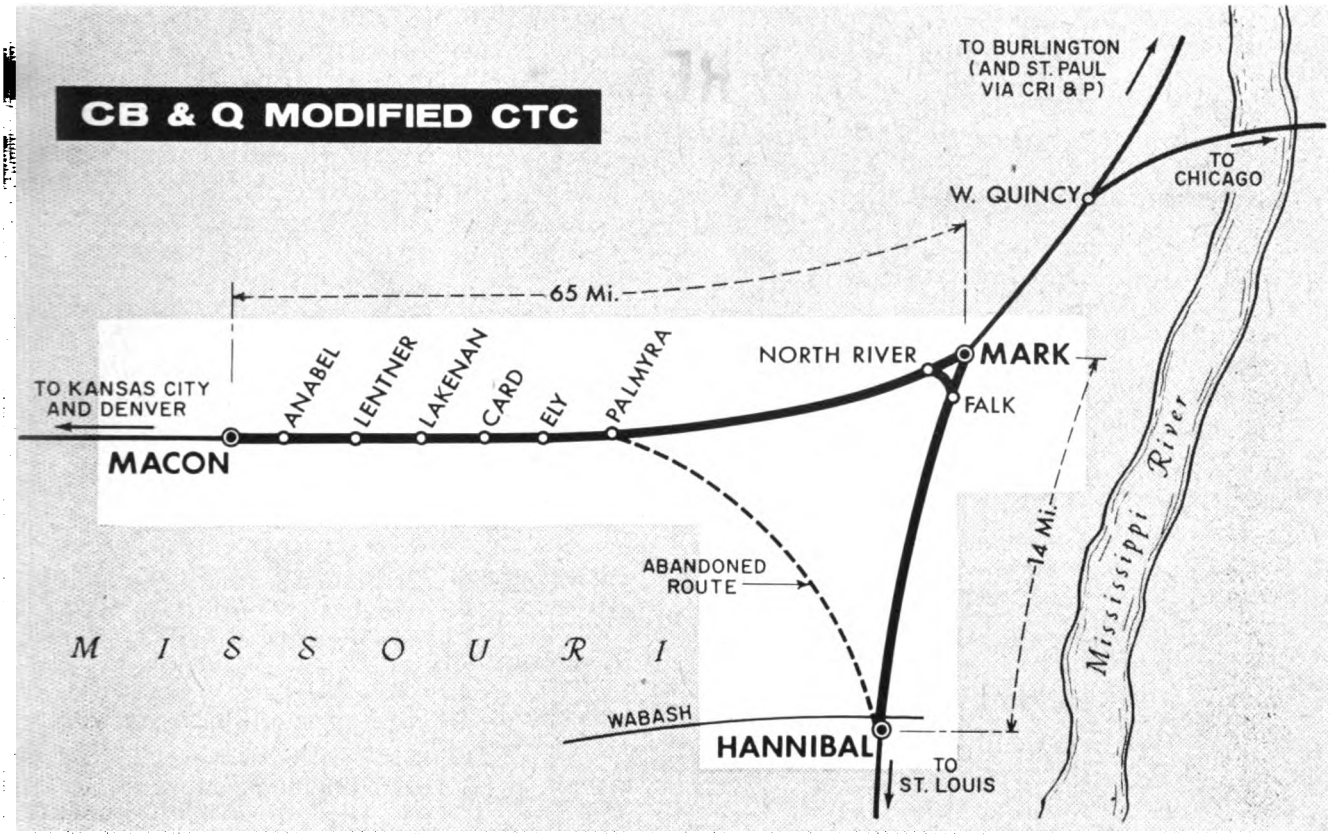


Burlington Installs Modified CTC

Power switch at one end of each siding and spring switch at the other end, is main feature of practice that cuts total cost to fit requirement for operation of 10 to 12 trains daily on "hot-shot" route.

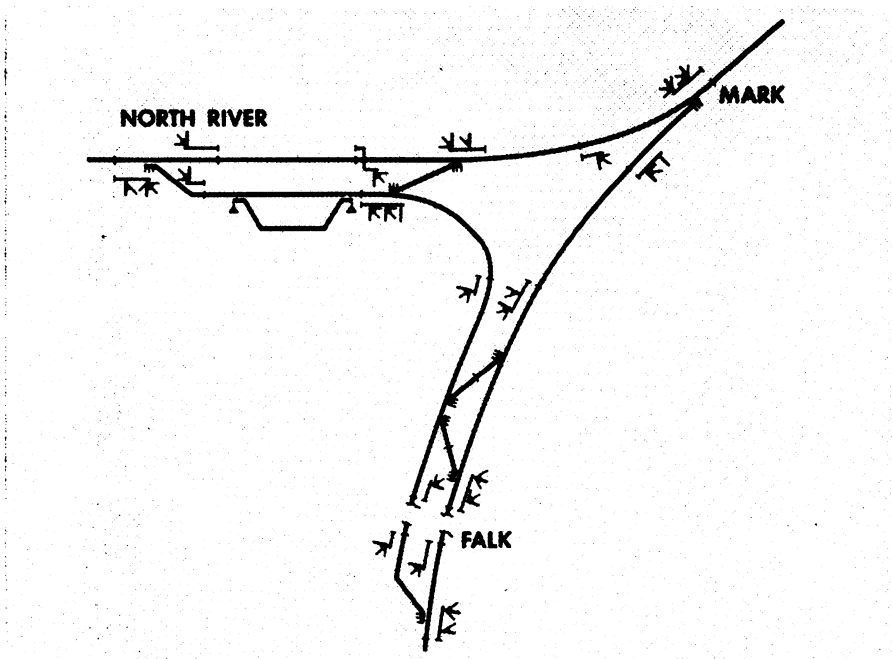
A MODIFIED FORM of centralized traffic control, designed to reduce first costs in proportion to requirements of comparatively light traffic, has been developed and installed extensively on the Burlington. The most recent project is 79 miles of single track between Hannibal and Macon, Mo., via Mark.

As shown on the map, Mark is a junction 2.8 miles west of West Quincy on the east-west route between Chicago and Kansas City, via Quincy, Mark, Macon and Brookfield. Also, the Burlington has a north-south line on the west side of the Mississippi river from St. Louis north through Hannibal, Mark and West Quincy, and on north to Burlington, Iowa, where connections are made with the Rock Island for St. Louis-St. Paul and Minneapolis through trains.

Previously the Burlington had a 29-mile cut-off from Hannibal to Palmyra for use by trains on the route between St. Louis and Kansas City, via Hannibal. Future maintenance of this cut-off was not justified by the volume of traffic. In order to abandon this cut-off, several track changes were made and CTC was installed.

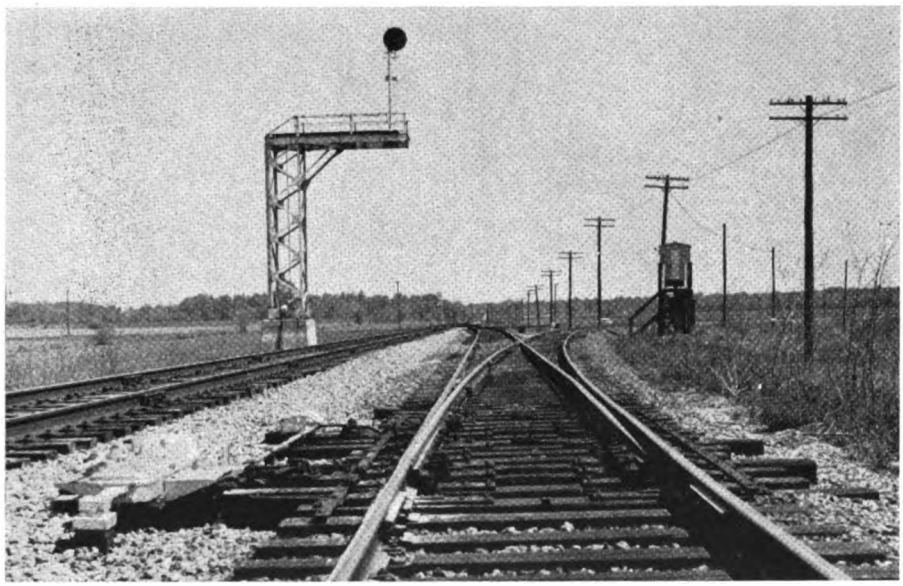
As shown in the plan, a new wye connection was built from Falk to North River for use by trains on the route between St. Louis and Kansas City. The new layout at Falk includes an 8,060-ft siding with switches and crossovers, so that this siding can be used by trains on either route, i.e., Hannibal-Kansas City or Hannibal-West Quincy. The new 9,000-ft siding at North River can be used by trains of the Hannibal-Kansas City route or the West Quincy-Kansas City route.

Mark and Hannibal, as shown in the plan, are included in the new CTC. As part of the project the previous automatic block signaling from



Lower quadrant symbol is flashing yellow, "approach medium." R/FY indicates "proceed over turnout not exceeding prescribed speed and approach next signal not exceeding medium speed."

Aspect to enter siding over hand throw switch is red over two lunar lights at 45 deg.

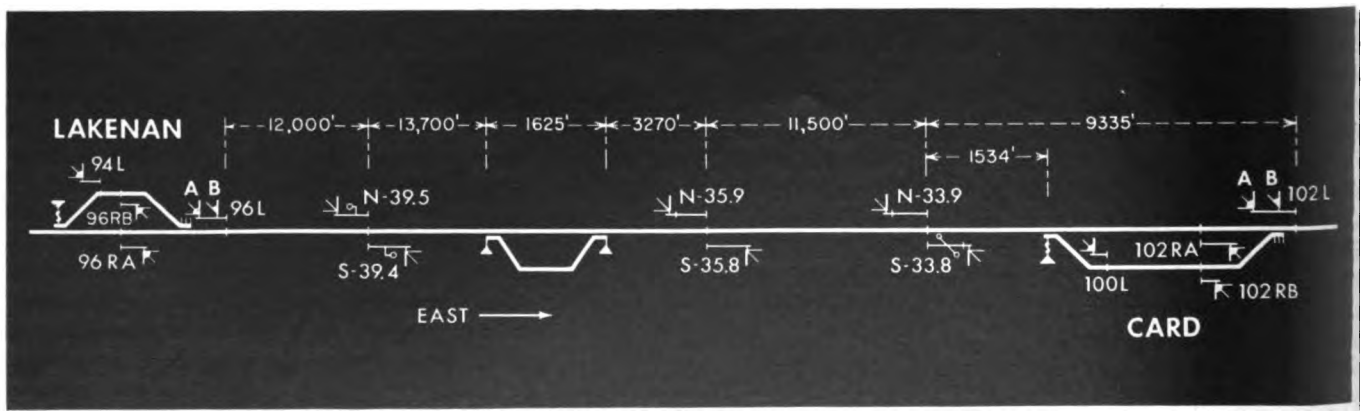


Looking easterly at Mark. Turnout is set for movement from North River to Falk.

Mark through Palmyra to Macon, 65 miles, and Hannibal to Mark, 14 miles, was replaced by modified CTC.

Automatic block gives protection, but necessitates continued use of timetable and train orders to authorize train movements. On the other hand, the Burlington has proved that the practice of authorizing train movements by signal indication, in centralized traffic control territories, is a means of saving train time, increasing track capacity, improving safety, and reducing operating expenses.

Thus, for the Hannibal-Macon territory, the objective was to adopt a form of CTC, modified according to the requirements for medium volume of traffic; and, by this modification to reduce the equipment required. The



Typical section of modified CTC. Purple markers (S39.4, N39.5) identify "grade" signals which allow passing of red aspect at restricted speed.

ost would be not much more than r complete system of conventional utomatic block.

As applying to similar circumances on other extended sections of ngle track, the Burlington, several ears ago, had arrived at the same onclusions, and, in 1950, had develped a form of modified CTC. A ajor project on 240 miles was inalled in 1951. This and other such stallations totaling 518 miles on urlington Lines are listed in the ble. On other parts of this railroad taling 963 miles, where heavier affic is operated, the Burlington has nventional CTC with power witches at both ends of sidings.

Compared with conventional CTC, hich includes a power switch and hree signals at each end of every iding, the modified system, as inalled on the Burlington, has a power witch at only one end of each siding; spring switch being used at the ther end. The layout at the power witch includes the usual arrangement f three signals. At the spring switch nd, there is a leave-siding signal and special take-siding aspect on an ntermediate signal.

One advantage of this modified arangement is that all the controls for n entire siding can be handled by ne field coding station. Considered s a whole, such an installation reduces the cost, at sidings, about 35 er cent compared with a power witch and complete signaling at both nds.

Normally Enter at Power End

All train movements are directed by signal indication. Ordinarily trains are directed to enter a siding at the power switch end in the customary manner. For example, referring to diagram, showing the siding at Card, Mo., for a westbound train the dispatcher sends out controls to reverse the power switch at the east end of the siding and clear signal 102L for the train to enter the siding. When this westbound train is to depart from the siding, the dispatcher clears the leave-siding dwarf signal 100L. This directs the train to pull out through the spring switch and depart, without the necessity for stopping to permit a member of the crew to operate the hand-throw stand. Thus most trains enter at the power end and depart at the spring switch end.

However, the signaling is arranged for a train to enter a siding at the spring switch end if the dispatcher decides that train time can thus be saved. This result is accomplished by adding an aspect to an intermediate signal.

Referring to drawing of the siding at Card, Mo., when the dispatcher decides that an eastbound train is to enter the spring switch end of the siding, he sends out a control code that causes eastward signal S-33.8 to display an aspect of "red over two lunar lights." These lunar lights are 3 ft apart, at an angle of 45 deg, mounted on the signal mast as shown in one of the pictures. Also, the next signal in approach, S-35.8 displays the approach aspect "yellow."

These aspects direct an eastbound train to pass signal S-33.8, and stop just short of the switch at the west end of Card siding. Then a member of the crew operates the lever of the hand-throw stand to reverse the switch so that the train can enter the siding. After train has entered siding he restores the switch normal, thus completing the move.

Power-end to Power-end Blocks

Insofar as opposing trains are concerned, the overall siding-to-siding block is from power switch to power switch, as, for example, from westward signal 102L at Card to westward signal 96L at Lakenan. Intermediate signals permit trains of the same direction to follow in the same overall siding-to-siding block. Signal S-33.8 is located so that the distance from this signal to signal 102L is approximately two miles.

Other factors being equal, the power switch is at the east end of one siding and at the west end of the next one. Where grades are involved the decision is on the basis that loaded trains in the direction of preponderance of traffic are to hold the main track, and lose very little time in making meets. Representatives of the operating, engineering and signal departments study conditions in the field and cooperate in determining the end at which the power switch and spring switch are to be located at each siding, to fit in with grades and operation of trains.

What is Medium Traffic?

As applying to single-track lines, the Burlington uses the terms *light-traffic, medium-traffic or heavy-traffic* on the basis of several factors: (1) average number of train movements; (2) train interference based on number of meets and passes within a given peak period of each day; and (3) tightness of schedules as part of overall run between major cities.

The scheduled daily traffic on the 65 miles between Mark and Macon includes four passenger trains and eight freights. This Mark-Macon line is part of a 466-mile route of the Burlington between Chicago and Kansas City. Fast passenger trains make this run in eight hours, including nine stops. Some scheduled freights make this run in 12 hours. These hot schedules are kept on an on-time basis to meet competition.

As part of the project, changes were made in sidings before installing the CTC. Sidings were lengthened at Anabel, Lentner, Lakenan, Ely and Palmyra. New sidings were constructed at Card and Falk. All seven sidings have a capacity of 140 cars. These seven sidings and the layouts at Mark and North River are included

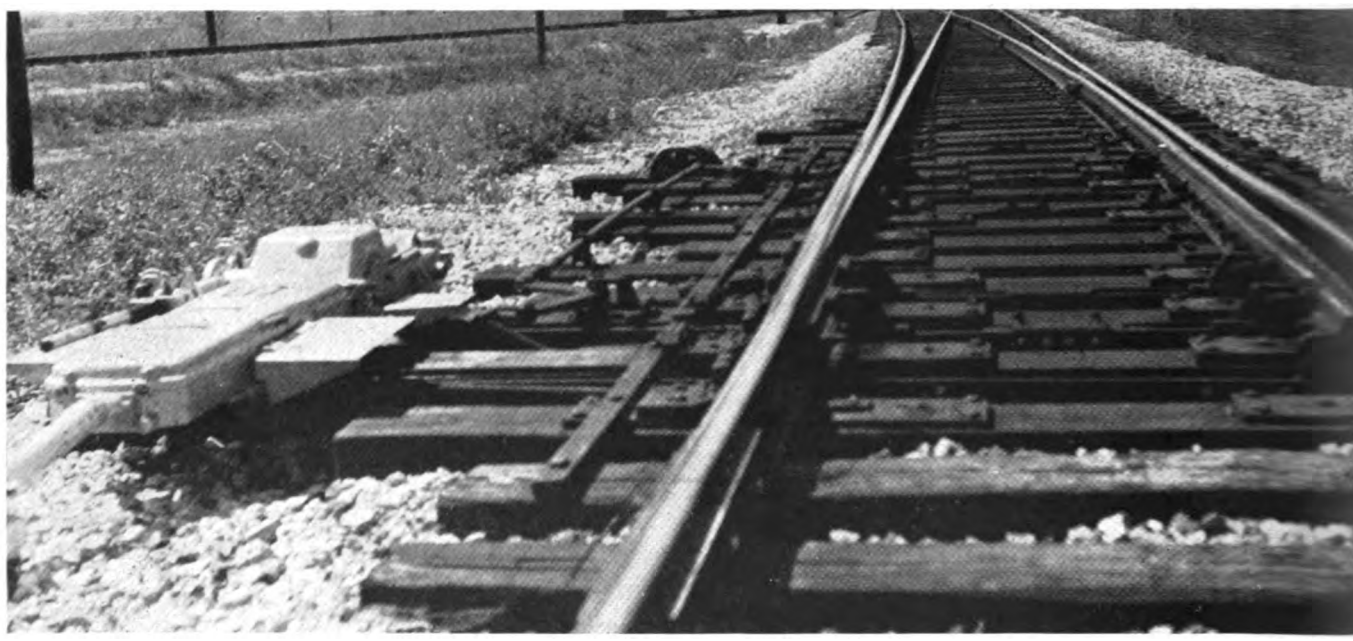
Modified CTC Installations on CB&Q

SINGLE-TRACK MODIFIED CTC ON BURLINGTON LINES

	Year Installed	Miles	Number of Trains Passenger	Freight
Alliance, Neb.-Ravenna	1951	240	4	5
Esterline, Tex.-Wichita Falls	1955	123	4	8
Bushnell, Ill.-Carthage Jct.	1955	76	4	7
Mark, Mo.-Macon	1957	65	4	8

Progress of modified CTC on the Burlington. Mileage now totals 504 miles.

Spring switch mechanism at one end of passing track. Rod extending into foreground is part of mechanical unlock for trailing movement.



Power switch at east end of siding at North River. The long switch points require a helper rod to the mid-point.

in the CTC system. Power switches are used at both ends of the sidings at Falk, North River, Palmyra, and Macon. A power switch at one end and spring switch at the other applies at Ely, Card, Lakenan, Lentner, Anabel. Previous sidings were removed or shortened and retained as house tracks at five locations.

New switch layouts with No. 15 frogs were installed at the ends of CTC sidings. For power operated switches, Racor adjustable rail braces and three vertical-pin type rods were installed. For each spring switch Racor adjustable braces and five Racor vertical pin-type rods were installed. A roller bearing was installed at each spring switch.

The switch points are 30 ft long and in order to be sure that the entire length moves over properly, an auxiliary throwing device, made of pipes and cranks, extends from the switch machine to a second operating rod 15 ft, 6 in. from the point. A special switch circuit controller checks operation of the middle section of the points.

At each spring switch, a new switch stand was installed, which in effect is a manually-operated mechanical switch-and-lock movement, including an automatic facing-point lock with an automatic release for trailing moves from the siding. An oil-buffer spring mechanism is connected to each switch.

As part of the CTC, electric locks

were installed on the hand-throw switches at spurs and house tracks. Automatic unlock controls in combination with track circuits were installed at 21 of these switches, which are used most frequently by the local freight crew. Mechanical-type locks, which require no special track circuit, were installed at 3 switches, which are used less frequently.

Each mechanical-type lock is controlled locally by a mechanical time release. When a conductor has permission from the dispatcher to use such a switch, he unlocks the padlock and opens the front door of the lock. This shunts the track, thus causing the signals in each direction to display the red aspect. Then he moves the lever to the preliminary position (about 7 deg). This starts the mechanical time device, set at a predetermined time. After this time has expired, the mechanical device lifts the toggle, thereby effecting a mechanical release. Then the man completes the operation of the crank, which pulls the plunger out of the lock rod. Later when he restores the plunger to normal position, he also thereby rewinds the mechanical-type time release device.

Coded Track and Coded Line

In this project, coded circuits are used for all the longer track circuits. Conventional dc track circuits using 4-ohm relays are used for the short track circuits, such as the OS track circuits at switches, and those for control of crossing protection. Audio frequency overlay track circuits are used to control electric locks on hand-throw switches.

Local line controls for signals are the coded type if the controls extend through dc track circuits. Audio frequency circuits, superimposed on line wires are used to transmit track occupancy indications of intermediate blocks.

Power Supply

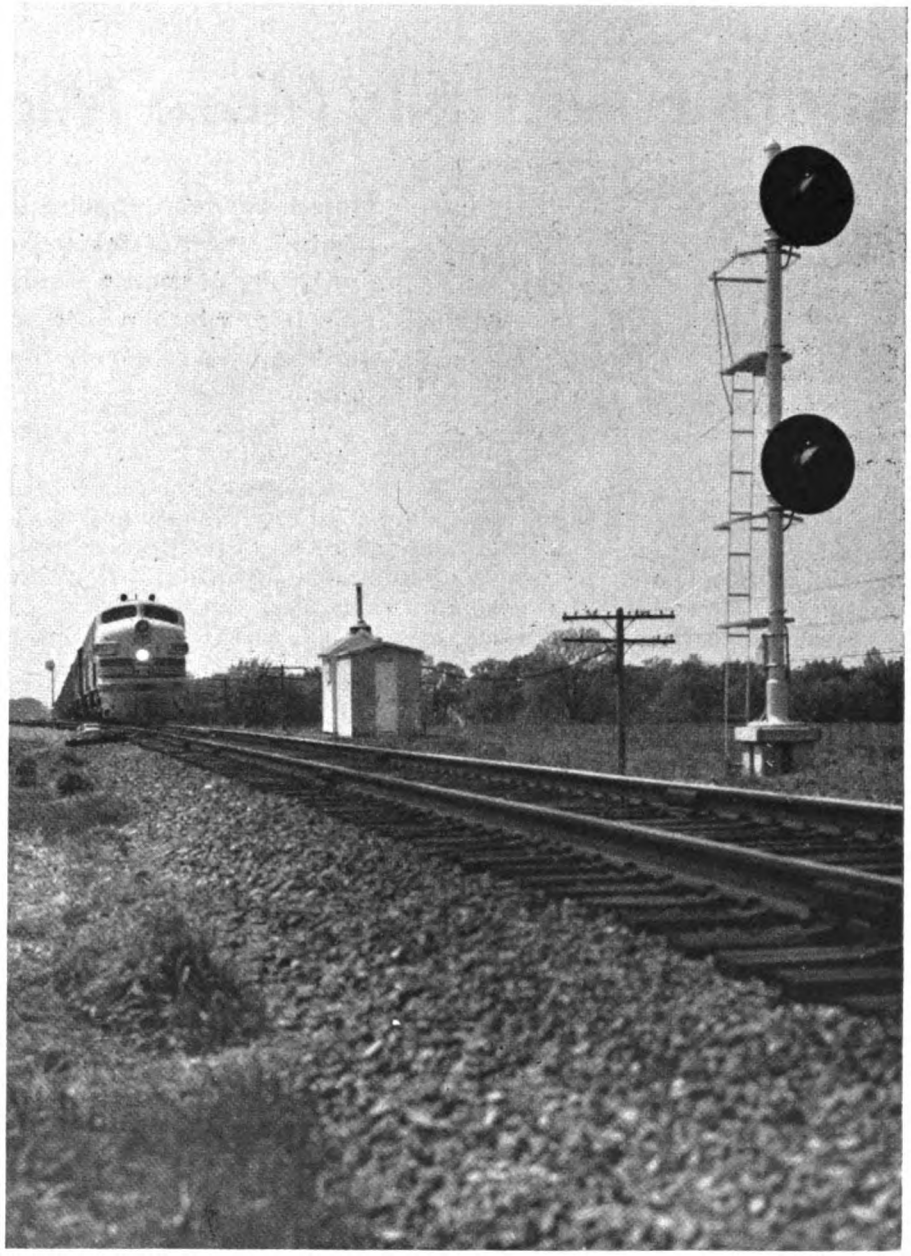
On this section ac power at 220 volts is distributed from various locations on a pair of No. 6 copper wires. Low voltage transformers feed through rectifiers to charge storage batteries, which are the Exide lead type. At each power switch there is a set of 12 cells of 80-a.h. battery, and at each intermediate signal there is a set of 5 cells of 60-a.h.

Battery circuits to switch machines are on No. 6 wires, if less than 500 ft; or No. 4 if longer. Cable from house to switch machine ordinarily includes an eight-conductor No. 12, and one two-conductor No. 6. From house to two-arm signal, cables include one 2-conductor No. 8 for lamp circuits; and two 4-conductor No. 12. Track connections are single-conductor No. 8. The insulated wire and cable was furnished by The Okonite Co.

Power Trencher Saves Work

A large percentage of the trenches for buried cable were dug by a Barber-Greene self-propelled power ditching machine. Where necessary to cross tracks, a power boring machine was used to drill a 4-in. hole through dirt fill under tracks, and then the cable was pulled through. This avoids disturbance of ballast and fill, as compared with digging a trench. Where ground was not firm enough for boring, a pusher was used to push pipe through fills.

This CTC project was planned and installed by railroad forces under the direction of A. L. Essman, Chief Signal Engineer. The major items of signal equipment were furnished by two companies: Union Switch & Signal Division of Westinghouse Air Brake Co. and General Railway Signal Co.



The Q's fast freights on light traffic lines move expeditiously with money-saving, modified CTC.