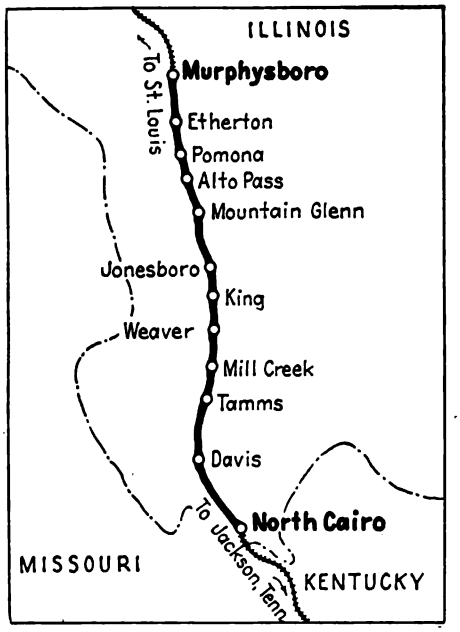
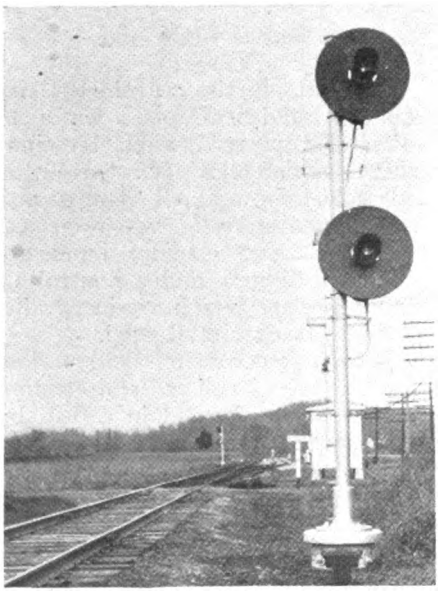
C.T.C. Big Help to G.M.& O.



Above—Fig. 1—Map of C.T.C. territory
Below—Signal at south end of King



Project on 58.5 mi. of single track, including heavy grades, has eliminated numerous train stops and saved train time

AS a means of reducing delays and increasing safety of train operation, the Gulf, Mobile & Ohio has installed centralized traffic control on 58.5 mi. of single track between Murphysboro, Ill., and North Cairo. This territory is a portion of the route between Chicago and Mobile, via St. Louis—Murphysboro being 90 mi. south of St. Louis. On the operating division between East St. Louis and North Cairo, train movements were previously authorized by timetable and train orders with no automatic block signaling. The 43-mi. section between Murphysboro and Tamms was equipped with centralized traffic control as the first project because trains were encountering delays in this territory due to heavy grades.

Between Pomona and Alto Pass the grade ascends southward, including about 2.5 mi. of 2 per cent and 1.75 mi. of 1.42 per cent. From Mountain Glenn to Alto Pass, about 4 mi., the grade ascends northward, varying from 1.57 per cent to 2.12 per cent. Throughout these heavy grades between Pomona and Mountain Glenn, the curves are numerous, and range from 4 to 6 deg., with one curve at 7 deg. 54 min. Between Mountain Glenn and Mill Creek the line goes up and down over three ridges with grades, a mile or more long, ranging from 0.8 per cent to 1.4 per cent. Between Mill Creek and Tamms the grade descends gradually to the south, and from Tamms to North Cairo the grade is slightly rolling to level.

The schedules include two passenger trains and four manifest freight trains each way daily. A local freight train is operated each way daily except Sunday. Extra trains are operated as required, so that the number of trains daily may vary from 12 to 14 or more. Helper locomotives were previously required between Murphysboro and Alto Pass, as well as between Mountain Glenn and Alto Pass, on all through freight trains operated by steam locomotives.

Longer and Fewer Sidings

As an important part of the improvement program, several changes and additions were made in the sidings. The previous sidings at Jonesboro and Weaver were removed, and a new siding was constructed at King. Most of the other sidings were lengthened, the car capacities being given in an accompanying table. The sidings, which were equipped with power switches and C.T.C. controlled signals, include Davis, Tamms, Mill Creek, King, Mountain Glenn, Alto Pass and Etherton. Also at the south end of

Table of Car Capacities of C.T.C. Controlled Passing Tracks Between Murphysboro, Ill., and North Cairo

Location	Number of Cars
Etherton	98
Alto Pass	112
Mountain Glenn	70
King	106
Mill Creek	95
Tamms	(yard)
Davis	98

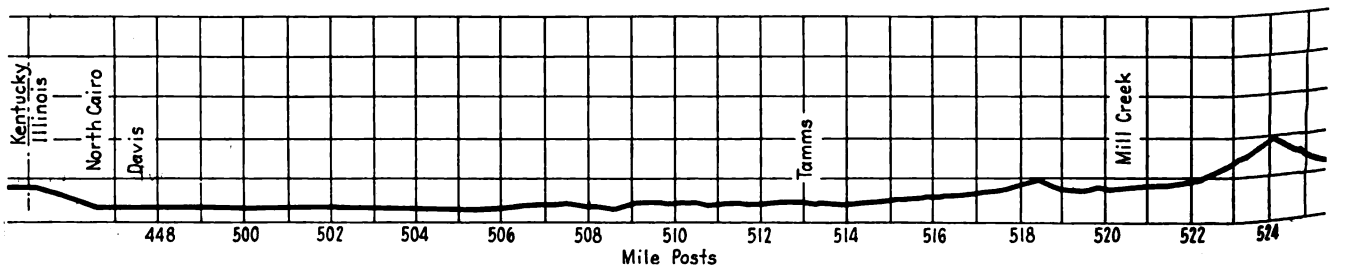
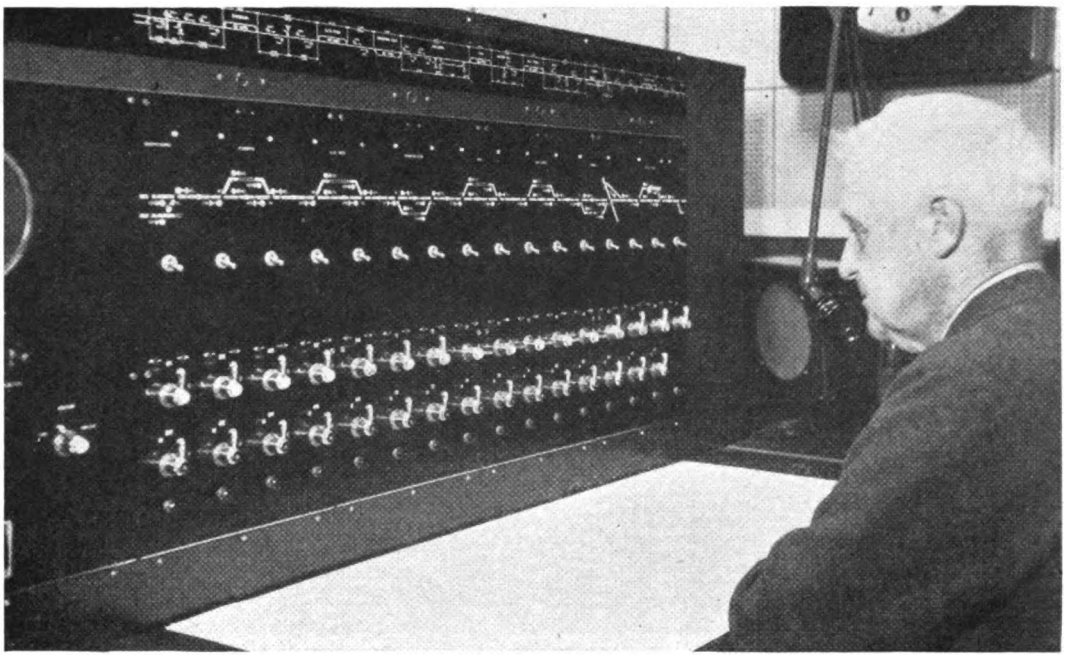


Fig. 2—Profile of the railroad in the centralized traffic control



The control machine for the entire territory is located in the dispatcher's office at Murphysboro, Ill.

Murphysboro a power switch and C.T.C. signals were installed at the connection between the yard track and the main track.

Between Murphysboro and Tamms the distances between power equipped sidings range from 5 mi. to about 6.5 mi. The block between sidings at Tamms and Davis is 14 mi. long. On account of the easy grades between these sidings, the trains can make better speed and time here than on the hills farther north. For this reason a decision was made not to install power switches and C.T.C. signals at the siding at Hodges Park, which is between Davis and North Cairo. The switches at Hodges Park are equipped with electric locks, the same as at the other hand-throw switches. At the seven sidings which were equipped with power machines, new No. 20 turnouts and switches were installed so that long trains can depart at speeds up to 30 m.p.h.

Benefits To Train Operation

Previously the train movements on this territory were authorized by timetable and train orders, no automatic block being in service. The train dispatcher for the division between East St. Louis and North Cairo was previously located in Murphysboro, and he is now in the same location. This dispatcher now operates the C.T.C. control machine to control the power switches and signals for authorizing train movements by signal indication on the 58.5 mi. between Murphysboro and North Cairo, and he continues to issue train orders on the remainder of the division between Murphysboro and East St. Louis.

Previously the section over the heavy grades and curves between Mill Creek and Pomona was a bottleneck of the entire division. Train speeds were low on account of the grades and curves. In numerous instances the trains lost a lot of time when entering and leaving the sidings because of the delays and stops required when operating the hand-throw switches.

Under timetable operation, the trains, in numerous instances, took siding and waited for long periods needlessly, although time and vacant track were available for the trains to be advanced. However, with this method of train operation the dispatcher had no means of knowing exactly where the trains were, and he could not change train orders quickly to take advantage of changing conditions.

On the other hand, now, with the centralized traffic control, the illuminated track diagram on the dispatcher's machine indicates the location and progress of each train. Accordingly, he can control the power switches and signals to authorize trains to move to

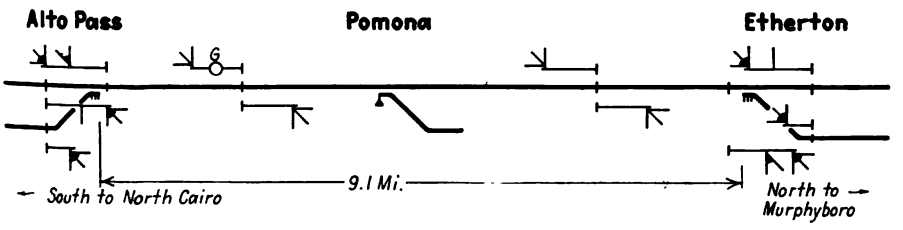
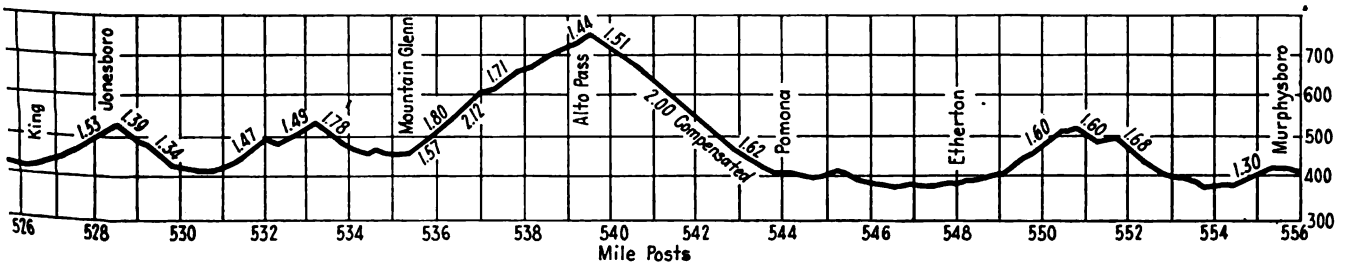
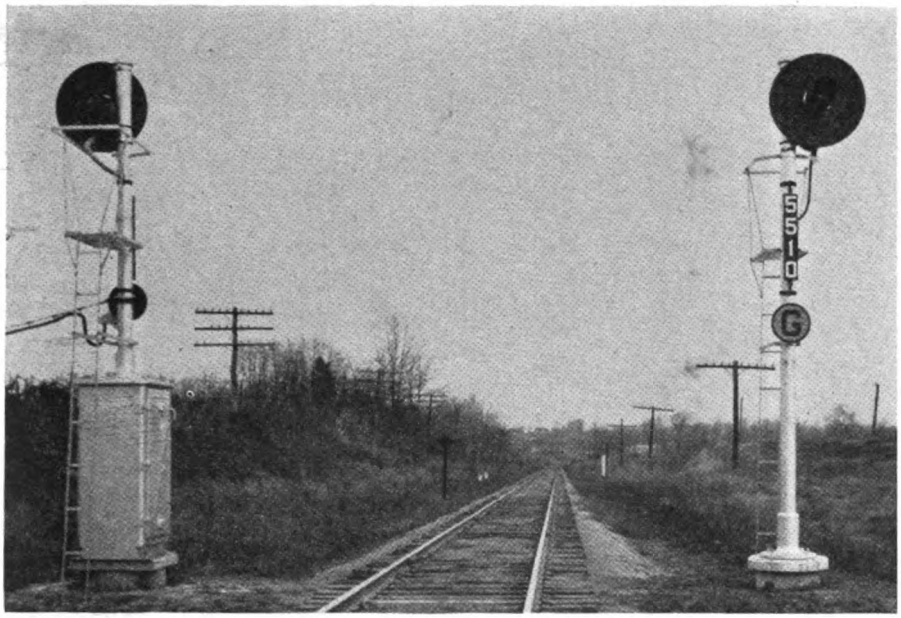


Fig. 3—Typical arrangement of signals between two sidings



territory between Murphysboro, Ill., and North Cairo



Typical intermediate signal location showing use of the grade marker signs on masts

the best advantage. For example, he can favor trains on ascending grades to keep them moving all the way up to and over the crest. In the meantime, when necessary for a train to take siding, he can plan the move so that the minimum number of stops and the minimum time are required. On account of the long sidings, many of the meets can be made without either train being required to stop. The dispatcher endeavors to plan meets so that, if the train is required to stop on a siding, it will be in a location where it can be started easily. By allowing the trains to keep going without stops on ascending grades, the need for helper locomotives on trains handled by steam locomotives has been eliminated. The elimination of the helpers was, of course, materially expedited by the introduction of Diesel-electric locomotives on two of the manifest through freights each direction daily. The use of the C.T.C., however, is just as important with respect to the success of operating the Diesel-electric locomotives because the tonnage handled by these trains depends, for the most part, on the opportunity to make a smooth non-stop run when approaching and climbing the heavy grades in both directions between Pomona and Mountain Glenn. Thus the C.T.C. is an essential part of the successful operation with both types of locomotives.

No heavy grades or curves are involved in the 16 mi. between Tamms and North Cairo, but the inclusion of this section in the C.T.C. is highly important. North Cairo is the south end of the operating division at which point the train and engine crews change. Accordingly, with the C.T.C. in service all the way between North Cairo and Murphysboro, the train movements can be authorized by signal indication on this entire 58.5 mi., without delays which would be incurred if train orders were still required on a short section.

Switches and Signals

The power switch machines in this project are the Model 5D, with 24-volt d.c. motors. These machines include dual control, so they can be operated manually when making switching moves. Insulated gage plates, 1 in. by 8 in., are used on two ties, the No. 0 tie, which is the one ahead of the points, and the No. 1 tie, which is the first one under the points. On two ties, the plates extend and are attached to the switch machine, thus holding it in place with reference to the rail. Stiles adjustable rail braces are used on the No. 0 and the No. 1 ties. Braces are used on not only the field side but also on the gage side of the rails on the No. 0 tie. The front rod is the swivel type.

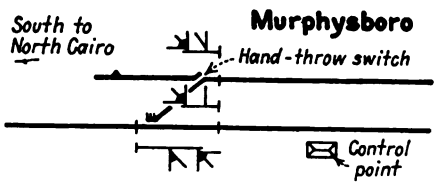


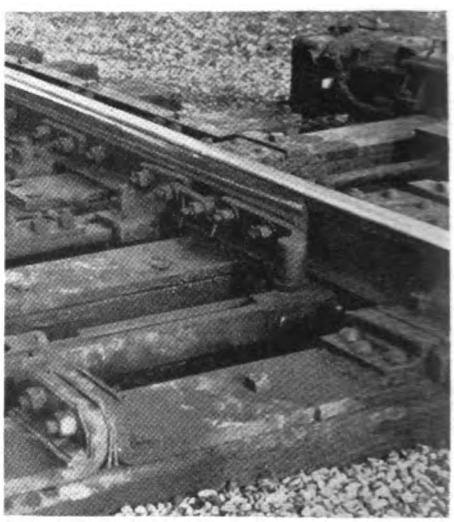
Fig. 4—Crossover at Murphysboro

At Murphysboro the yard track is connected to the main track by a crossover, and the yard track extends as a house track to serve industries. As shown in the sketch Fig. 4, the switch at the main track end of this crossover is operated by the power switch, but the other switch is operated by a hand-throw stand. This stand also operates a pipe-connected derail on the house track. This hand-throw switch is normally lined for the move via the crossover to the main track. A bolt-lock connection extends from the power switch to the hand-throw switch to lock it in the normal position when the power switch is reversed. Also, if the hand-throw switch is not normal, power is cut off from the switch machine, thus preventing its operation.

Local Controls

Coded track circuits were installed for all the long track circuits. These operate at 75 impulses per minute, and are used only for detecting track occupancy. The reason for using coded equipment was to make possible the use of track circuits ranging up to 11,000 ft. in length. The OS detector track circuits are the normally-energized d.c. neutral type, using the primary-secondary scheme as a means of effecting a good shunt and holding the shunt. The primary relays are rated at 4 ohms, and the secondary relays at 425 ohms.

For the most part, the bonds on this project are the American Steel & Wire Company's Tigerweld railhead plug type. On curves, where the rails are changed more often, the bonds are the S-1 type with plugs driven in holes in the web of the rail. These bonds can be removed and reinstalled readily when rail is changed.



Swivel-type front rod

The local line controls of signals between any two sidings are the either-direction type in which two wires are used in one direction or the other, de-

The power switch layouts are equipped with adjustable rail braces and the insulated gage plates on the No. 0 and the No. 1 ties

pending on the direction established by the C.T.C. control. The operating coils of the searchlight signals, rated at 250 ohms, are connected directly in these line circuits. In general, this two-wire, either-direction polarized line circuit, as installed in this project, is basically the same as used on a Louisville & Nashville installation, as explained in detail on page 528 of the October, 1943, issue, and on page 614 of the September, 1946, issue of *Railway Signaling*.

As applying to a station-to-station block with only two automatic blocks, track circuits in each entire automatic block are repeated to the field locations, where the track repeater relays serve to control a relay which, through

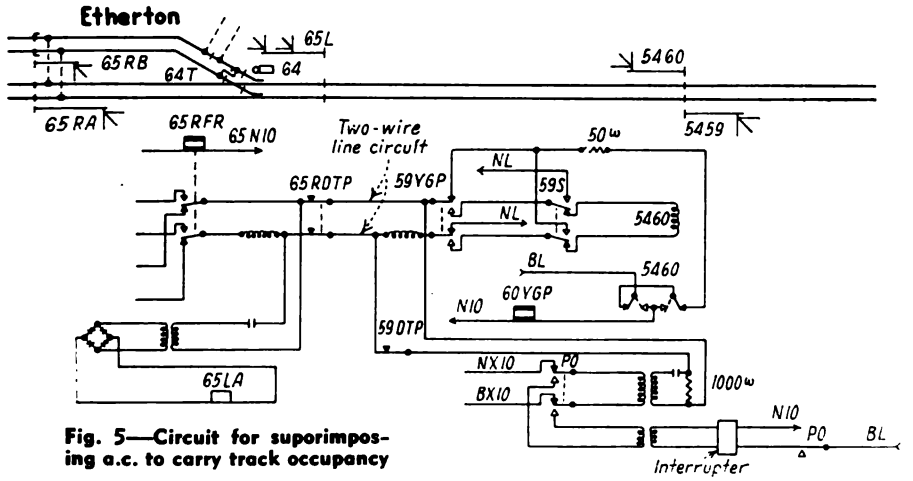


Fig. 5—Circuit for suporimposing a.c. to carry track occupancy

the C.T.C. line code system, controls the lamp on the dispatcher's machine to indicate track occupancy of the corresponding station-to-station block. In a station-to-station block including three automatic blocks, a.c. is superimposed on the signal line wires to carry in to the field station to control of a relay to check the occupancy of the third automatic block. If the commercial a.c. power fails, as applying to an intermediate signal, a power-off relay is released to close contacts which starts an alternator, fed from the storage battery, to feed a.c. energy for this track-occupancy indication, superimposed on the line wires to the nearest field station. See Fig. 5.

Control of Electric Locks

As a part of this C.T.C. project, an electric lock and pipe-connected derail were installed at each main-track hand-throw switch and turnout except at Davis where a 20 m.p.h. speed restriction is in effect and turnouts at Hodges Park where dwarf signals were installed to govern movements from the siding. When a train on a spur track or the locked siding, at Hodges Park, is ready to depart, the conductor telephones to the dispatcher to determine whether the train is to pull out. If so, the conductor opens the door of the case of the electric lock on the switch. A contact, which is opened by the door, causes a switch and lock repeater relay, LP, to be released. Contacts in this relay connect the two line control wires from the south to relay SF, and the two line control wires from the north to relay NF. If the station leaving signals are at Stop, and the station-to-station block is not occupied, the two relays, NF and SF, are picked up by energy coming in on the line wire circuits. A circuit through front contacts of these two relays and a contact closed with the case door open, energizes the lock coil. The dwarf signals at Hodges Park will clear automatically when the switch is reversed and the block unoccupied.

When a train on the main track is

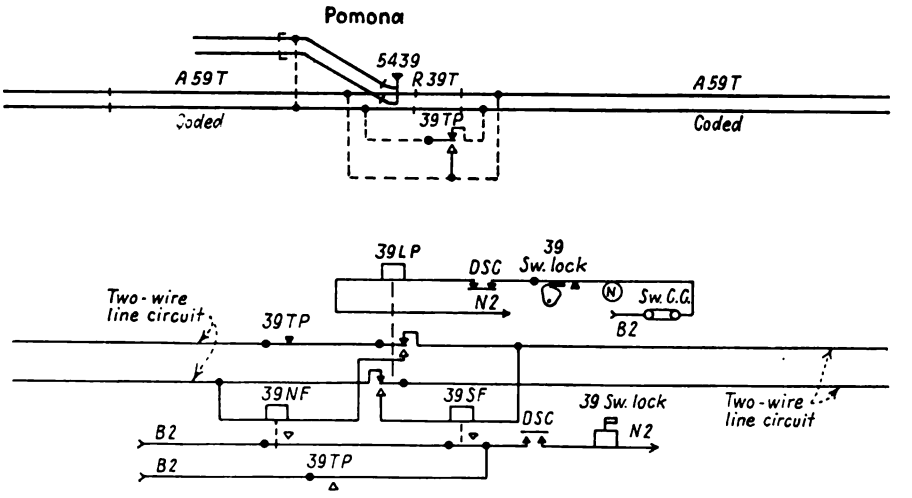
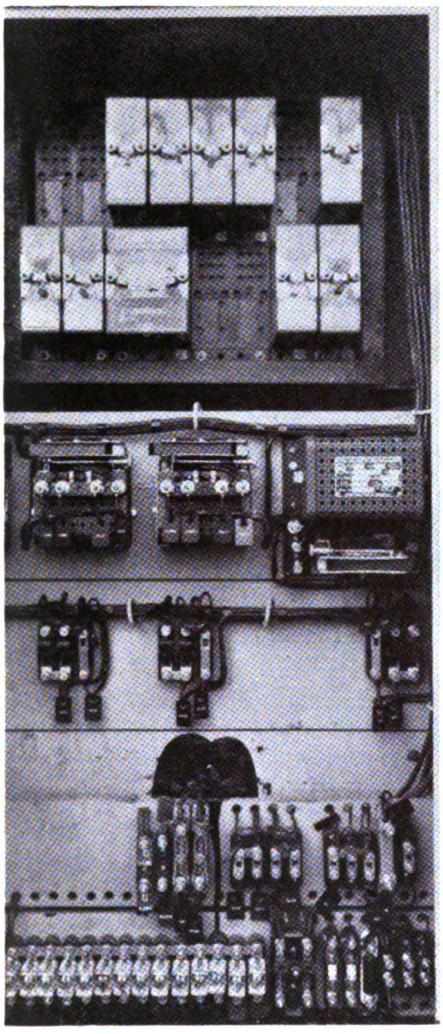


Fig. 6—Circuit for control of electric lock on hand-throw switch



Relay side of signal case

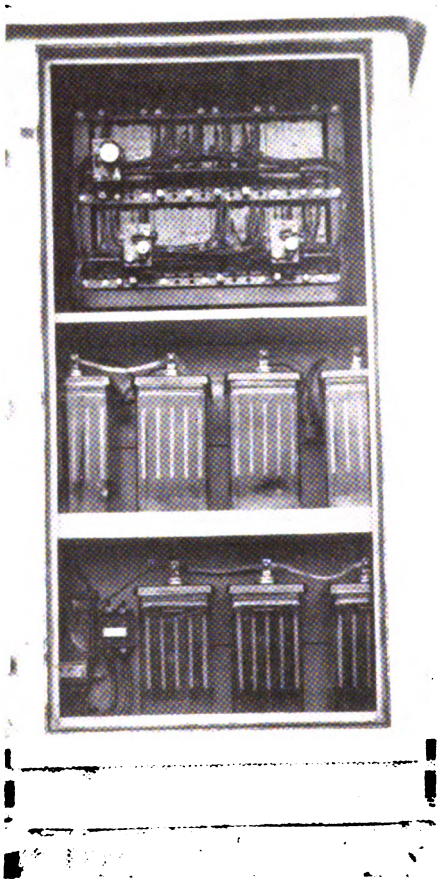
to enter a spur, the locomotive or first car is stopped on a short track circuit in approach to the facing points. The release of the relay for this track circuit, in combination with a contact closed when the conductor opens the lock case, completes a circuit to energize the lock. Thus the two line wires serve not only as local line control circuits for the signals, but also carry track-occupancy indications to the field stations, and they also serve in the control of electric locks on hand-throw switches located in station-to-station blocks.

Pole Line Construction

The line wires for this C.T.C. project were installed on a crossarm which was added to the existing pole line for communication circuits. The two line wires for the C.T.C. code and the two line wires for the either-direction local signal control circuit are No. 10 Copperweld with a thin coating of plastic weatherproof insulation, known as Formex. The 220-volt single-phase a.c. power distribution circuit is on two No. 6 Formex insulated copper wires. This circuit is not continuous but feeds out in one direction or both directions from 12 locations where commercial supply was available. A gap, the length of one track circuit extends between the ends of each of these feeds, thus saving line wire. In order to minimize interference, the wires of the C.T.C. code line and the wires of the a.c. power circuit are transposed every 17 poles.

Power Supply

The 220-volt a.c. power distribution line circuit feeds a 750-watt, 220-110-volt line transformer at each signal and power switch location. These are



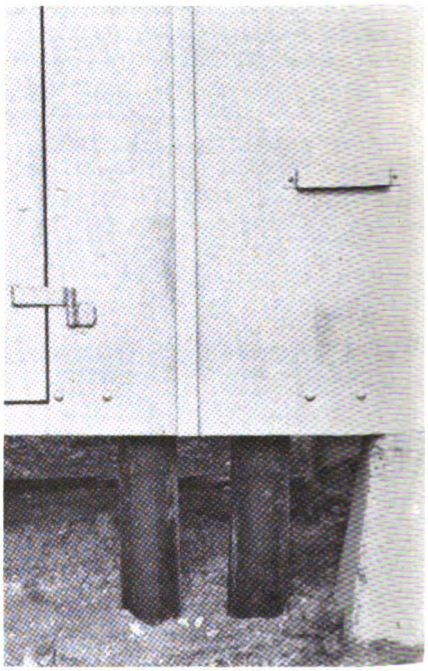
Battery side of signal case

G.R.S. Co. air-cooled transformers. In the instrument houses and cases, rectifiers are used to charge storage batteries. At each power switch location there is a set of 12 cells of 80-a.h. lead storage battery which operates the switch machine and also operates the line code equipment. Also in each house there are two sets of five cells of 80-a.h. battery to feed the line circuits and to serve as a standby for the signal lamps. Each track circuit is fed by one cell of 80-a.h. battery. The storage batteries on this project are Exide, with the exception of 100 cells at locations on the south end which are Gould. The C.T.C. code line battery at the office in Murphysboro consists of 77 Exide Type BTM-3 cells, which give 154 volts to the line.

The signal lamps are the two-filament type rated at 10 volts 13 + 3½ watts. These lamps are lighted constantly when on the normal a.c. feed. If the commercial a.c. power fails, the lamps are fed from battery with approach control in effect.

All of the relays on the C.T.C. project in the instrument houses as well as in the cases at intermediate signals are of the most modern plug-in quick-detachable type. The code-following track relays are rated at 0.25 ohms, the red signal repeater relays at 900 ohms, the yellow-green signal repeater relays at 300 ohms and the directional stick relays at 900 ohms. The d.c. neutral relays on the short track circuits are rated at 4 ohms.

The drops from the line poles to the cases are in cable made up of copper wires with Okoprene insulation—No. 9 wire for the a.c. power and C.T.C. code circuits, and No. 14 for signal control circuits. The buried cable to the track connections is single-conductor No. 9 Okonite. The buried cable to the signals is two-conductor



Cable protection under house

No. 9 for lamp circuits and No. 14 for controls. In the buried cables to switches, the power wires are No. 9 and the controls No. 14.

This centralized traffic control project was planned and installed by signal forces of the Gulf, Mobile & Ohio under the direction of H. C. Sampson, superintendent signals, the principal items of signaling equipment being furnished by the General Railway Signal Company.