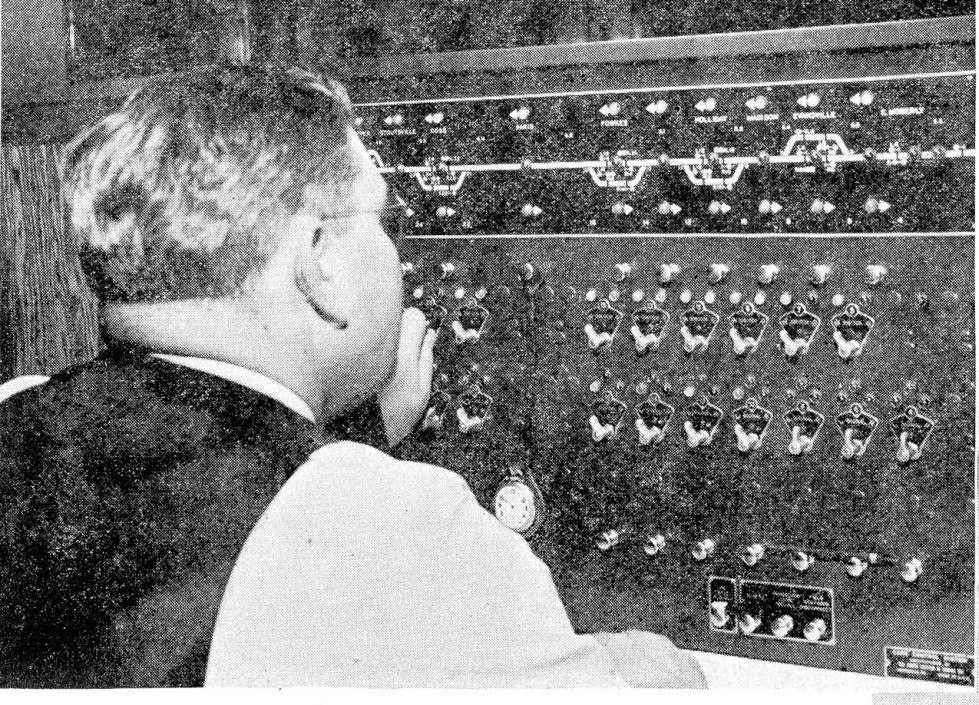
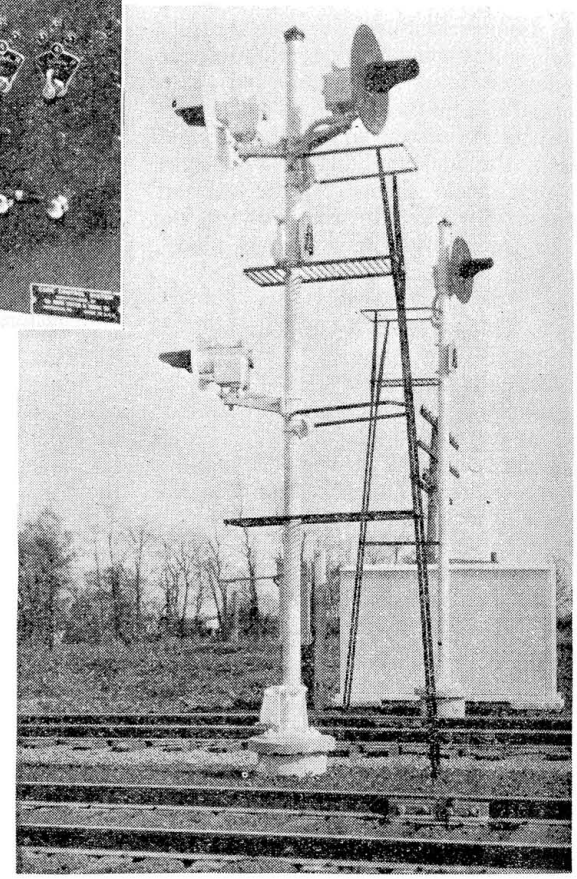
Manual



The control machine for the Moberly-Clapper territory is in the dispatcher's office at Moberly

Absolute manual block rules and methods of operation apply to system which includes automatic track circuit protection throughout, and signals which are controlled from the dispatcher's office to expedite train moves



Back-to-back mounting of signals such as No. 10 and No. 11 in Fig. 2

For use on medium traffic single-track lines, where the movements are such that there are infrequent close following movements, the train speeds are relatively uniform, and the general traffic interference is caused by opposing trains, the Wabash has installed a manual block-remote control arrangement of signals and aspects.

Designed to Save Critical Materials as Compared With Automatic Block

The positive manual block principle of operation is the basis of the increased safety and operation. To provide increased flexibility of operation, short blocks were established at the meetings points, in addition to the usual siding-to-siding block, the block signals are remotely controlled, and track indication of the train progress are provided. To provide increased safety, the features of automatic block signaling such as continuous track circuits, etc., are provided.

The manual block-remote control signal system was developed with the co-operation of the Union Switch & Signal Company as a substitute for and an improvement over automatic block signaling as a result of war-time restrictions in the use of critical materials. To go ahead with the program of providing additional safety by means of signals on the railroad it was necessary to develop a system that would require less scarce materials, such as line wire, number of signals, etc., than are ordinarily required for automatic block signals.

The scene of the development, a 210-mile single-track connecting line between Decatur, Ill., and Moberly, Mo., is an important link in a through freight route between Kansas City on the west and Chicago, Detroit, Toledo and other points on the east. One local passenger train is operated in each direction daily on the section between Decatur and Hannibal, 142 miles, but there is no passenger service between Hannibal and Moberly, 68 miles. The number of freight trains may vary from five to ten each way daily, depending on the traffic, tonnage ratings of locomotives and grades on the different sections of the line. On a recent day there were nine trains westward and 7 eastward between Moberly and Hannibal.

Curves and Grades

The line crosses level prairie country between Decatur and Jacksonville with the exception of the crossing of the Sangamon river just east of Springfield. Between Hannibal and Moberly the railroad passes through rolling hills with numerous curves up to 6 deg. 20 min., and grades up to

Block-Remote Control

Developed on the Wabash

1.26 per cent for as much as two miles, and up to 1.1 per cent for up to six miles. The ratings applying to the larger sized locomotives is 2,950 tons eastbound and 2,700 tons westbound.

Why Signaling Was Needed

Prior to 1943, there was no signaling on any portion of this 210 miles between Decatur and Moberly, train movements being authorized by timetables and train orders. Choosing a section where curves and high banks resulted in short sighting distance, automatic signaling was installed in 1943, on 55 miles between Markham, near Jacksonville, Ill., and Kinderhook. On this project, efforts were made to minimize the use of critical materials, such as copper line wire. Nevertheless, the Wabash realized the impracticability of proceeding with the installation of signaling on the remaining 155 miles between Decatur and Moberly, unless some scheme could be devised to eliminate the copper line control wires, reduce the number of signals, etc., such as required in the automatic block previously completed. On the other hand, on account of the increased volume of important war traffic being handled, it was important to provide a system of protection, as well as means for expediting train movements. After numerous conferences between representatives of the operating and the signal departments, the Wabash developed this new arrangement of signals and additional aspects for use in manual block signaling.

Meets I.C.C. Requirements

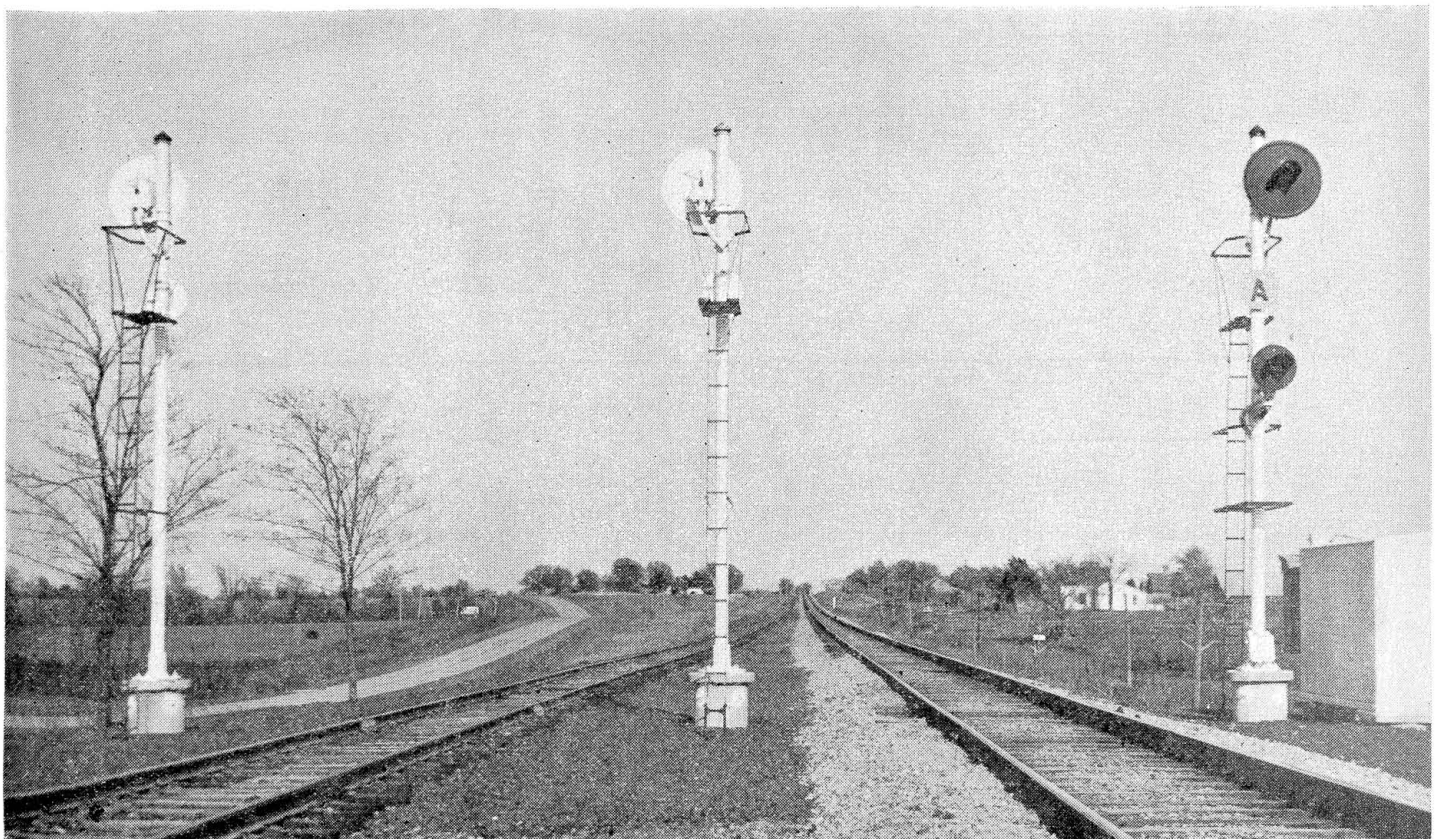
The installation meets the requirements of the Interstate Commerce Commission as applying to manual block, and, therefore, approvals of the projects were granted by the Commission. Also, due to the small amount of critical materials required, the War Production Board has authorized the construction and allotments of materials.

Four Projects Total 134 Miles

The first installation of this manual block-remote control was placed in service May 21, 1944, on 34.7 miles of single track between Decatur, Ill., and Starne interlocking near Springfield, Ill. The experience with this project was satisfactory, and a second installation on 39.1 miles between Moberly and Clapper, Mo., was authorized, this being completed on April 1, 1945. Authorities have been granted and materials ordered to complete two more projects this year; on 37 miles between Springfield and Jacksonville, and 28.5 miles between Clapper and Hannibal. The four projects will total 134 miles of manual block-remote control.

The Decatur-Springfield territory is controlled from a machine in the dispatcher's office at Decatur, and an additional section for this machine will control the Springfield-Jacksonville territory. Likewise a machine, in the dispatcher's office at Moberly, controls the Moberly-Clapper terri-

The three signals, such as No. 3, No. 1 and No. 2 at clearance point at west end of a siding on north side of main track, such as the layout at Station A, Fig. 2



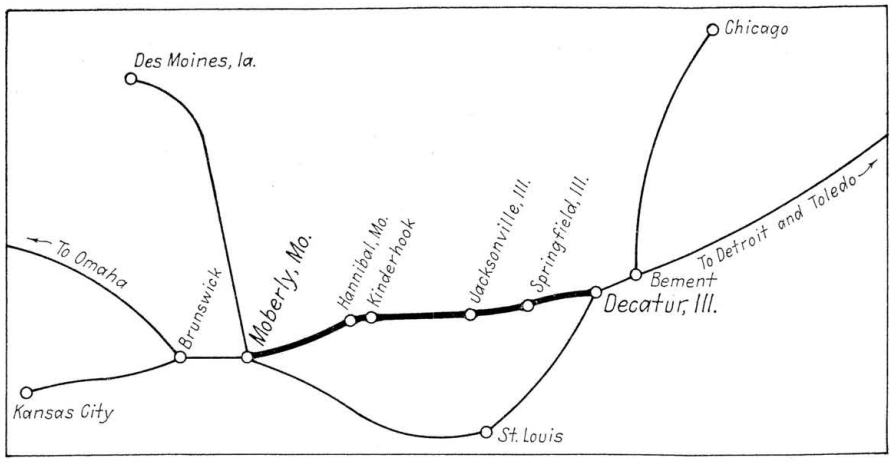


Fig. 1—Map of part of the Wabash showing manual block-remote control territories

tory, and an additional section will control the extension of this project from Clapper to Hannibal.

New Signaling Arrangement

Referring to Station A in Fig. 2, the main track westward station-leaving signal No. 1 normally displays the red aspect, which indicates an absolute Stop. If there is no train between this signal No. 1 and signal No. 7 at Station B, and also if the dispatcher sends out the proper control, signal No. 1 operates to display the green aspect, thus authorizing a westbound train on the main track at Station A to proceed to signal No. 7 at Station B.

As shown in Fig. 3, if there is a westbound train on the siding at Station A, and the dispatcher is ready for this train to depart, he sends out a control, and if there is no train between Station A and Station B, signal No. 3 displays an aspect of lunar white which is flashed 75 times per minute. Then the head brakeman reverses the switch, after which the aspect on signal No. 3 changes to green, which authorizes the train to pull out on the main line, and proceed to Station B, the switch at Station A being placed normal by the rear brakeman before the train departs.

An item to be noted is that the signals such as No. 1 and No. 3 govern from one siding to the next as one undivided manual block, with no provision for using signals to authorize a following train to enter into an occupied block. Thus in these respects this project is the same as other manual block signaling. As the train proceeds westward, the westward approach signal No. 5 provides advance information as to whether the train is to be stopped short of the next siding switch or is to proceed beyond that switch without stopping.

Take-Siding Operation

Referring now to Fig. 4, if the westbound train is to be directed to take siding at Station B, then westward signal No. 7 at Station B is controlled by the dispatcher to display red in the top unit and flashing red in the bottom unit, while at the same time, approach signal No. 5 displays yellow as advance information. Accordingly the westbound train is stopped short of the switch at the east end at Station B. After the head brakeman throws the switch, the train enters the siding and the switch is placed normal.

Referring to Fig. 5, if the dispatcher wants the westbound train to hold the main track and pull on down to stop short of signal No. 9 to wait for a meet with a train that is to take siding, he sends out a control which causes westward main track signal No. 7 to display red in the top unit over a flashing yellow in the bottom unit.

Referring now to Fig. 6, if the westbound train is to be authorized to proceed on the main track through Station B and to continue on the main track to Station C, then the dispatcher sends out two controls, one of which causes westward main track station-leaving signal No. 9 at the west end of Station B to display the

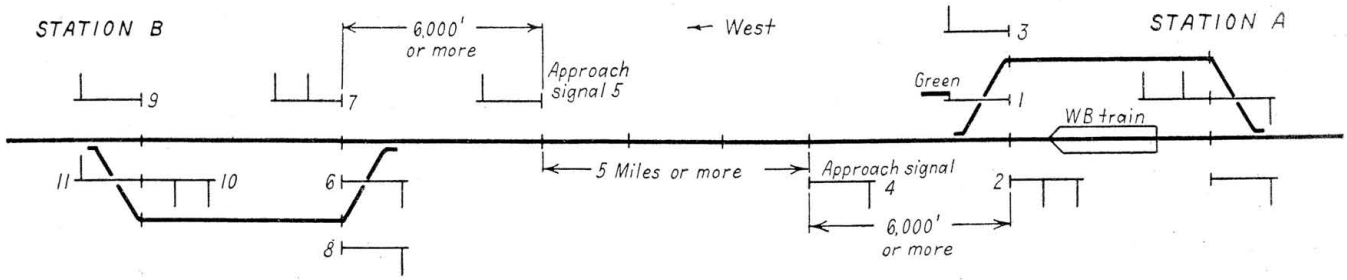


Fig. 2—The green aspect on westward station-leaving signal 1 at the west end of Station A, authorized westbound train to proceed to signal No. 7 at Station B

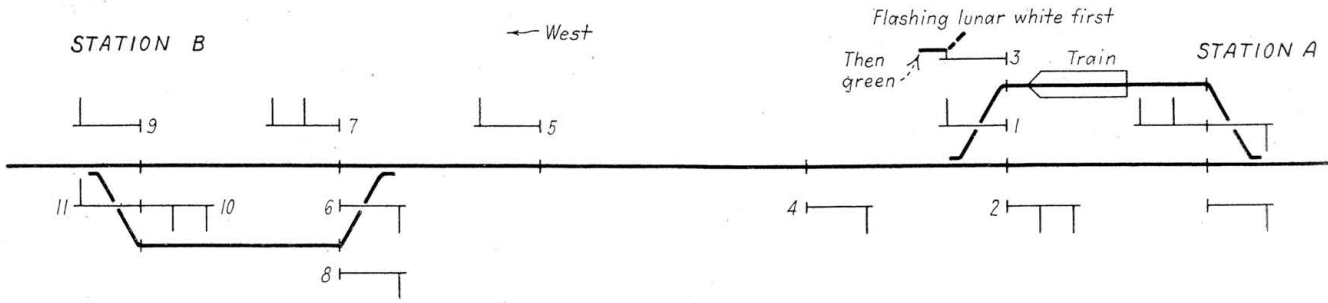


Fig. 3—Flashing lunar white aspect on leave-siding signal No. 3 at Station A authorizes the head brakeman to throw the switch, then aspect changes to green which authorizes train to proceed to the Station B

green aspect, and the second control causes westward main track station-entering signal No. 7 to display an aspect of green-over-red. Not until signal No. 9 displays green, can the green-over-red be displayed on signal No. 7.

If the dispatcher wants to hold the westbound train short of the east switch at Station B, he would not send out any control, so that westward signal No. 7 would continue to display red-over-red (steady burning) which indicates Stop.

Manual Block Aspects

Basically, the signaling is "two-position," the same as in any other manual block. For example, a "high green" is the only aspect that authorizes a train to depart from a station and proceed to the next one. Steady-burning red indicates Stop, and this is absolute stop according to A.A.R. rule 292. The signals are designated as absolute stop signals by the absence of a number plate, and also by an "A" marker on the mast, this marker letter being red on a yellow background, and the letter is studded with reflector buttons.

The flashing-red for the take-siding aspect and the flashing lunar white for the preliminary leave-siding aspect are instructions concerning

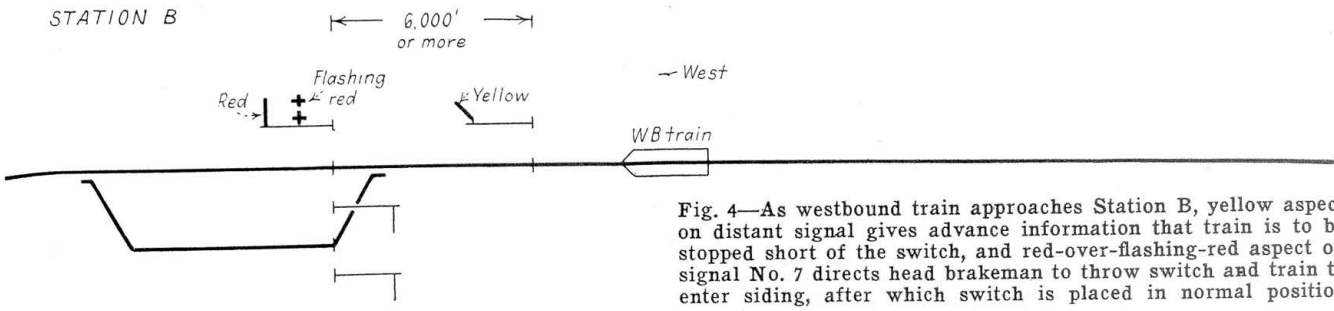


Fig. 4—As westbound train approaches Station B, yellow aspect on distant signal gives advance information that train is to be stopped short of the switch, and red-over-flashing-red aspect on signal No. 7 directs head brakeman to throw switch and train to enter siding, after which switch is placed in normal position

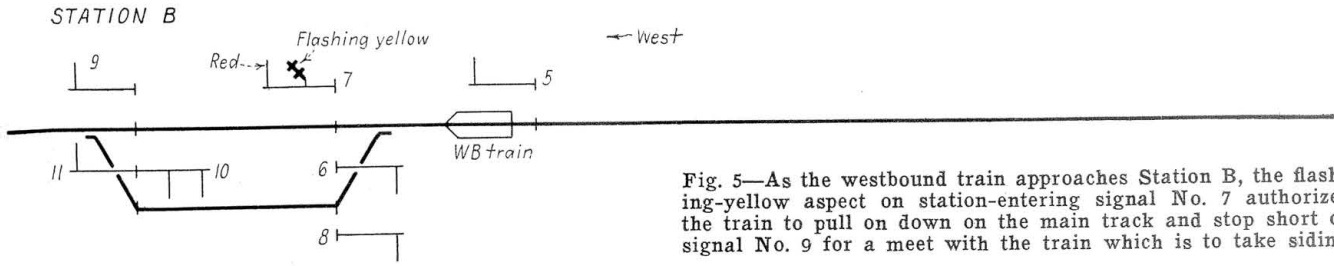


Fig. 5—As the westbound train approaches Station B, the flashing-yellow aspect on station-entering signal No. 7 authorizes the train to pull on down on the main track and stop short of signal No. 9 for a meet with the train which is to take siding

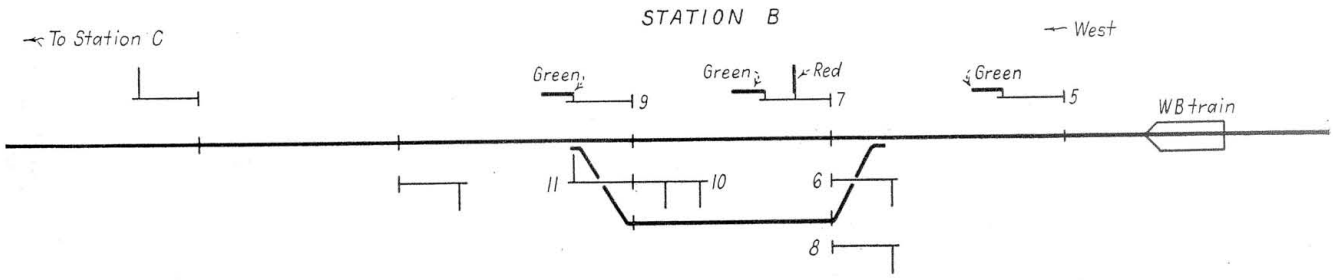
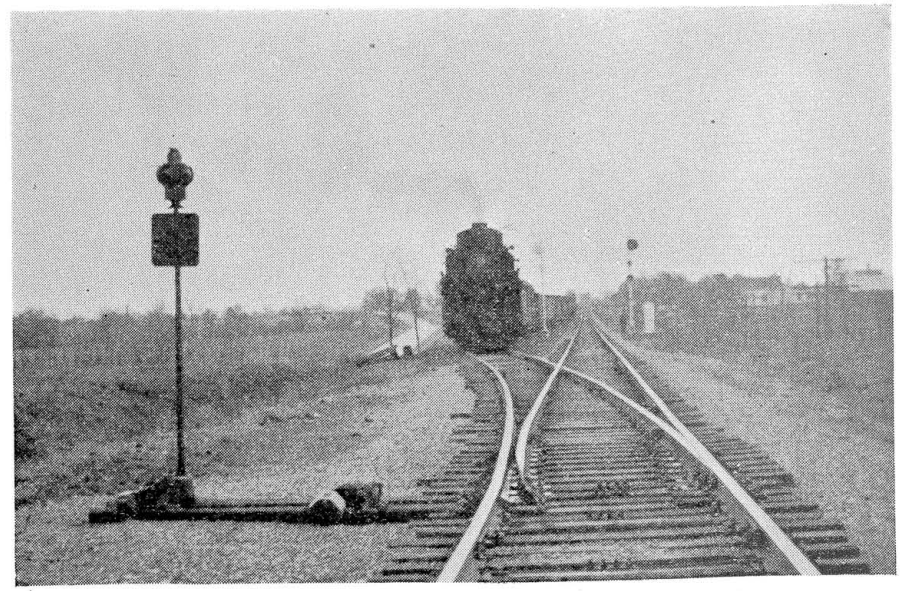


Fig. 6—If westward train is to be directed to proceed at speed on main track through Station B, and continue to Station C, signal No. 5 displays green, signal No. 7 green-over-red and signal No. 9 green



Westbound train pulling out of west end of a siding on the north side of the main track in layout such as at the west end of the Station A, Fig. 2

operations of the hand-throw switch stand. The flashing-yellow under red on a station-entering signal, such as signal No. 7, is in the category of special instructions to pull the train on down on the main track to the other end of the siding. There are two reasons for using the flashing yellow in this instance: (1) This is distinctive information to the engineman to proceed on main track approaching next signal at end of siding prepared to stop; and (2) The flashing-yellow-under-red is only used at the station blocks and it was decided this aspect should be different from steady yellow aspect to provide a more definite and informative instruction.

Flashing Saves Extra Unit

In general, the benefit of flashing a lamp is that an additional aspect is thereby derived without the complication of an additional signal unit. A second benefit is that a flashing aspect is distinctively different from a steady burning one. As applying to the Wabash project, the flashing aspects are for special instructions, whereas the red for Stop and the "high green" to go to the next station are the same as in other manual block signaling.

New Location For Station-Entering Signal

A new idea in the location of signals on this project is that the station-entering signals, such as signal No. 2, Fig. 3, are opposite the fouling point on the turn-out, and, therefore, are in line with signals No. 1 and No. 3, rather than being located in approach to the facing point of the switch as is the practice in automatic block signaling. The Wabash practice, with signal No. 2 in line with the other two signals, allows an eastward train, for example, to stop short of the switch and pull into the siding without the confusing practice of being required to pass a signal indicating Stop. Also the Wabash arrangement permits the elimination of a short track circuit through each switch, thereby reducing the amount of materials required.

An important item in this project is that all signals are high signals, the same as other manual block signals. For example, in Fig. 2, the eastward leave-siding signal No. 8 at Station B is on a high mast, the same as the other signals. Also the westward leave siding signal No. 11 at Station B is a high signal but in this instance no separate high mast is required because signal 11 is on the east side of the same mast on which eastward station-entering signal 10 is mounted.

All High Signals and Are To the Right of Track Governed

In order to eliminate chances for confusion between signals by enginemen, each signal is at the right of the track governed. This practice required that the siding be thrown over to 20-ft. centers, in order to allow clearance for a high signal between the main track and the siding, this being necessary at both ends of each siding.

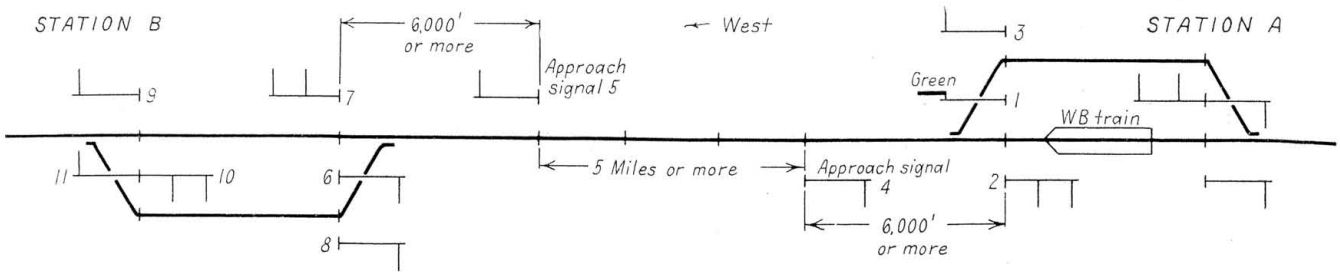
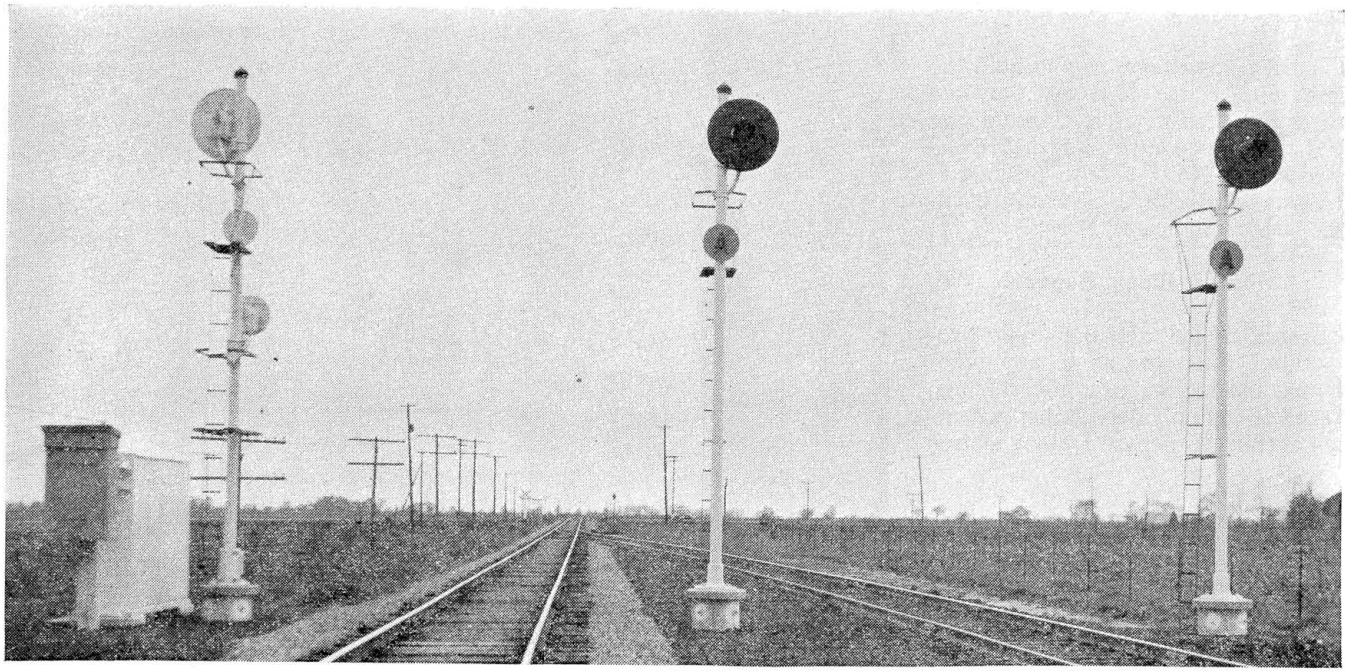


Fig. 2—Repeated here for ready reference concerning layout of signals

Location of Approach Signals

An Approach signal, such as signal No. 5, in Fig. 2, is located about 7,000 ft. plus or minus from its corresponding station-entering signal, such as signal No. 7 at Station B. This dis-



tance varies depending on grades, and the necessity to shift the location in order to secure maximum sighting distance on curves. With 6,000 to 8,000 ft. between each approach signal and its corresponding station-entering signal, this may leave a distance of up to 5 miles or more between the two approach signals if the distance between sidings is 7 miles or more.

These signals between sidings are approach signals and are controlled as automatic block signals. The fact that only two of these signals are used between two sidings is a decided saving in the number of signals required as compared with the usual automatic block signaling practice of having two or more intermediate signal locations to provide adequate opposing protection. This protection is provided on this Wabash project by the station-leaving manual block signals, being normally at stop and controlled in only one direction at a time, therefore, no opposing protecting intermediate automatic signals are required.

Spacing of Sidings

Between Moberly and Clapper, 39 miles, there are four sidings used for meeting trains: Evansville, Holliday, Goss, and Fowkes. Manual block remote control signals as previously discussed were installed at these four sidings. At other intermediate points on this territory such as at Madison and Paris, there are short house tracks connected to the main track. These house tracks are used only by the local freight train when setting out or picking up cars, but the train does not clear the main track, thereby automatically preventing the clearing of a signal to admit another train into the overall station-to-station manual block. Trains must not clear the main track block at any tracks other than at sidings equipped with block signals, except in an emergency. Trains clearing the main track at any other tracks in emergency must, before again occupying main track, obtain proper authority, and then the movement must be made under flag protection.

No Line Control Wires

The automatic track circuit controls throughout on all main track on this project are accomplished by modern coded track circuit equipment, thereby obviating line wires for local field control circuits. The manual control of the signals between Decatur and Jacksonville from the dispatcher's office at Decatur is accomplished by coding apparatus which is superimposed on previously existing line wires which are used also for a telephone circuit and connected simplex to handle a telegraph circuit. Similarly on the Moberly-Hannibal territory the controls from the dispatcher's office are handled by coding apparatus superimposed on the previously existing line wires which also carry the telephone train dispatching circuit and are connected simplex to carry a telegraph circuit.

A commercial supply of a-c. at 220-volts was available at or near each station, and a pair of No. 9 galvanized iron line wires are installed the length of each siding to carry this a-c. out to the instrument house at the two switches to be used in charging storage batteries. On any given section of single track between sidings the track circuits and the two approach signals are fed from primary battery, thus eliminating the requirement for a line circuit to distribute a-c. power.

Thus a summary shows that the installation of this signaling required no new line wires with the exception of the two iron wires for a-c. power the length of each siding.

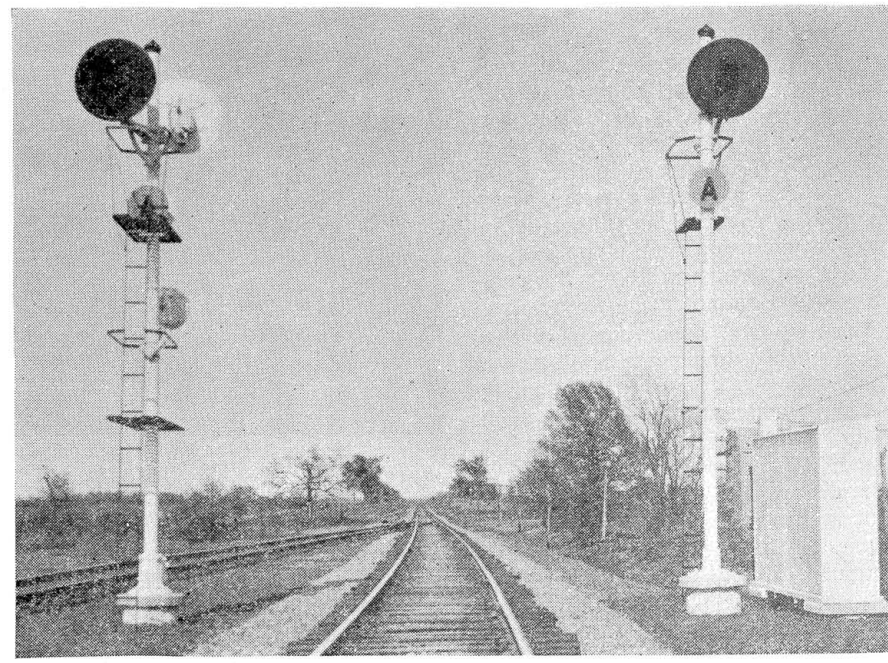
Important Conclusions

The reduction in line wire and the number of signals between sidings on this manual block project as compared with the 1943 automatic block signaling between Jacksonville and Hannibal, just about offsets the cost of the control machine, line coding apparatus and other special equipment. This conclusion may not apply with reference to other territories because the cost of equipment for the manual block-remote control increases in greater proportion as the number of siding switches than the increase on a mileage basis.

As applying to the Decatur-Moberly territory, the conclusion of the Wabash is that the manual block-remote control requires less materials, and costs no more than automatic block. Furthermore, the manual block not only affords complete automatic protection against head-on or rear-end collisions but also give the dispatcher information of trains progressing through the territory and allows the dispatcher to display signals for the movement of trains through the blocks and in and out of the sidings.

The manual block-remote control does not provide means for using signal aspects to authorize following train movements in a given station-to-

As applying to a layout at a siding on the north side of the main track such as at Station A in Fig. 2, the picture to the left on the opposite page shows the layout of the three signals such as signals No. 2, No. 1 and No. 3 at west end of Station A



And also the picture to the right on this page shows the signals at the east end of a siding on the north side of the main track such as at Station A in Fig. 2, the one mast to the left has the leave-siding searchlight signal on this side and the two searchlight units on the other side

direction of traffic that is established in a station-to-station block by control from the dispatcher's machine. These features have been explained in detail in previous articles in *Railway Signaling* and will not be discussed here except to point out the new features which apply specifically to this Wabash installation.

Eliminates One Track Circuit

Referring to Fig. 7, station-entering signals such as signal No. 2 at Station A are located opposite the foul-

outs where the shunt foulings are used, two Cadweld bonds were applied to each joint.

Switch Circuit Controllers

A switch circuit controller was installed at each main track switch the same as in an automatic block signal project. Also as is standard practice on the Wabash, an insulated rail joint is installed in the joint nearest the switch on the rail which is on the same side as the stand. The wiring from the rails and through the contacts of

ward to signal No. 1. The receipt of this code causes an indication to go to the control machine to indicate that the station-to-station block is unoccupied, and that traffic direction in this block is established westward.

If westward main track signals No. 9 and No. 7 at Station B are cleared to display the green aspect, or if signal No. 7 displays the red-over-flashing-yellow aspect, then 180 code is fed eastward from signal No. 7 to approach signal No. 5, thus causing the spectacle in that searchlight signal to be moved to the green position.

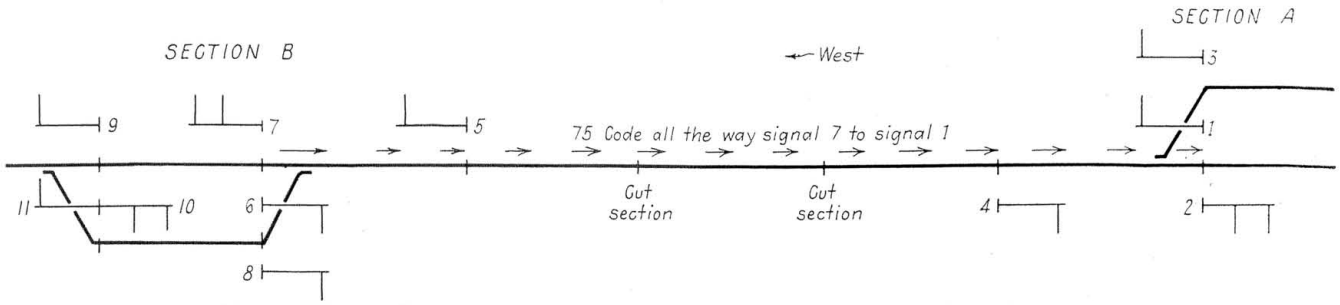


Fig. 7—With traffic-direction westward, and no signal cleared, 75 code feeds eastward

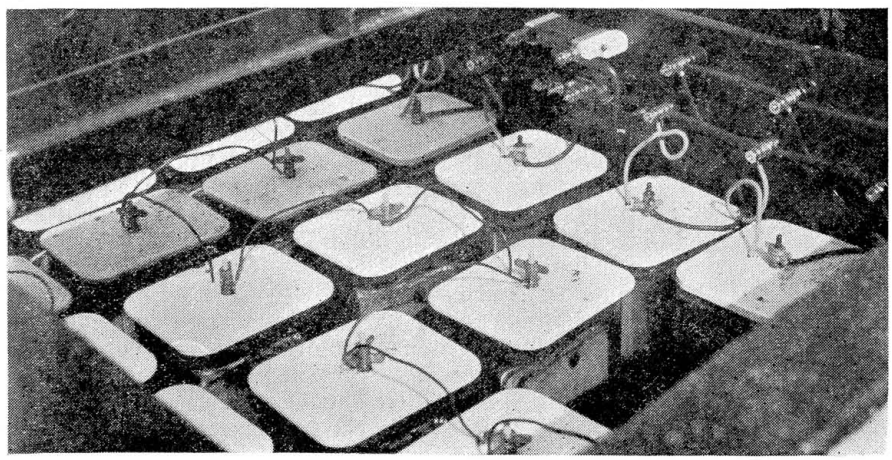
ing point on the turnout, thereby being in line with signals No. 1 and No. 3, rather than being in approach to the facing point of the switch as is common practice in automatic block. This new location of signal No. 3 eliminates the short track circuit through the switch. Therefore, one track circuit extends between approach signal No. 4 and signal No. 1 with a shunt fouling on the turnout to signal No. 3. Thus this track circuit may be up to 7,000 ft. or more in length. If the overall distance between sidings is about 8 miles the distance between the two approach signals may be up to 5 miles, in which case there would be two intermediate cut sections, thus making three track circuits each about 8,800 ft. long. Thus the coded track circuits range from about 6,000 ft. up to about 9,000 ft. in length. The rail joints are bonded with Cadweld bonds. On the turn-

the controller are connected so that when the switch is opened more than ¼ in. the track circuit is opened as well as shunted.

Referring to Fig. 7, in a typical station-to-station block with the traffic direction established westward, 75 code is feeding eastward from signal No. 7 at Station B to westward approach signal No. 5. This causes the spectacle in the searchlight signal to be positioned to the yellow, but the lamp is not lighted. Taking code from a 75 code transmitter at signal 5, this code is fed cascade through as many track circuits as there may be between the two approach signals No. 5 and No. 4. The code is merely repeated through the cut sections, no code transmitters being located at these cuts. At the eastward approach signal No. 4, the incoming 75 code from the west causes 75 code from a transmitter at that signal to be fed on east-

Regardless of whether 75 or 180 code is being received to control signal No. 5, nevertheless 75 code is fed on eastward from signal No. 5 through to signal No. 1. An important point is that track circuit code must feed all the way through from signal No. 7 to signal No. 1, if either signal No. 1 or signal No. 3 is to be cleared.

The signals at the switches are normally lighted but the approach signals are not. When traffic is lined up for a westbound train, the track circuit feed is eastward from approach signal No. 5 and there is a 0.3-ohm relay in series with the battery feeding this code. When a westbound train approaches to within about a mile of signal No. 5, the shunt of the train on the track circuit causes an increased flow of current to the track feed, and this causes the relay to be picked up. This relay in turn closes a circuit to energize a slow-acting repeater relay which in turn closes a circuit to light the lamp in signal No. 5. The lamp in this signal is thus lighted when a westbound train is approaching. The lamp in this signal is not lighted when an eastbound train is operated through the station-to-station block. By thus lighting this signal lamp only when needed, the consumption of the primary battery is reduced.



At an intermediate signal a set of 15 cells of primary battery feeds signal lamp and searchlight signal coil

The section of main track opposite a siding, as for example in Fig. 8 between signals No. 7 and No. 10 at Station B, is connected as one track circuit that can be fed either direction under the control of the dispatcher, the direction of feed being from the exit end to the entrance end. Referring to Fig. 8, if the last train operated was westbound, then the track circuit is feeding from signal No. 10 eastward to signal No. 7. Normally this track circuit is fed at 75 code, and when 75 code is being received signal No. 7 can be controlled by the dispatcher to display the red-over-flashing-yellow to direct a westbound train to pull on down the main track and stop short of signal No. 9. On the other hand, if the dispatcher clears westbound station-leaving signal No. 9 to the green aspect, then 180 track code is sent eastward from that signal to signal No. 7. This 180 code, in combination with control from the dispatcher's machine, causes the green-over-red aspect to be displayed on signal No. 7.

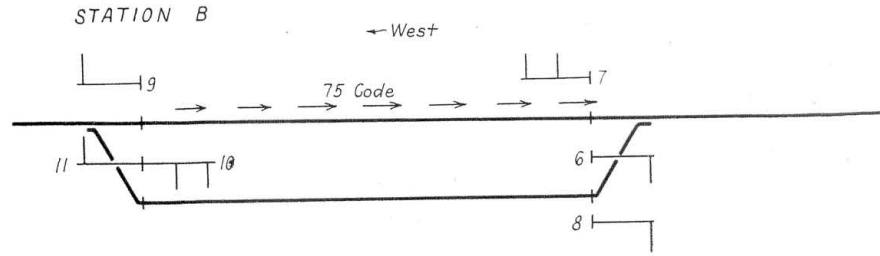


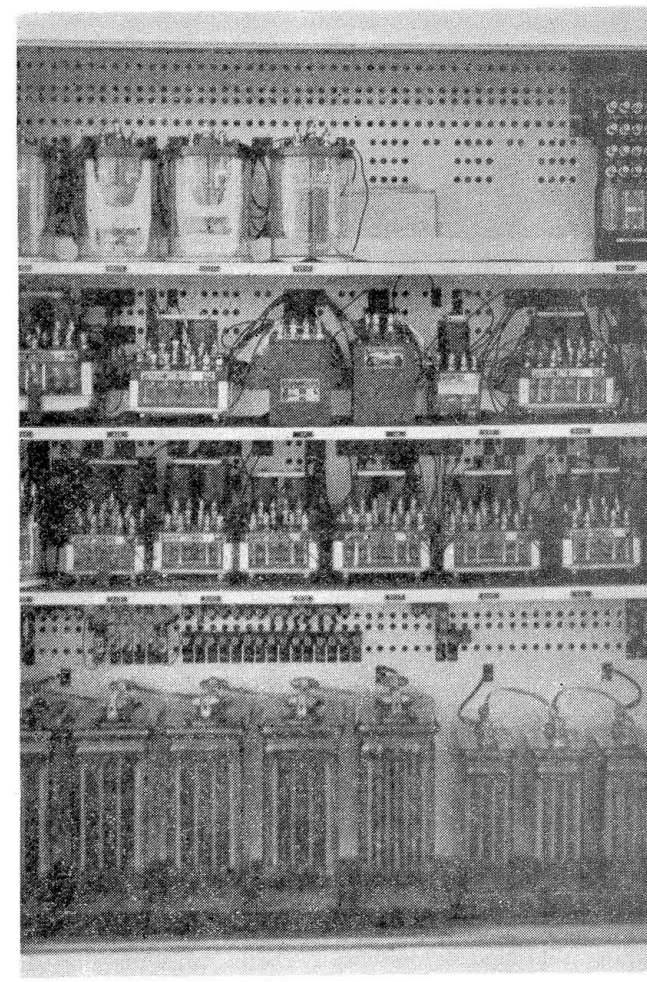
Fig. 8—For westward traffic direction and no signal clear, 75 code feeds from signal 9 to signal 7

Methods of Power Supply

At each intermediate signal there is a set of 16 cells of Edison 500-a.h. primary battery which operates the coil of the searchlight signal, feeds the signal lamp when lighted on approach control, and also operates the 75 code transmitter for the coded track circuits fed from that signal. The mechanism coils of the two approach signals in a block are normally energized. The lamp in an approach signal is lighted only when a train in the direction for which the signal controls is approaching that signal, thus the burning time is a minimum. The track circuit code transmitter is normally in operation but is cut out by approach control circuits when it is not needed, thus saving primary battery. Experience on the Decatur-Starne territory which has been in service since May 21, 1944, indicates that the sets of 16 cells of 500-a.h. primary battery at the approach signals will render a life of about 9 months.

At the approach signals and at the cut section locations there is a separate set of three cells of National Carbon high-voltage 500-a.h. primary cells to feed each track circuit. If traffic is established westward about half the time and eastward the other half, then each of these sets of track battery is in service only half the time. Furthermore, when feeding through the contacts of a 75 code transmitter, the circuit is closed only half the time. Thus the life of these track batteries, in territories where trains run through at normal speed without stopping may range from 9 months to a year.

A commercial supply of 220-volt a-c. power was available at each station, and a distribution circuit on two No. 9 galvanized iron wire was extended to each of the two siding switches. At these switches this 220 volts feed through rectifiers to charge storage batteries. One set of five cells of Exide 120-a.h. storage cells is used to feed the local 10-volt circuits and to operate the line coding equipment. One cell of the same type of battery rated at 60-a.h. feeds each track circuit. Normally the lamps in the signals are lighted from the low-voltage side of a transformer. If the a-c. power fails, these lamps are fed from the 10-volt storage battery. The lamps are the double-filament type rated at 10 + 3.5 watts at 10 volts. The lamps in the approach signals are the single-filament type rated at 5 watts 10 volts.



Interior of sheet metal case at a typical end of a siding, including relays, storage batteries and the coded track circuit apparatus

Installed by the Wabash

This installation of manual block-remote control was planned and installed by signal forces of the Wabash, under the direction of G. A. Rodger, signal engineer, the major items of signal equipment being furnished by the Union Switch & Signal Company. The instrument cases were wired complete in the Wabash signal shop at Decatur, Ill.