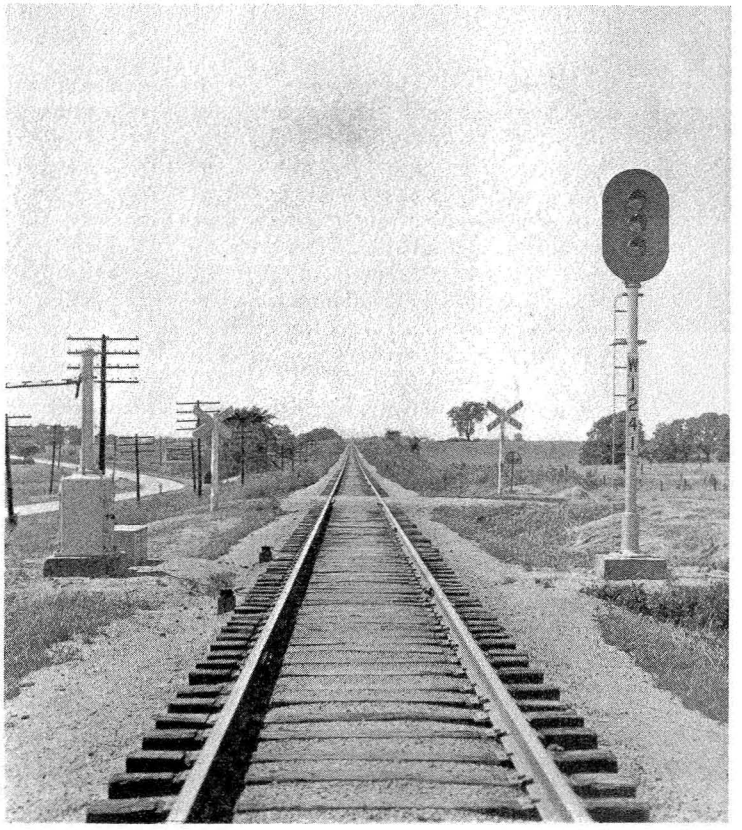
Automatic Signal Program on the Illinois Central

Projects on the Western Lines include new installations on 112 miles and re-signaling on 132 miles—Construction forces well-organized and equipped



Typical intermediate signal

A complete signaling program is under way between Broadview, Ill., and Waterloo, Iowa, 259 miles, on the Western lines of the Illinois Central which extends between Chicago on the east and Sioux City, Iowa, and Omaha, Neb., on the west. For the most part this line is single track.

Between Broadview and Freeport, Ill., 102 miles, the three-position upper-quadrant semaphore signaling with A.P.B. controls which was installed in 1915-18, is to be revised to utilize more modern directional stick controls, and the semaphores are to be replaced with color-light signal heads. Between West Junction, in Freeport, and Scales Mound, Ill., 36 miles, new color-light automatic signaling has been installed. Between Scales Mound and Portage, Ill., 16 miles, lower-quadrant two-position semaphore signaling with overlap controls, installed in 1912, was rebuilt, using new relays, A.P.B. controls and new color-light signal heads. Between Portage and East Dubuque, Ill., the line is double-track with upper-quadrant semaphore automatic signaling, no changes being made. Between Dubuque, Iowa, and Peosta, 14 miles, the two-position lower-quadrant semaphore signaling with overlap controls installed in 1912 was reconstructed, using new relays, A.P.B. controls and new color-light signal heads. At Peosta, the installation includes a power switch machine at each end of a 90-car passing track and new color-light signals, all of which are controlled remotely from a set of desk levers in the station. Between Peosta and Waterloo, Iowa, 76 miles, no signaling was in service before, and, therefore, new A.P.B. signaling with color-light signals is being installed. The installation between Peosta and Masonville, 40 miles, is nearing completion. Thus the new construction and reconstruction involves 244 miles of line on various sections between Chicago and Waterloo.

Character of Line and Traffic

To those who have known Illinois as a prairie state, it may be interesting to note that the northwestern section is rough to the extent of being almost mountainous, the highest point in the state, 1,294 ft. above sea level being at Scales Mound, near the Illinois Central. In passing through these hills, the line includes numerous curves and grades. Between Dubuque, Iowa, and Peosta, the line ascends from 618 ft. elevation at the Mississippi River to 1,034 ft. in a distance of 16 miles, which includes 0.9 per cent maximum grade, numerous curves and bridges to cross streams.

On account of the grades, curves and other local conditions, the passing tracks could not be spaced on a time distance basis, the spacing in some instances is about 4 miles and in others up to 6 miles. A few of the passing tracks will hold up to 90 cars, but most of them will hold about 60 cars.

This line handles 6 passenger trains and up to 34 freight trains daily. The maximum permissible speeds are 60 m.p.h. for freight trains and 70 m.p.h. for conventional passenger trains, the diesel propelled light-weight, Land O' Corn, being allowed 80 m.p.h. as maximum.

The preponderance of high-class freight traffic is eastbound, including about three to four trains of meat between 9 p.m. and midnight, and several trains of western fruit and other products which usually pass through this territory during the early forenoon. The 2,900 class locomotives are rated at 3,000 tons. However, in order to provide service and increase speeds, the meat and fruit trains take whatever is ready to go, thus some of these trains may have only 40 to 60 cars.

In general, the automatic signaling was reconstructed and new sections were added to improve safety and to save train time by permitting following moves at closer spacing and to make closer meets with safety on a line where train movements are authorized by time table and train orders.

Apparatus and Equipment

The apparatus, circuits and equipment are practically the same on the reconstructed and the newly signaled territories, the only difference being that the old cases, masts and ladders, track bonding and some of the old line wire were reused.

In the old "home" and "distant"

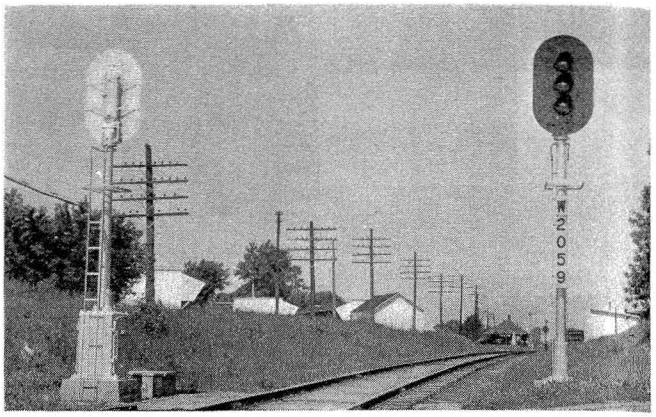
two-position lower-quadrant signaling, the "distant" signals were removed, the home signals being converted to three-aspect color-light signals, and in only two instances was it necessary to move signals to secure proper spacing. With a gas welding outfit, the old masts were cut off to the proper height. The ladders were remade to include platforms for use with light signals, this work being done at the signal locations.

The old mechanisms were removed, the cases being cleaned and repainted. New terminal boards, which were made and wired at headquarters, were installed in these old cases, new relays being installed throughout as a part of the new A.P.B. system of control circuits. Thus, except for the shape of the cases, the reconstructed signaling is the same as the newly signaled territories. The relays are all new. The track relays are the DN-11 neutral type rated at 2 ohms. The polar line relays rated at 150 ohms, are the DP retained neutral type. The advantage of the retained neutral feature is that it prevents a flash of red when the aspect is changed from yellow to green or green to yellow, and no extra slow-release relays are required to prevent such undesirable operation.

Non-Stop Permissive Aspect

The signals present three aspects; green for Clear, yellow for Approach and red as the most restrictive aspect. When encountering a red aspect on an intermediate signal, a train is permitted by rule to pass it, without stopping, proceeding from such signal to the next signal indicating Proceed, at restricted speed not exceeding fifteen miles per hour. This rule, which obviates numerous unnecessary train stops, is a feature of Illinois Central operation which has been in effect for years on this road.

When the red aspect is displayed on a station departure signal, a train is required to stop and it must stay until authorized to proceed. Upon authority, and information from the train dispatcher (or operator or signalman, on instruction of the train dispatcher) that there is no *opposing* train in the block, it may, after filling out block card, proceed at restricted speed to the next signal displaying a Proceed indication. The train dispatcher will make record of information given in train order book. In case of failure of means of communication, or if the train dispatcher does not know that there is no opposing train movement involved, the train or engine may proceed when preceded by a flagman to the next signal displaying a Proceed indication.



Typical head-block double-signal location at an end of one siding

The new signals are the Type-P color-light with the three lamps in a vertical row, the complete unit being mounted on top of the masts. The lamps are rated at 10-volts 18-watts, and are burned at about 9.5 volts. Lamps are lighted continuously except in case of an a-c. power outage at which time approach lighting is in effect. Each signal is equipped with a 2-in. back light in the red unit, this feature being provided as an aid in furnishing information concerning the locations of trains for the benefit of men using motor cars.

Special Features of A.P.B.

The A.P.B. system of controls is used throughout. A double location is located at each passing track switch in the usual manner. In most instances the distance between passing tracks is less than 5 miles, and in some instances as small as 3 miles. In such layouts, the intermediates include two single locations which are staggered. For example, as shown in Fig. 1, the distance between switches is only 3 miles. The spacing between the two staggered intermediates is a minimum of 6,000 ft.

In a layout such as shown in Fig. 1, the control of a signal such as No. 1 is overlapped for direct control of the red aspect for following moves to signal 4. In other words, signal 1 will not change from the red to the yellow aspect until the rear of a westbound train passes signal 4. Eastward signal 6 has a corresponding overlap control. This feature requires two extra line wires between the signals 3 and 4. When the distance between passing tracks is 5 miles and less than 7 miles, two double locations of intermediate signals are used.

Power Supply

Commercial power at 110-volts is available at practically all the stations. Using No. 6 copper wire with weather-proof covering, this 110-volt circuit was extended almost half way from each station to the next, including the last signal or cut section location. Thus a gap of the length of a track circuit requires no 110-volt power line. At each location this 110-volt circuit extends into the case to feed a low-voltage transformer which feeds the rectifiers for charging the batteries, and also normally feeds the signal lamps. At each signal there is a set of five 80-a.h. Exide DMGO-9 storage cells on floating charge from an RX-10 rectifier. This battery feeds line circuits and acts as a standby for the signal lamps in case of an a-c. power outage. One cell of the same type of battery is used on each track circuit, being charged by a 3 X 3 X 104 rectifier.

Two Switch Circuit Controllers Operate Shunts

On the Illinois Central the line circuits are not taken through switch circuit controllers, this being done to

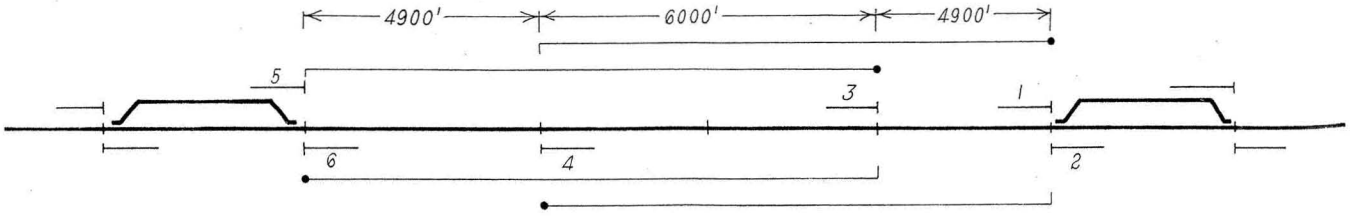


Fig. 1—Arrangement of signals and limits of controls where over-all distance is short

avoid the possibility of grounds. A special feature is that two switch circuit controllers are used at each switch, one being connected to each of the two switch points. The controller connected to the normally-closed point is adjusted to shunt the track if the point is open more than ¼ in., and the other is adjusted to ½ in.

The shunt connections are bare stranded Copperweld wire ⅜ in. in diameter and consisting of seven strands. These strands are run along the sides of ties, being held in place with awning hooks, which have a loop like a staple, but only one shaft to be driven. At the rail these strands end in ⅜-in. plugs which are driven in the web of the rail. At the controller, these stranded conductors are soldered into lugs which are bolted to connectors which extend into the controller boxes, as shown in one of the views.

This same general form of construction, using bare stranded conductors, is used between the rails and the bootleg outlets for track circuit connections. The bootleg outlets are on the same side of the track as the instrument case, so that the stranded connectors, for the "far" rail extend along the sides of the ties. The bolts in the sides of the cast-iron bootleg outlet box are insulated from the box. On the inside of the box, a cable conductor is connected to the same bolt to which the lug is connected on the outside. This cast-iron box is attached by means of hook bolts to a concrete riser pier 2 ft. high with a 2-in. hole in the center for the cable. The track cables are No. 9 single conductor with Kerite insulation and mummy finish outside covering.

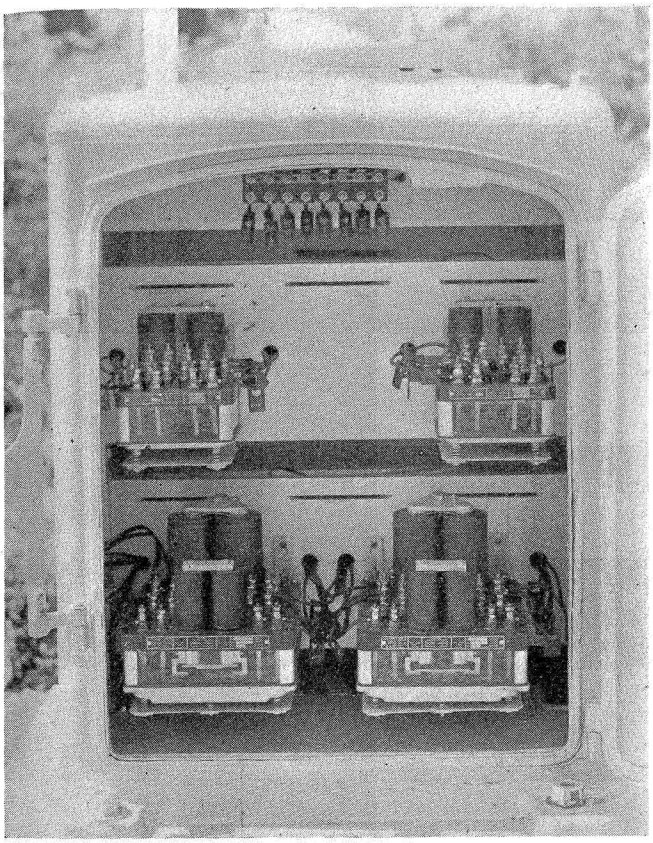
Much of the Construction Work Done at Headquarters

An abandoned railroad warehouse at Dubuque was used as signal construction headquarters, where the cases were wired and other materials prepared for installation in the field.

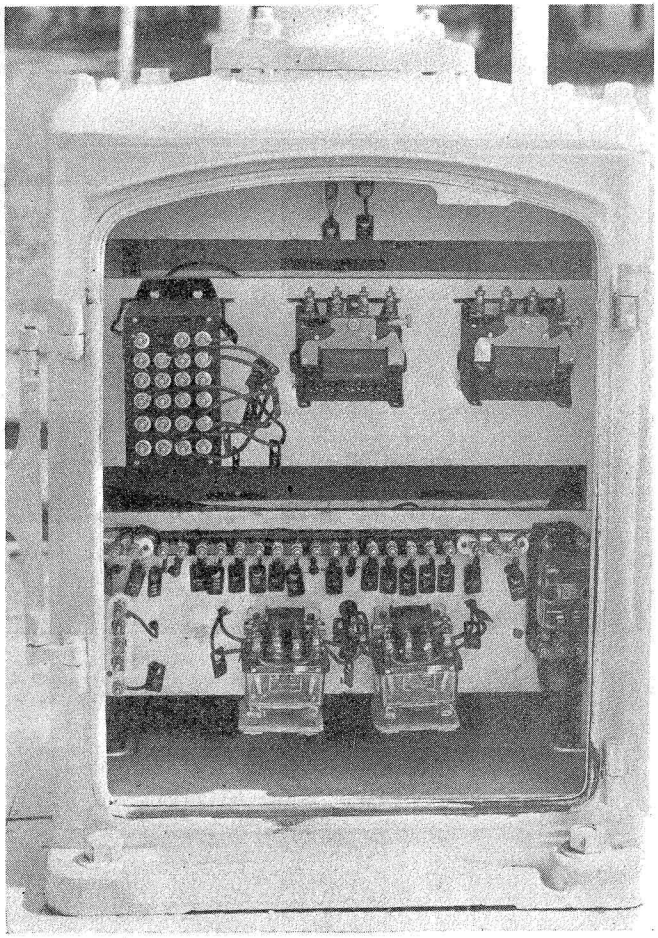
One case of each typical type was wired. Then the wiring was removed to determine the standard lengths of jumpers. Two men were assigned to make jumpers, the wire used being 19 strand, No. 14 flexible with 2/64 in. wall of Okoprene and no tape or braid. Bee wire eyelets were used. Using a Graphotype printing machine, one man made all the tags. Seven wiremen, each working alone on a case, were assigned to install the arresters and terminals as well as the wiring, relays, rectifiers, transformers, etc. On the average, a wireman completed two cases each working day.

In the meantime, another crew made the concrete foundations in a yard nearby, using a power mixer driven by a gasoline engine. The signal foundations are 50 in. high. A 6-in. duct leads from the top of the foundation slanting out to a point about 2 ft. below the ground line on the track side. To form this duct, a section of gas pipe, covered with oil to prevent sticking, is set in the form, and about once every 15 minutes this is turned until the concrete starts to harden, then the pipe is pulled out. Next the ladders were installed on the masts ready for loading. Using low-sided gondola cars, the equipment to be unloaded at a given location was loaded as a group, including the foundations, the wired cases, the masts with ladders attached, and the signal heads.

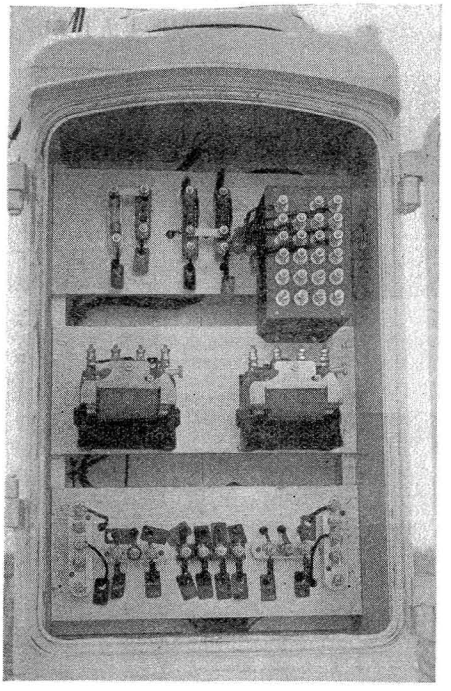
In the meantime, one crew went out on the road to dig the holes on a section on which the equipment could be distributed in one day. The loaded cars were made up in a work train including a car with a Burro crane mounted on rails on the car. On arrival at a location, the foundations were set, the cases were placed, the masts erected and the color-light signals were placed, all with the use of the Burro crane. The crane was operated by a man regularly assigned to



The relays are mounted on the track side of the signal case



The transformers and rectifiers are on the field side



Interior of a case at a cut-section

this work. Two signalmen worked on the cars to select the materials and attach the hooks. Four men worked on the ground to line the foundations, turn down the nuts on the bolts, etc. On the average, the two signals at a double location could thus be installed complete in about 15 min., 25 double locations being placed in one certain day.

Pole Line Work

While the crews were working at the Dubuque headquarters, a line crew did the line work including the installation of new 10-pin. arms and the line wires for signal line circuits and power distribution.

The signal line control circuits are No. 12 copper alloy 30 per cent conductivity, with weatherproof covering. The line circuit for each direction requires one line wire in connection with common, thus totaling three line wires. Between staggered intermediate signals, certain special overlaps require two more line wires.

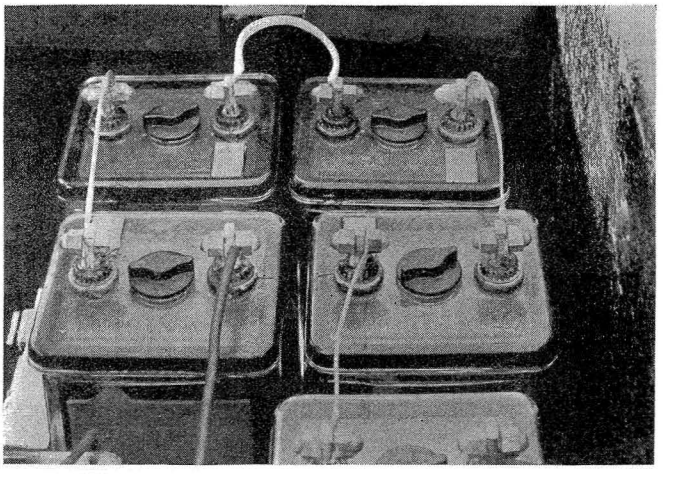
Having completed the work at headquarters and set the signals in place, the signal construction forces concentrated on the work in the field. The camp car outfit includes, two dining cars, five bunk cars, one foreman's car and two tool cars. Two foremen and about 40 men are assigned to this field work.

Signal Work in the Field Was Well Organized

One foreman has charge of the so-called ground work, including the installation of the underground cables, and the bonding. The bonds are of the rail head type using pins in 3/8-in. holes, bonds of three different manufacture being used. Using Raco power machines, two men drilled the holes, two men applied the bonds and one man distributed the bonds, supervised the installations of insulated joints, etc. These five men averaged about three miles daily.

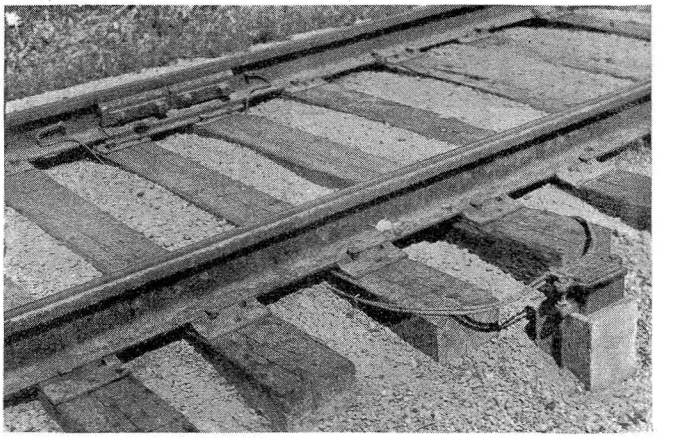
In the meantime, other men installed the underground cable, bootleg outlets, rail connections, etc., and also made up and installed the line drop cables from the line poles to the instrument cases. These men also set the switch circuit controllers and installed the shunt connections to the rails.

A separate crew under a different foreman was known as the hook-up gang. They made the line taps, connected the cables coming into the cases, installed the storage battery,

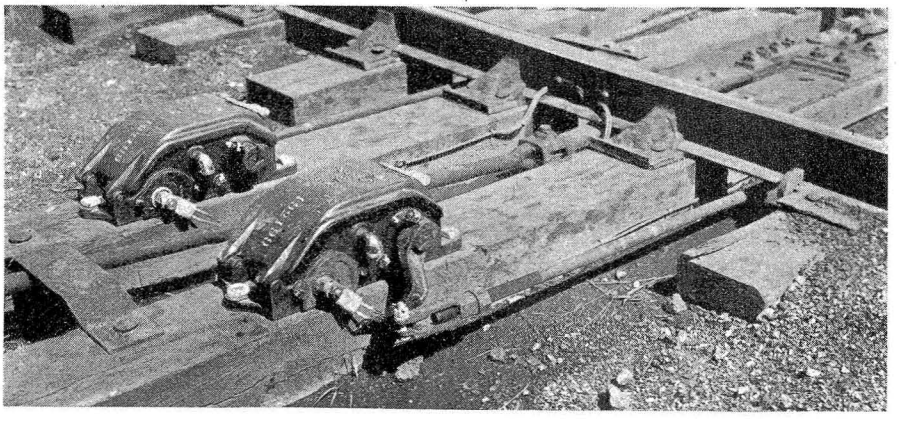


The storage batteries are housed in concrete boxes at signals

Bootleg outlet with stranded connections to the "far" rail



Below—The two switch circuit controllers at a switch with the stranded shunts



and, in general, completed the installation ready for service. With their assistance, the supervisor made a complete check of the circuits and the operations of the signaling.

This signaling program was planned and constructed by the signal department forces of the Illinois Central, under the jurisdiction of W. M. Vandersluis, superintendent of telegraph and signals, and H. G. Morgan, signal engineer. C. M. Bishop, signal supervisor, had charge of the construction forces. The signaling equipment was furnished by the Union Switch & Signal Company.