New Automatic Block Signaling on the

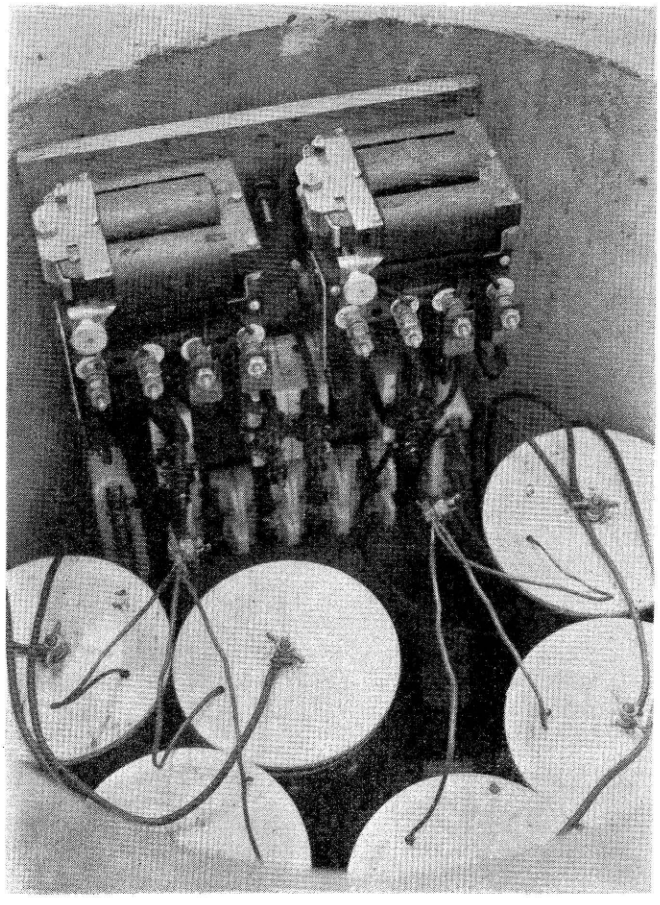
Straight primary and a-c. primary power supply used on single-track searchlight installation

AUTOMATIC block signaling, using absolute permissive block control, has been installed by the Chicago, Milwaukee, St. Paul & Pacific on 14 miles of single track between Marquette, Iowa, and Monona. This territory is a portion of a main line between Madison, Wis., on the east and Calmar, Iowa, on the west. Lines from Madison extend to Chicago and Milwaukee. From Calmar, one line extends north to St. Paul, Minn., and another extends west to Mitchell, S. D. At Marquette, the east-and-west line crosses a north-and-south line of the same railroad extending from La Crosse, Wis., through Dubuque, Iowa and Savanna, Ill., to Rock Island, Ill. The Marquette-Calmar section, therefore, handles not only east and west traffic but also considerable freight between connections at Savanna and points in Iowa, Dakota and Minnesota.

Traffic Handled

Two first-class passenger trains are operated in each direction daily on the Chicago-Madison-Marquette-Calmar-St. Paul route. The freight train schedules are operated to meet traffic requirements for handling live stock, packed meats and other products. One freight is operated daily except Monday, two others daily except Sunday, one is run Saturday only and another Sunday only, the net result being three eastbound freights daily. One through freight is operated westbound daily and another daily except Saturday. A way freight is operated westbound every day in the week except Sunday.

A mixed train, operated daily except Sunday, runs from Marquette to Beulah and then over the branch line to Elkader and back to Marquette. About two or three days each week, this train runs on to Monona to pick up or set out cars. The total number of train movements on the Marquette-Monona section totals 12 daily, with extra trains as may be required. A special condition is that the majority of trains are run during the night.



At cut-section locations, rectifiers are placed in the concrete wells with the primary battery

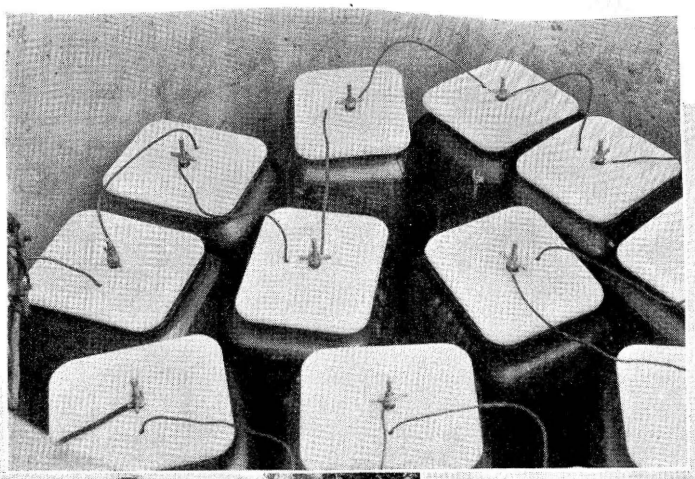
Reason for Signaling

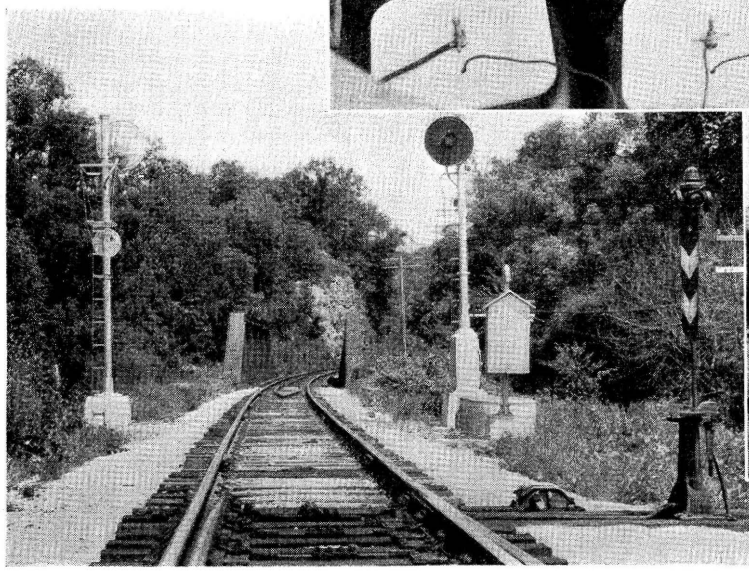
Except for the Elkader branch local mixed train, the traffic between Marquette and Monona is no greater than on the remainder of the 42.3 mile territory between Marquette and Calmar. The reason that the Marquette-Monona section was signaled, is that the line was built up along the valley of Giard Creek, the difference in elevation between Marquette on the Mississippi river and Monona being about 600 ft. The ascending grade westbound varies up to a maximum of 1.19 per cent. In winding along the gorge, the line crosses the creek 30 times, and makes 32 curves ranging up to 8 deg. 40 min. In order to improve train operation in this territory, the track was rebuilt; new 131-lb. rail was laid with heavy tie-plates, good ties and a thick layer of gravel ballast.

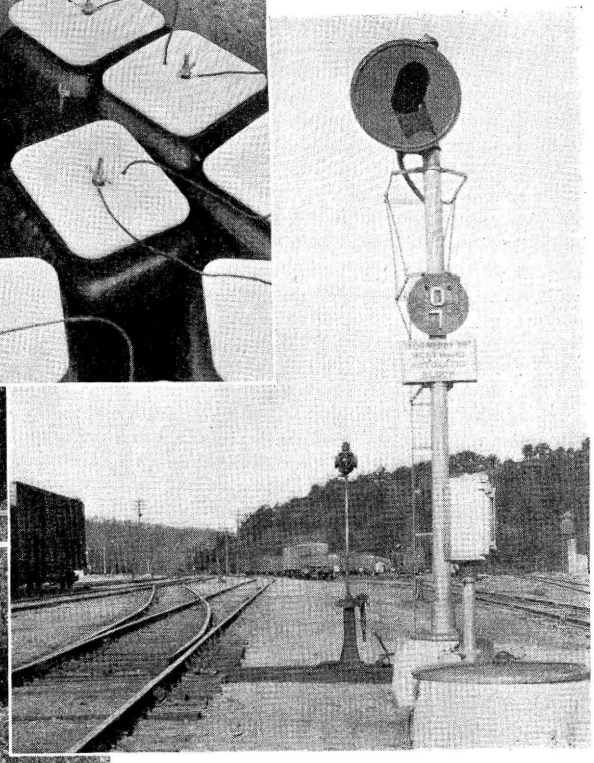
Prior to the installation of the automatic signals, train movements in this territory were authorized by timetable, train orders, and manual block. On account of the numerous curves and high bluffs, the sighting distances are short and considerable time would be required to establish flag protection in case a train stops on the main line.

In various combinations of train movements, the improved safety afforded by automatic block signals was highly desirable in this territory. Furthermore, with the automatic block signaling protection, train movements can now be authorized by

Milwaukee







Above—1,000-a.h. primary cells at Sig. 7-5.
Above—First westward signal at Marquette.
Left—Double location at east end of Giard

time-table and train orders, without the use of manual block, thus reducing delays in many instances.

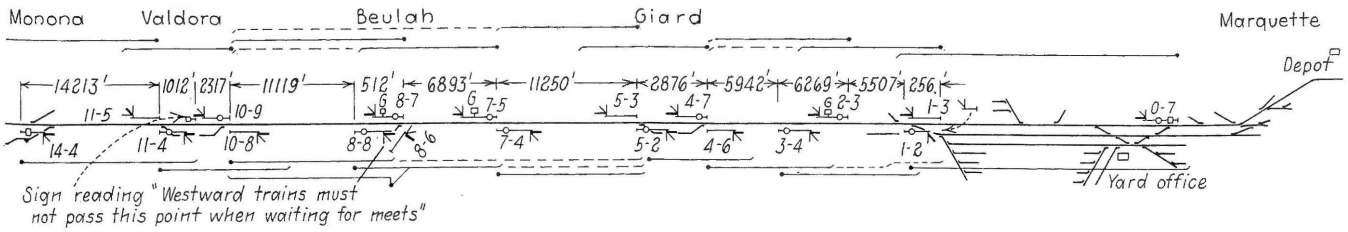
Signaling Layout

When designing the signaling layout, head-block double signal locations were planned at each end of the two passing tracks at Giard and Valdora, and at the west end of Marquette Yard. Eastward signal 1-2 at Marquette Yard serves not only as an automatic block signal but also as facing-point protection for the switch connecting to the lead from the yard, which is equipped with a spring switch mechanism including an oil buffer. A dwarf signal 1-3A on the yard lead governs westbound train movements from this yard lead to the main line. This dwarf signal displays a yellow proceed aspect at all times when the controls are set up for signal 13 to display either a yellow or a green aspect, providing no trains are approaching signal No. 1-3 on the main track, or when the switch is reversed by hand and the block is unoccupied. Two main line signals, 8-7 and 8-8, were located to protect the junction at Beulah, and a signal was provided on the Elkader branch to govern train movements onto the main line. Signals governing entrance into automatic block territory were located at Marquette Yard 0-7 and at Monona 14-4.

The distance between signal 14-4 at Monona and signal 11-5 at the west end of Valdora is only 13,876 ft., and, therefore, no intermediate signals are provided. To prevent two opposing trains from accepting clear aspects on these two signals simultaneously, the control of signal 14-4 is overlapped into the station limits at Valdora, and a sign opposite the end of the overlap track circuit reads as follows: "Westward trains must not pass this point when waiting for meets."

The distance from the east end of Valdora to the west end of Giard is 29,774 ft. or 5.6 miles. The two junction-protecting signals, 8-7 and 8-8, at Beulah serve also as one set of intermediates, and there is another double intermediate location, signals 7-4 and 7-5. The locations of the head-block signals were determined by the locations of the switches, but the locations of the intermediate signals were determined by field checks to choose points at which the signals could be seen as far as possible by the engineman of an approaching train, the locations of curves, bridges and bluffs being considered.

The control circuits are based on the standard absolute permissive block system, arranged to display absolute Stop aspects for opposing moves, and permissive aspects to permit following moves in the same block



Track and signal plan of automatics between Marquette and Monona

between station layouts. The station departure signals, 1-3 at the west end of Marquette Yard, signals 4-6 and 5-3 at Giard, and signals 10-8 and 11-5 at Valdora, as well as the signal on the branch line at Beulah, are all absolute stop signals, Rule 292, and are so designated by the absence of number plates. A telephone is provided in the vicinity of each of these signals, so that, if a train encounters a Stop aspect at such a signal, a member of the train crew can communicate with the operator at Marquette or the dispatcher. By means of a double-pole, double-throw knife switch, any of these telephones can be connected either to a block line or to the dispatcher's circuit.

When a train is ready to pull off the Elkader branch to the main line, the train stops and a trainman secures information by telephone to determine whether the move should be made. If the move is authorized, the trainman throws the track switch, which places all opposing and conflicting signals to display the Stop aspect, then after a 2-min. interval, controlled through a time-element relay, the signals on the branch line will clear.

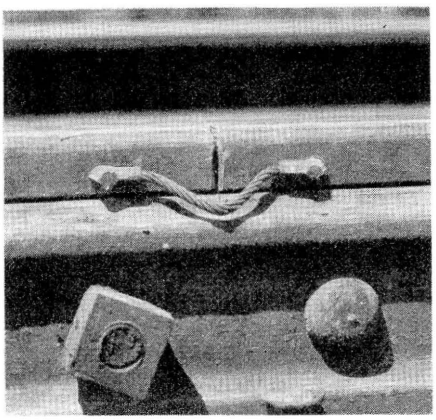
Signals other than the absolute are permissive, Rule 291, as designated by number plates, and a train encountering a red aspect on such a signal is required to stop and wait one minute, and can then proceed at restricted speed, keeping a strict watch for an open switch, a broken rail, a train in the block, or other obstruction.

Signal Controls

The signals are of the d-c. searchlight type with 250-ohm operating coils. The circuit for this operating coil of each signal is extended on a one-wire-and-common line circuit through contacts of track relays and to fingers in a polechanger signal-repeater relay at the next signal ahead.

The pole-changer relay at each signal, except where double approach indications are provided, is energized when either the yellow or green aspect is displayed. This relay is rated at 225 ohms, and has slow-pickup as well as slow-release characteristics. The purpose of using the contacts of this relay, rather than contacts in the searchlight signal mechanism, to pole-change the line circuit for the signal in the rear, is that the slow-acting feature of the relay tides over the period while the signal is changing from yellow to green or vice versa, thus preventing "flash" operations of the signal in the rear.

A 220-volt a-c. single phase circuit on No. 10 w.p. copper line wire extends westward 5 miles from the shop at Marquette to the cut section west of signal 5.3. A similar power distribution circuit extends from Monona, 4 miles east to the cut section east of signal 10-8. This leaves



Typical bonded joint

a gap including signals 7-4, 7-5, 8-7 and 8-8, as well as 8 track circuit feeds at which no a-c. power is available.

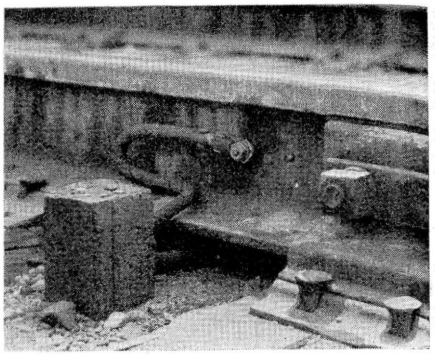
Power Supply System

In this territory where a-c. is available, a set of 13 cells of 500 a.h. primary battery is provided at each signal. An RT-5 Type rectifier, connected across this battery is adjusted so that the rectifier carries about 80 m.a. and the normal discharge from the battery is only 10 m.a., when the pole-changer relay and the line control to the rear are energized. The lamp in the signal is lighted normally from the W-10 transformer, but, in case of an a-c. power outage, an ANL-30 power-off relay switches the lamp feed to the 13-cell set of primary battery. The track relays are the DN-11 type rated at 4 ohms. At each track feed location there is a set of three cells of 500 a.h. primary battery connected in multiple with a RT-5 Type rectifier connected across the battery. On a typical track circuit with 0.55 volt at the battery and a 1.5-ohm limiting resistance, the total current to the rails was 200 m.a., of which 190 m.a. was from the rectifier and 10 m.a. from the battery. At the relay, the readings were 0.53 volts and 127 m.a.

Based on experience gained on other extensive territories on the Milwaukee where this same type of a-c. primary power supply system is used, the 13-cell signal batteries should render a life of from four to five years, and the track batteries at least three years.

At each of the four signals where no a-c. power is available, there is a 13-cell set of 1,000 a.h. primary battery which normally feeds the 225-ohm pole-changer relay, and the 250-ohm coil of the searchlight signal in the rear. At these signals where straight primary is used, the signal lamps are fed on approach control. With 8.9 volts on the battery circuit, the normal discharge is about 90 m.a., and when the lamp is illuminated the discharge is about 2.25 amp. The lamps are of the double-filament type rated at 13 + 3.5 watts. A 13-cell, 1,000 a.h. battery in this service renders an average life of 230 to 255 days.

In the straight primary battery territory each track circuit is fed by three cells of 500 a.h. (or 1,000 a.h.)



Rail connection construction

primary battery connected in multiple. The average life of such a set of battery is about 120 days. All of the battery used on this installation were furnished by Thomas A. Edison, Inc.

Construction Program

The 220-volt a-c. power distribution line wires, as well as the No. 10 w.p. copper line wires for the signal control line circuits, were strung on a crossarm which was added to the existing pole line.

The concrete signal foundations were poured in place from a power mixer on a flat car in a work train. In view of the fact that most all of the trains are operated at night, the track could be used to an advantage during daylight hours by work trains, and, therefore, excellent progress was made. While pouring the foundations, the battery tubs, signal masts and ladders were unloaded at each location.

The instrument cases were wired complete, with the terminals, arresters, tags and jumpers in place, this work being done in the crew headquarters at Marquette. The arresters on the signal line control circuits are the No. 2, Premier type of the Western Railroad Supply Company. A ½-in. by 8 ft. Copperweld ground rod is provided at each location.

The instrument cases, as well as

the searchlight signal heads, were hauled out to the locations on trailers behind motor cars and were installed by the crew which erected the masts and ladders.

The connections from the instrument cases to the rails are in single-conductor No. 9 underground cable, which, at the rail, is brought up through a section of plastic trunking 18 in. long and out through two holes in the side and 2½ in. and 3 in. from the top. In this riser, a second lead is taped on and extends to a second connection on the opposite side of the rail. After this tap connection is made and wrapped with tape, the trunking riser is filled with sand which is topped off with a layer of sealing compound. The rail connections are made with Saco plug-type connectors, as shown in one of the illustrations.

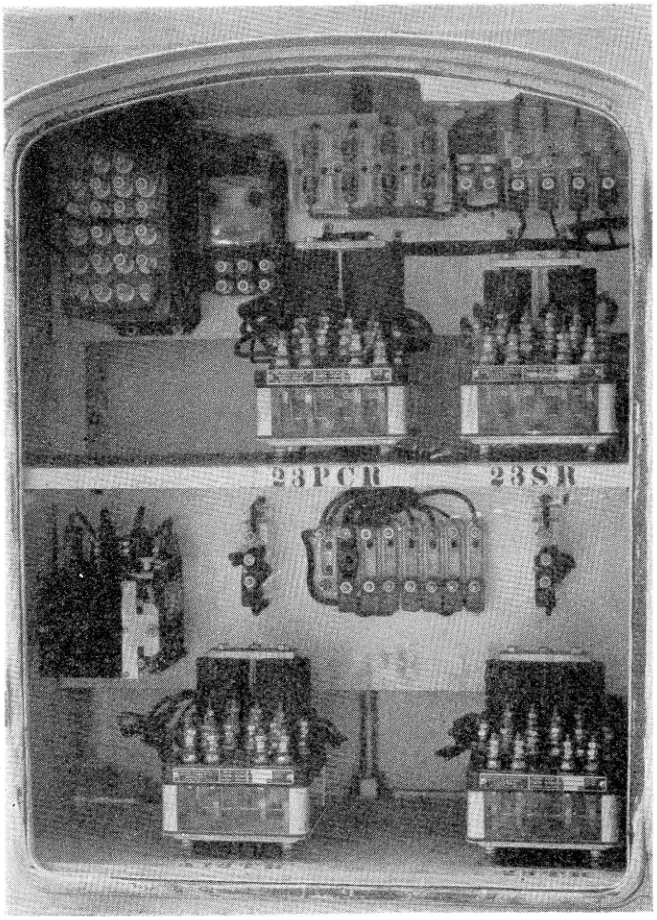
Use of Junction Boxes

An underground cable extends from the instrument case on the pole line side, underground and up to a junction box on the side of the foundation of the signal on the other side of the track. These junction boxes are made of the cases and covers of discarded type U-3 switch circuit controllers. From these boxes, ordinary insulated wires extend up inside the masts to the searchlight signal heads. The underground cable on this installation is of the Kerite mummy finish type, no metal being included in the outer covering.

The cables from the line poles to the cases were made up with No. 14 single conductors with insulation tape and braid, these cables being tied with short wraps of No. 14 insulated wire, the ends of which are striped and twisted around the messenger.

Each rail joint is bonded with a Hammerhead type Ohio Brass Company mechanically applied rail-head bond. Holes for these bonds were drilled with a Raco power drilling machine. All of the drills used for this work were ground on a Sellers drill grinder which insures that both lips of a drill are identical, thus insuring that the holes will be drilled to proper diameter. The insulated rail joints are of the armoured continuous type with six bolts and were furnished by the Rail Joint Company, New York.

The engineering, preparation of plans and construction of this project was handled by signal forces of the Milwaukee under the direction of L. B. Porter, superintendent telegraph and signals. J. Ellefson, signal inspector, had general supervision in the field and V. F. Rathje was foreman of the construction crew. The major items of signal equipment were furnished by the Union Switch & Signal Company.



Interior of typical instrument case showing wiring arrangements

T. & T. Convention

(Continued from page 567)

set applying to telephone maintenance included 87 pages, and a second set applying to the installation and maintenance of single-channel carrier telephone equipment included 52 pages.

The report of subcommittee 2B, presented by R. C. Thayer (G. N.) chairman, included specifications for the installation and operation of telephone directional "OS" train announcers, specifications for the operation of printer start-stop regenerative repeater, and specifications for a five-unit single magnet reperforator. These specifications were all adopted for submission to letter ballot for inclusion in the Manual. In answer to a question from the floor, A. S. Hunt (D. & R. G. W.), explained that his road had several installations of the automatic "OS" announcers. Also, the Erie has one such installation, as explained on page 158 of the March issue of *Railway Signaling*.

Subcommittee 2C, presented by R. A. Hendrie (M. P.), included specifications for utilization and maintenance of the West portable test set, specifications for the installation, operation and maintenance of 1,000 cycle ringing equipment and composite ringing equipment.

Research and Development

The report of Committee 3, Communication Transmission, presented by R. B. Steele (C. N.), included detailed explanations concerning the characteristics of open lines and cables, and carrier transposition systems. The report of Committee 4, Research and Development, was presented by J. L. Niesse (N. Y. C.) who introduced the subcommittee chairmen. The report of subcommittee 4A, presented by R. C. Thayer (G. N.), included directions for making resistance tests of joints in line wires, the use of microphones, and specifications for amplifiers and loudspeakers for use on railroad telephone dispatcher circuits. Several roads reported difficulties in controlling the volume of the output of the loudspeaker in a dispatcher's office which may be caused by the distance from the line stations or variations in speech. Some of the arrangements, used to control the volume automatically, cause a loss of the first syllable of each word. R. A. Clark (N. & W.) explained that his road had several installations which operate on the principle of speech control, not volume control. The equipment is adjusted so that the speech from the most distant station or from the operator with the weakest voice