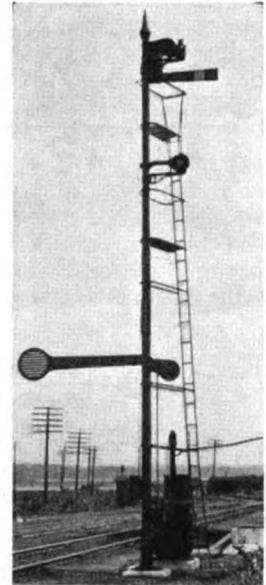


Chicago, St. Paul, Minneapolis & Omaha

# Eliminates Nearly 20,000 Train Stops Annually

By Installing Effective Signal Protection



**Grade crossing with C. M. St. P. & P., gauntlet drawbridge, and  
junction switches controlled by table interlocking  
machine---Mechanical gate protection solves  
light-traffic crossing problem**

**W**ITH an investment of \$13,000, the Chicago, St. Paul, Minneapolis & Omaha has effected an estimated annual net saving of \$10,000 by installing complete signal protection to eliminate an annual total of nearly 20,000 train stops at the Lakeland Jct., Minn., grade crossing with the Chicago, Milwaukee, St. Paul & Pacific, and at the Hudson, Wis., drawbridge over the St. Croix river.

### Operating Obstacles

The St. Croix, a navigable river, is at this point the boundary between Minnesota and Wisconsin. Hudson, on the east bank of the river, is an important city on the Omaha's automatic-signalized double-track line from St. Paul, Minn., to Elroy, Wis., whence the St. Paul-Chicago main line is operated by the Chicago & North Western, of which system the Omaha is a part. At Lakeland Jct., just across the river from Hudson, the Omaha crosses at grade the Milwaukee's branch line between Hastings, Minn., and Stillwater. Here also is a connection between the two roads, as well as a junction with the Omaha's own branch line to Stillwater, which parallels the Milwaukee line. The fact that the double track is gauntleted over the drawbridge, and that the westward main track is used for traffic in either direction between Hudson and junction switch 1, still further complicated the problem of operating trains safely and without delays.

Although the river traffic averages monthly only three or four boats that require drawing the bridge, the Federal law requires that a bridge operator be kept constantly in attendance 24 hours each day during the navigation season. In the absence of interlocking protection, Minnesota and Wisconsin laws required all trains crossing the drawbridge to come to a complete stop before proceeding through the gauntlet and across the Milwaukee branch line. Eastbound trains, also, were required to

stop short of this branch line, despite the fact that the Milwaukee operates here only two (mixed) trains daily, one in the morning and one in the afternoon.

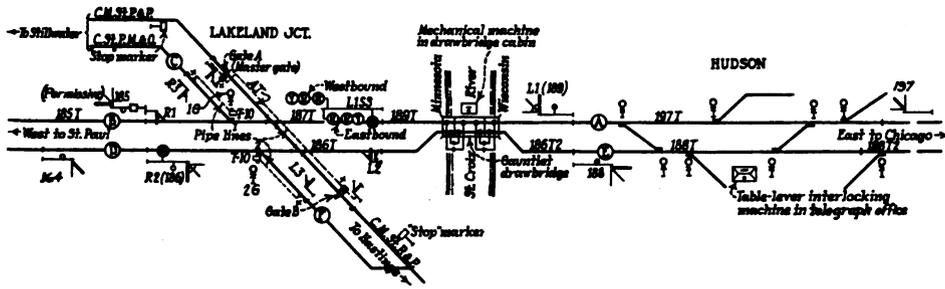
These were not the only obstacles to the efficient operation of trains. The grade on the Omaha double-track main line ascends in either direction out of Hudson, the eastward grade being 1.28 per cent, the westward grade 1.30 per cent. A long eastbound freight train, stopping at Hudson for water, was, under the former system of operation, compelled to make a second stop after its rear end had crossed the drawbridge, in order to permit a helper engine to couple to the rear end for the four-mile help out of Hudson.

It became apparent that a comparatively large saving could be made by eliminating all of these unnecessary stops, and, in 1929, the authorization was granted for the installation of complete signal and interlocking protection for the drawbridge and grade crossing; the new plant was placed in service December 13, 1930. Shortly before the construction work was started, a survey was made, which revealed that, with the traffic prevailing at that time, 10,030 eastbound trains and 9,782 westbound trains annually were compelled to stop for the grade crossing and drawbridge alone, making a total of 19,812 such stops, most of which could be eliminated by the proposed signaling project.

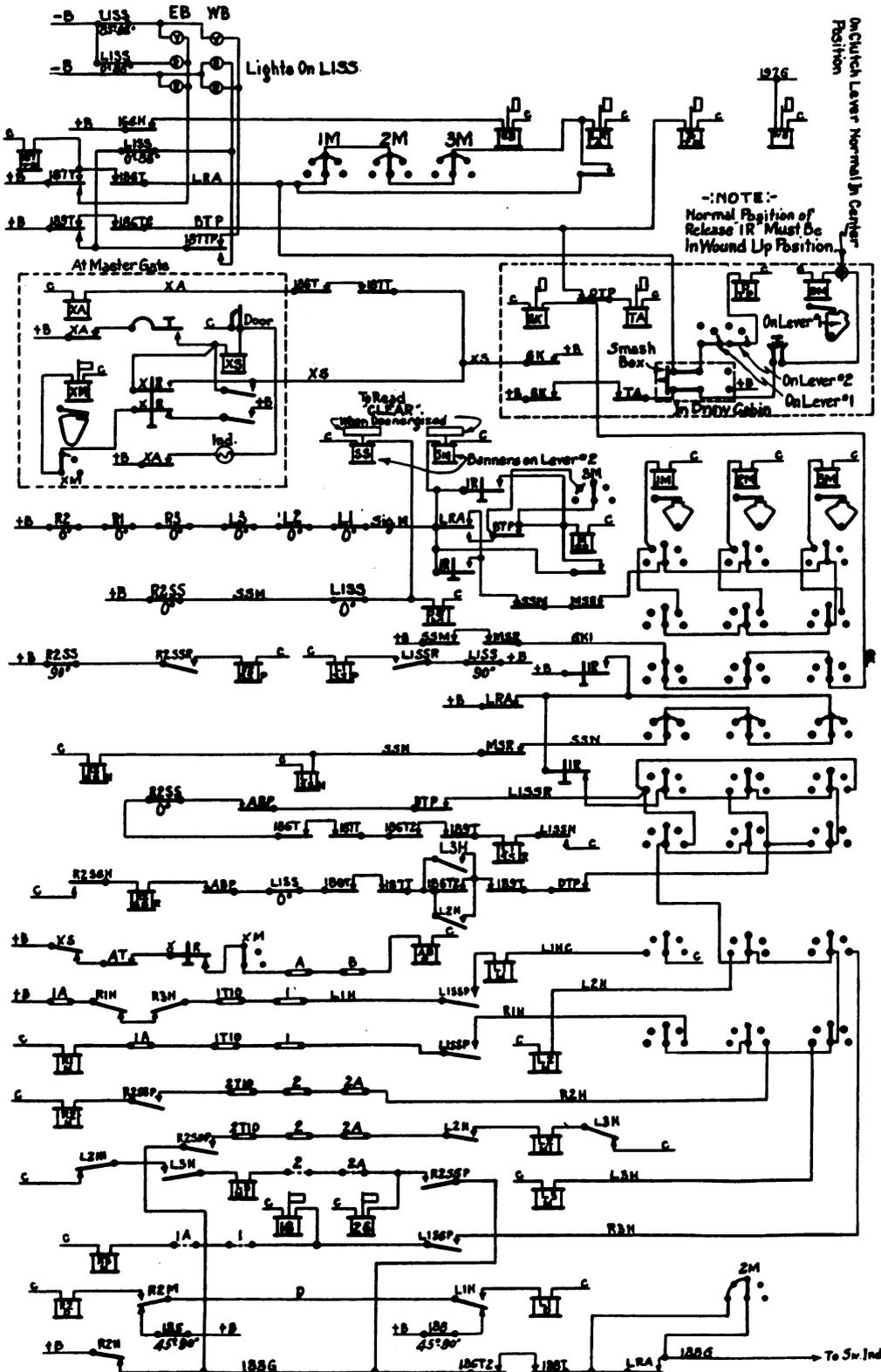
### The New Facilities

In view of the fact that the traffic on the Milwaukee consisted of only one light train in each direction daily, no consideration was given to a plan of eliminating these train-stops. Instead, a very practicable gate-and-signal arrangement was devised which affords ample protection for both lines and eliminates the necessity of stopping the many Omaha trains before they cross the Milwaukee track.

A General Railway Signal Company four-lever dwarf-



The signals, gate-lock, and other functions are controlled by a three-lever table interlocking machine in the telegraph office at Hudson



type mechanical interlocking machine was installed in the cabin on the drawbridge to operate the rail locks, bridge circuit controllers and bridge-mechanism clutch-lever lock, this machine being controlled by the drawbridge operator, who, because of the fact that the drawbridge is a steam-operated plant, is a licensed engineer.

With the exception mentioned below, complete signal protection is provided for every possible movement at the grade crossing, drawbridge and two junction switches. The smash signals shown in the track-and-signal diagram were installed, by order of the Minnesota Railroad & Warehouse Commission, to assure obedience to the high home signals for the crossing, these signals serving also as home signals for the Minnesota side of the draw. With the consent of the Wisconsin Railroad Commission no smash signals were installed on the Wisconsin side, nor was a signal required for a back-up movement through the draw from the Wisconsin side, these movements being handled on the dispatchers' authority. The arrangement of the signals and gates is shown in the illustration.

A Style T-10 Union hand-operated switch mechanism, pipe-connected to a Hayes Type-HP6 derail, is used for the protection and operation of each of the two junction switches. Besides the circuit controller in this mechanism, a switch circuit controller is connected to the normally-closed switch point, also. This apparatus provides double circuit-controller protection, as well as facing-point-lock protection. Further protection is afforded by switch indicators, this equipment being standard on the Omaha for all main-line switches in automatic block signal territory.

Excepting signal L1SS,

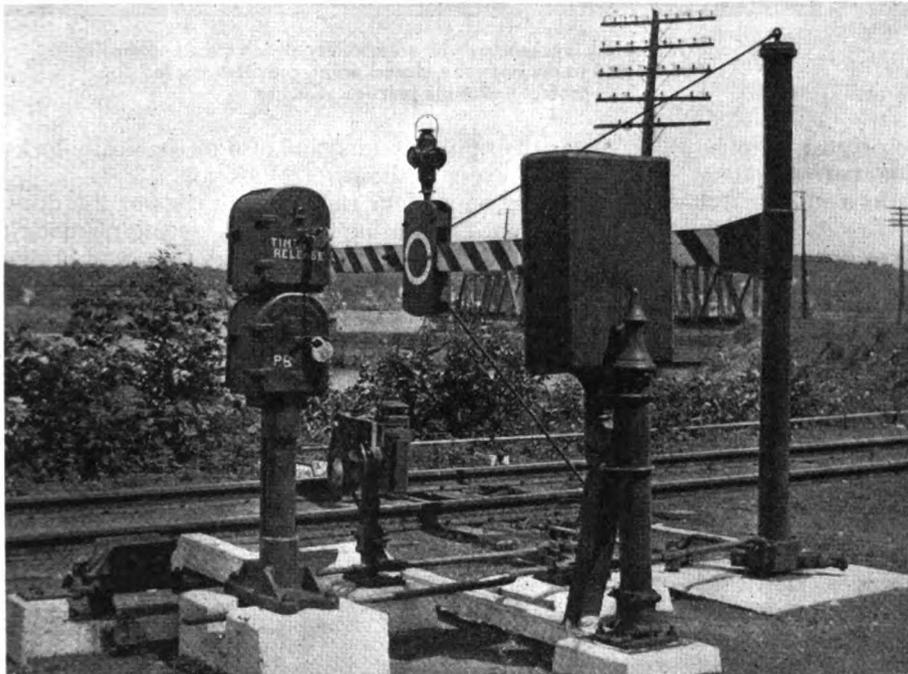
all of the signals are of the semaphore type, which is used in the adjoining automatic block signal territory. The power signals are Model 2A.

The ultimate control of all the signals, gates and junction switches in the entire plant is vested in a General Railway Signal Company three-unit table-lever interlocking machine in the Hudson depot telegraph office, where it is operated by the telegraph operator. Since this is a three-trick telegraph office, the installation of this interlocking machine did not necessitate any increase in the operating force.

### Gate Arrangement for Grade Crossing

The gate-and-signal arrangement protecting the Milwaukee grade crossing is one that has met with success at other crossings on the Omaha where the traffic on the foreign road was so light that comparatively little was to be gained by eliminating those train-stops. The master gate, *A*, is pipe-connected to gate *B* and the two corresponding signals. An outlying-switch-type electric lock at gate *A* protects against improper operation of the

graph operator at Hudson. If the trainman receives the operator's approval, he will return to the gate-lock and operate the push-button as explained in the preceding paragraph. If this does not release the lock, he will operate the clock-work release in accordance with instructions posted in the release case. An "ultra emergency" release is provided in the form of a sealed link in the lock rod, which may be broken in the case that it is impossible to obtain a release by using the clock-work mechanism. Authority to break this seal must be obtained from the telegraph operator, who is required immediately to notify the signal maintainer of this action.

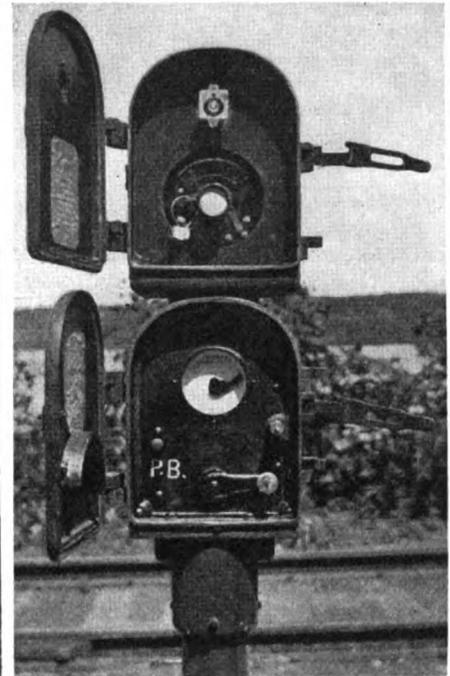


gates, and a switch circuit controller, pipe-connected to each gate, is used for checking the control circuits of the conflicting signals.

After a Milwaukee train has come to a stop, the trainman proceeds to the lock case and opens the door marked P. B. With this door open, the table-lever interlocking machine levers at Hudson all normal and no trains approaching from either direction on the Omaha, the lamp in the upper case will show a white light. The trainman then operates the push-button marked P. B.; this completes the electric lock circuit and causes the gate-lock lever to be unlocked, permitting the trainman to operate this lever to the left. This in turn lifts the plunger out of the lock rod connected to the master gate, whereupon the gates can be cleared for the movement of the train. This method of releasing the lock and operating the gates is simple and requires less than a minute's time after the trainman has arrived at the lock case.

In the event that the indication lamp is not lighted with the lower door wide open, the trainman will first satisfy himself that no Omaha train is approaching from either direction. He will then use the telephone, installed nearby for this purpose, to communicate with the tele-

Close-up of the electric gate-lock equipment



Manually operated gates effectively solved the light-traffic grade-crossing problem

The color-light units attached to the mast supporting smash signal *LISS* serve as a repeater of the smash blade, and govern movements in either direction on the westward main track. This signal was made up by using G.R.S. marker light units with 10-volt 10-watt lamps.

### Smash Signals on Minnesota Side

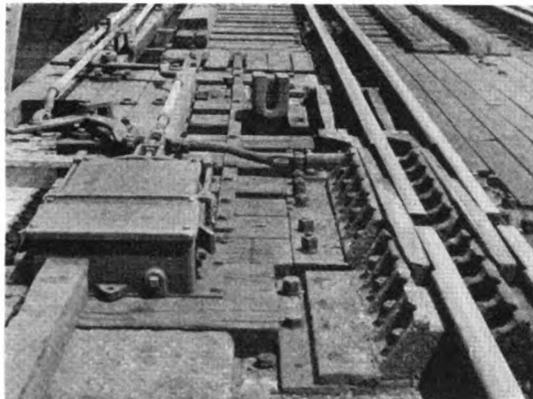
Each smash signal, instead of being directly connected to the motor mechanism, is pipe-connected with an up-and-down rod. This permits of the mechanism being placed just above the mast base casting where it can be hand-operated, in the event of a power failure, by a man standing on the ground instead of on a ladder. This is in line with Safety First principles strongly advocated on this road.

Shortly after the plant was installed, several failures occurred when a trainman would use the hand-crank and improperly replace it in its case, the result being that the common return circuit for the smash-signal mechanism remained broken and the plant therefore inoperative. To overcome this defect, a wood lining was built for the hand-crank case, of such a shape that

it is now impossible to replace the crank in any but the correct position.

Signals *R3* and *L3* are controlled through the table interlocking machine at Hudson in such a way that they can clear only after switch *1* or *2*, respectively, has been reversed by the trainman with the acknowledgment of the telegraph operator.

When the telegraph operator throws lever No. 3 to



Rail locks and bridge circuit controller



A Style-T10 switch mechanism, with an auxiliary switch circuit controller connected to the normally closed point, provides ample protection for the junction switches

the right or left, depending upon which signal is to be cleared, the switch indicator near the corresponding switch will clear, providing that conditions are correct for it to do so. The switch indicator in the clear position is the trainman's authority to throw the switch. Because of the nature of the signaling it is not desirable to be able to clear *R3* and *L3* simultaneously, since the only function of the latter signal is to protect an eastbound movement (through the gauntlet) originating at *F*. That is, signals *R3* and *L3* are, in effect, conflicting signals, and, therefore, can most effectively be controlled by the same lever.

### Stop for Helper Eliminated

Signal *L3* is used principally in eliminating the second stop previously required when helper engines were coupled to long freight trains at Hudson, as described in an introductory paragraph. Under the present system of operation, the helper engine for a heavy eastbound train will leave Hudson prior to the arrival of the freight train, and will cross the drawbridge on train-order authority. It will then get in the clear on the connecting track in the rear of signal *L3*. As soon as the freight train has stopped at the water tank the telegraph operator will throw lever 3 to the left to clear the switch indicator for switch 2, thereby enabling the helper-engine pilot to operate the switch and clear the signal. The helper engine then enters the main track, is coupled to the rear of the train and the train is ready to "highball" as soon as the head engine has taken water.

Westward movements past signals *L1* and *L1SS* and eastward movements past *R2* are most frequent. These routes are automatically lined up when the operator properly manipulates the levers of the table interlocking machine. For instance, to clear *L1*, the operator throws lever No. 1 to the left. Assuming that conditions are correct, smash-signal *L1SS* and signals *L1SS* and *L1* will clear. Similarly, signal *R2* and smash-signal *R2* will clear after the operator has thrown lever No. 2 to the right, if all other conditions are correct. Mechanical locking between levers No. 1, 2 and 3 prevents any improper manipulation, and a clock-work time release enables the operator to change routes when necessary.

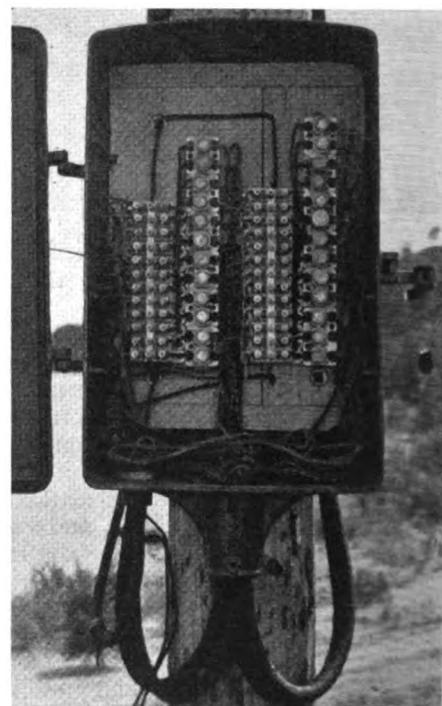
A G.R.S. four-lever dwarf interlocking machine was

installed in the drawbridge cabin. Lever No. 4 operates the bridge track-circuit controllers on each end of the draw span; lever No. 3 the facing-point locks used for rail locking, as well as the clutch lever in the engine room, when the latter is in the center or normal position; and lever No. 2 the signal controller. Lever No. 1 is a master lever which is locked electrically in both the normal and the reverse position, and which, like lever No.

2, controls the signal circuits, and also mechanically locks all the other levers in the reverse position.

Rail locking on all four rails on both ends of the draw span is obtained by using a G.R.S. facing-point-lock casting with the lock-rod end cut off. A four-way bridge circuit controller at each end of the span makes and breaks the track circuits, around only the dead space at each end of the draw span.

Two 14-conductor No. 14-solid Trenchlay aerial cables carry the control circuits the full length of the draw span. These cables are terminated in a four-way



At each end of the draw span the aerial cable terminates in a four-way relay box

relay box at each end of the span, where each conductor is fused and arrested. A 10-conductor No. 14-solid aerial cable carries the control circuits entering the drawbridge cabin from the arrester box at the west end of the draw span. The aerial cables are suspended from

$\frac{3}{8}$ -in. 7-strand, 6,000-lb. Copperweld messenger wire, using  $1\frac{1}{2}$ -in. National Copperweld cable rings. Five- or seven-conductor modified Trenchlay cable is used for all of the underground wiring, which comprises the wiring between each relay case and its related units. All open line wire is No. 10 double-braid weather-proof 40 per cent conductivity Copperweld. The ground rods are  $\frac{3}{8}$ -in. 8-ft. Copperweld clamp-and-safety-screw type.

Direct current, taken from 500-a.h. Edison primary batteries, is used for the operation of every electrical unit, as a-c. power is not available. All relays used in the installation are G.R.S. Type-K neutral. Three Graybar Electric Type-M magneto telephones are in service at the gate and at signals *L1* and *R1*, for the use of the trainmen in communicating with the telegraph operator at Hudson.

The maintenance force was not increased. The signal maintainer and helper maintaining this new plant maintain also another 16-lever G.R.S. Model-2 all-electric interlocker, 4 crossing signals, and 16 Model-2A automatic signals, in addition to having charge of the division signal store-room.

Completion reports showing the actual cost of the plant are not as yet available, but the cost is estimated to be \$13,000, borne entirely by the Omaha. The net annual saving to the latter road is estimated at 78 per cent of this expenditure.

Plans and specifications for the plant were prepared under the direction of Geo. Boyce, superintendent of telegraph and signals, and W. C. Johnson, general signal supervisor. The work was done by the Omaha's signal construction forces, in charge of F. W. Bleier, signal foreman.



## C. & I. M. Installs Interlocking

(Continued from page 336)

which are plainly seen in daylight and stand out at night due to light from the head lights of an approaching automobile being reflected in the sign. The sign and light unit are mounted on a four-inch Arco cast-iron pipe post set in concrete. This special type of warning sign was developed by the C. & I. M. to meet the requirement at this particular location, ordinarily this road uses the standard A. R. A. Signal Section type of flashing-light crossing signal.

The wiring distribution from the tower to the signals and switch machines on the C. & I. M. is in parkway cables run in vitrified clay duct lines extending from the tower to concrete manholes located at central points on the plant. From these manholes parkway cable buried in the ground is run to junction boxes on the signal foundations or to the controller units at the switches. Single conductors are used from these junction boxes to the signals or switch machines. Likewise parkway cable is run to Union pipe pedestal type parkway outlets out the rails.

The wiring distribution on the Wabash is all overhead, using bunched multi-conductor braided cables suspended from messenger cables supported on the pole line.

The insulated wires and cables were furnished by Kerite and the storage batteries by Exide. The Union Switch & Signal Company furnished the remainder of the interlocking materials and installed the plant complete under the jurisdiction of C. H. Paris, chief engineer of the C. & I. M., to whom *Railway Signaling* is indebted for the information in this article.

## Michigan Adopts Crossing Signal With "Stop-on-Red" Sign

**D**URING the 1931 session of the Legislature of the State of Michigan an Act was passed regarding highway-railway grade crossing protection.

Section 3 of this act requires the State Highway Commission to install and maintain on the highway, approach warning signs not less than 250 ft. nor more than 350 ft. from each crossing. Section 5 has to do with the standard crossbuck signs including additional information as to the number of railroad tracks, for example, "Railroad Crossing 2 Tracks."

Section 8 deals with the automatic highway crossing signals and is given in full as follows:

"Section 8. When in the discretion of the Michigan Public Utilities Commission the safety of the public shall hereafter require that some protection device or improvement in existing devices be provided at a railway crossing to warn of the approach of trains about to cross the highway, it shall be the duty of the Michigan Public Utilities Commission and it is hereby empowered to order the railway authorities owning the tracks of such crossings to provide protection of a flashing-light type equipped with a gong of approved type at each signal which shall, unless otherwise agreed upon by the highway authorities responsible for the maintenance of the highway, be installed on the right-hand side of the highway approaching the crossing from each direction on the near side of and at a distance from the center line of the outside tracks to be determined by the railway authorities and at a distance from the center line of the highway and above the crown of the roadway to be determined by the highway authorities responsible for the maintenance of the highway. All flashing-light types of protection shall consist of two eight-inch diameter lights equipped with red lenses and reflectors mounted side by side on an appropriate standard arranged to flash alternately, each light to be visible from both directions on the highway. All standards carrying flashing lights shall also carry at a height to be specified by the highway authorities, a crossbuck design bearing the designation "Railroad Crossing . . . . . Tracks", with letters studded with reflecting buttons, this design conforming to the requirements for "Crossing Signs" as specified in this act. The standard shall in addition bear the designation "Stop on Red" in reflecting-button design of similar type to the crossing sign. Whenever flashing lights are installed at any crossing and the Michigan Public Utilities Commission shall find it necessary, they shall be so arranged that for every train or switching movement over the crossing, the flashing lights shall be in operation for a period of not less than 20 sec. nor more than 60 sec. in advance of the train movement reaching the nearest established curb line of the highway and the flashing lights shall continue to operate until the train movement has passed the established curb line on the near side of the highway. The cost of all flashing-light installations and alterations or relocations of same shall be borne equally by the railway and highway authorities, and thereafter they shall be maintained by the railway authorities at their own expense except that the highway authorities shall pay \$10 per month to the railroad authorities for each crossing protected by flash-light signals. The railway authorities shall, however, furnish standard equipment uniform for all railroads and on a cost and installation basis consistent for all railroads and unusual or unbalanced costs shall be subject to the review and adjustment of the Michigan Public Utilities Commission."