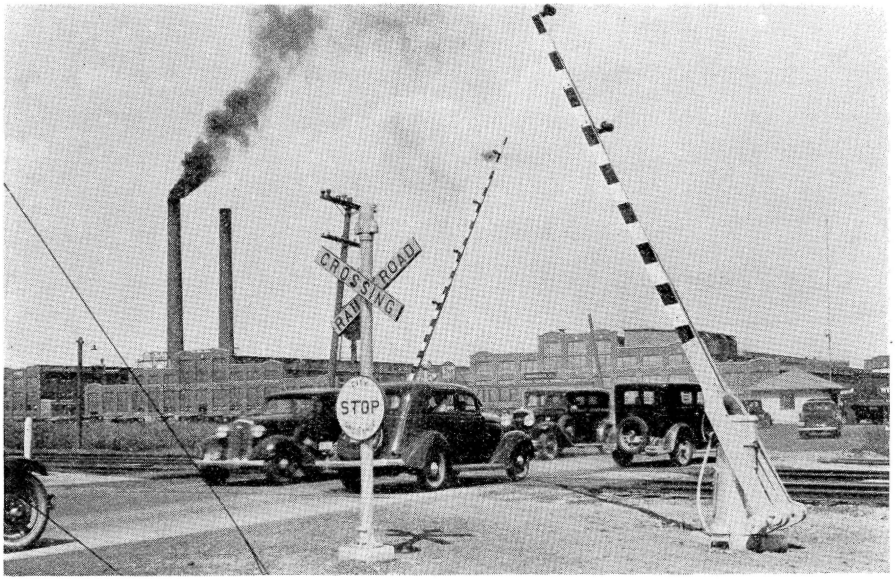
Railway Signaling

North Western Installs Automatic Gates



Heavy automobile traffic is handled on the highway where it crosses the double-track main line

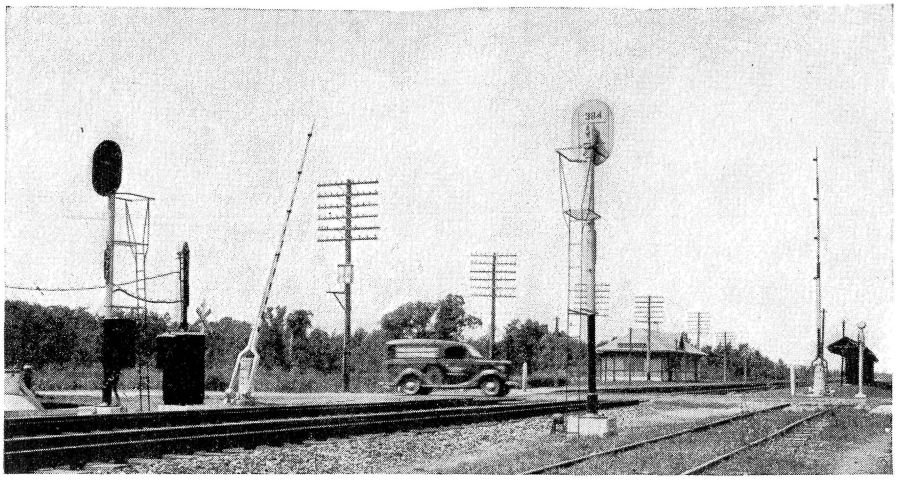
Improved protection in service 24 hr. daily—Replaces part-time watchman service at reduced operating expense

At the Greenwood Avenue crossing in Waukegan, Ill., the Chicago & North Western has installed automatically-controlled, electro-hydraulic gates in order to reduce the hazard and provide full 24-hr. protection in place of 16-hr. watchman service formerly in effect at this crossing.

At this location an east and west highway crosses the Milwaukee division double-track main line, which is used by high-speed through trains, such as the "400" and other passenger trains, aggregating 30 scheduled passenger trains daily, in addition to several freight trains.

This section of Greenwood avenue is the main route for motor traffic to and from the extensive asbestos plant of the Johns-Manville Company and the power plant of the Public Service Company of Northern Illinois, located just east of the tracks. In addition to numerous trucks, the highway traffic includes the private automobiles of several hundred employees who use the crossing going to and from work. The Johns-Manville plant is in operation 24 hr. daily, and when the shifts change at 7:30 a. m., 3:30 p. m. and 11:30 p. m., a continuous stream of traffic moves over the crossing for half an hour or more. In addition to other problems, the view from an eastbound vehicle toward northbound approaching trains is obstructed by a hotel building located on the west side of the tracks and south of the highway.

This crossing was formerly protected by a watchman, two tricks covering the period from 6 a.m. to 10 p.m. When the employees of the asbestos plant were leaving for home or, especially, when they were arriving to go on duty, some of them were so insistent about proceeding over the crossing that the watchman had difficulty in preventing them from crossing in the face of approaching trains. When the Johns-Manville plant increased its schedule to capacity and its continuous operation resulted in a much greater use of the crossing, prompt action was taken by the railroad to improve the existing protection and the installation of automatic gates was decided upon. This proposition met with the instant approval of



General view of crossing looking north, showing the gates, automatic block signals and instrument housings

the local, city and factory officials and was also approved by the Illinois Commerce Commission.

The concrete pavement of the highway approaching the crossing from the west is 20 ft. wide. Cinder filling, level with the pavement, extending from the pavement to the north line of the highway, provides a sidewalk for pedestrians. Owing to the heavy pedestrian traffic over the crossing, it was decided that the gates should be located so as to include the sidewalks as well as the roadway.

Location of Gate Posts and Length of Arms

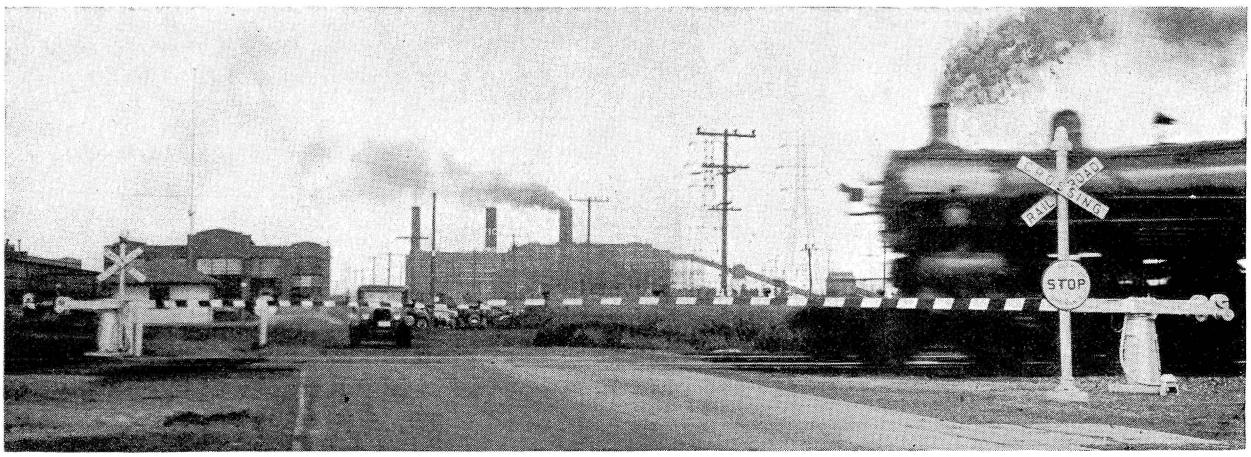
The next point for consideration was to decide how far each gate arm should extend over the highway. As applied to gates controlled automatically, the Illinois Commerce Commission has approved the use of a gate that extends over the right half of the pavement as viewed by a motorist approaching the crossing. The theory of this is that obstruction of the normal path of travel affords adequate protection, and should the gates fail in the lowered position or are so held by a train stopped on the control circuits, the highway will not be blocked indefinitely because, after a driver has stopped and has ascertained the position of trains, he can, if necessary, turn out to the left and pass around the end of the gate arms. The use of arms blocking only the right half of the roadway, has another advantage in that vehicles on the track, when the gates are lowered, may leave the crossing without hindrance.

The representatives of the North Western decided to use the method approved by the commission with respect to the location of the gate posts and the length of the arms. As installed, the gate posts are 15 ft. from the edge of the pavement, while the arms are 27 ft. long so as to extend 2 ft. beyond the center line of the 20-ft. pavement. The gate posts are located approximately 18 ft. from the nearest rail.

In addition to the gates, a standard crossbuck "Railroad Crossing" sign, mounted on a pipe mast, is located at the right of the highway approaching from each direction. In addition, there is a city ordinance circular STOP sign for each direction of approach. These crossbuck and stop signs were in service prior to the installation of the gates. A standard crossing bell, installed as a part of the gate project, is located on the top of the sign post east of the tracks, which rings automatically from the time a train enters a control circuit until the gates are down.

The next question was to decide what kind and number of lamps were to be used on each gate, and how they were to be controlled. As viewed from a distance, the two gate arms present the appearance of one gate or barrier extending entirely across the highway. In order that the night aspect should duplicate the day aspect, as just explained, a row of red lamps across the entire highway, visible to highway traffic in both directions, was attached to the top edge of the gate arms. In order to cover the entire width of the highway and outline the length of the arm, four lamps were provided on each arm. The lamp on the tip is located as near as practicable to the end so as to mark the extent of the arm when down. The other lamps are spaced five feet apart.

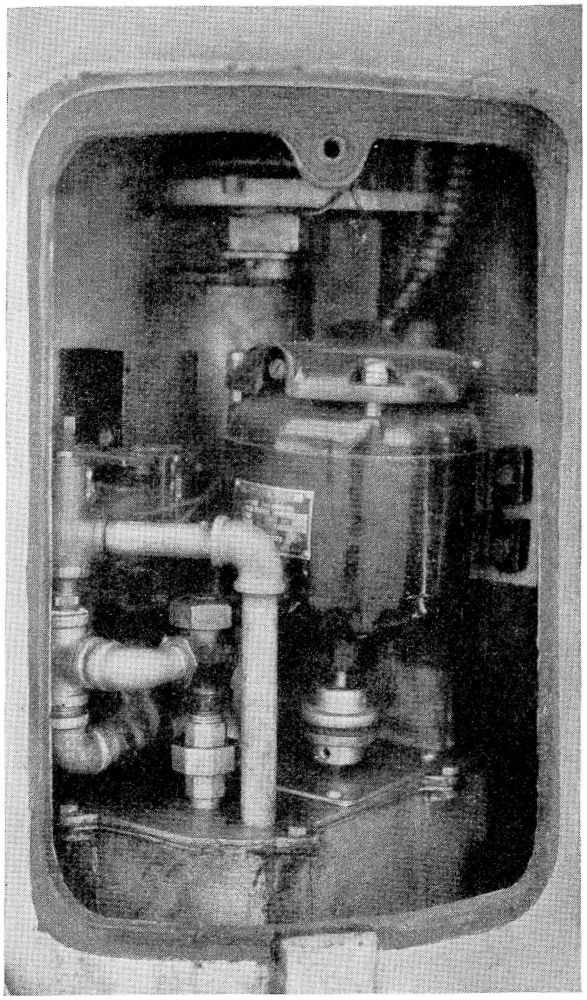
With the thought that the lamps should perform the function of a long-distance warning to a motorist approaching at speed, a three-inch, optical-type lens was adopted affording a long-range aspect rather than using a wide-angle lens which would give a good short-range but would be unsatisfactory at longer distances.



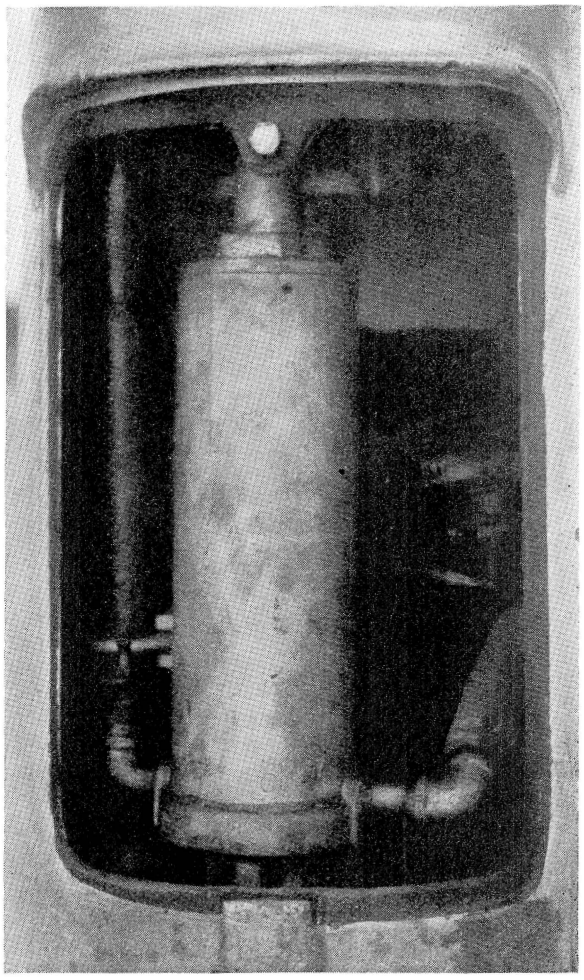
When the gates are down, it appears to the driver of an approaching vehicle that each arm extends across the entire width of the pavement

After considering these factors, the Western Railroad Supply Company's Type-1553 lamp, with cast-aluminum body, was adopted.

The lamps are equipped with 10-volt, 10-watt bulbs, and are lighted continuously whenever a train is occupying an approach control circuit and, in addition, remain lighted until the gate arm is raised to its normal position. By this scheme the position of the arm is clearly defined at night, and the probabilities of its warning being unintentionally violated are remote. The normal control of the lights is effected through the regular approach circuits. The lamp feed is paralleled by a circuit controlled through a mercury contact on the gate mechanism, which remains closed except when the gate is raised to its normal position. The lamps are normally fed by a transformer from the a-c. source and, in case of an a-c. power failure, are automatically cut over to feed from the storage battery.



Left—View of one side of the interior of mast showing motor, pump and reservoir



Right—View of opposite side of housing showing cylinder and piston for operating gate arm

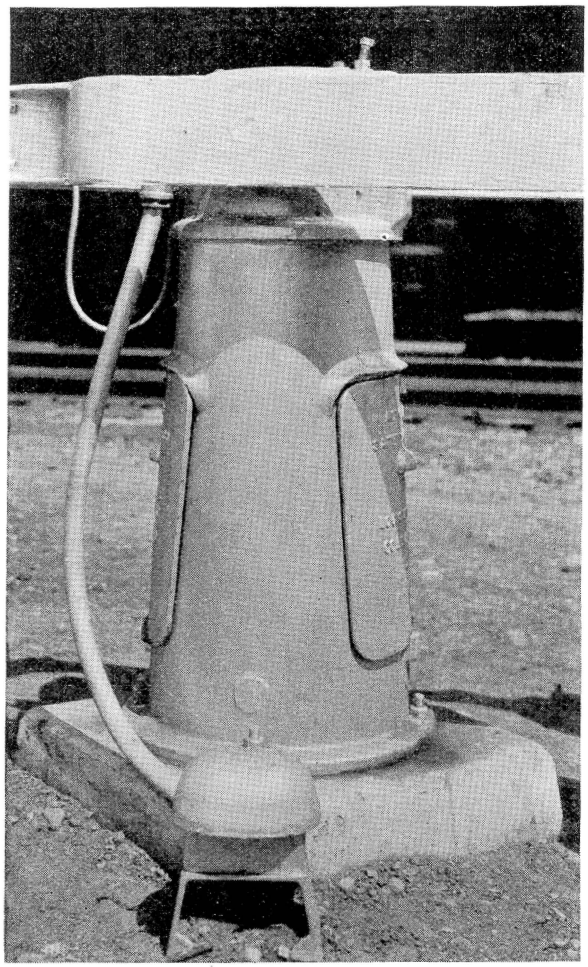
Type of Gate Mechanism

The gate mechanisms used in this installation are of the electro-hydraulic type manufactured by the Automatic Safety Gate Company, for which the Western Railroad Supply Company is the exclusive railroad sales agent. The mechanisms are of somewhat different construction than those of the same manufacture described in previous articles, in that, rather than using one centrally located motor-pump unit with separate oil lines to each gate mechanism, the gate units as installed on the Chicago & North Western have each a separate motor-driven oil pump as an integral part of its mechanism, thus eliminating underground oil pipe runs and accomplishing the further advantage that any defective operation is localized to one gate.

Each gate machine consists of a cast-iron base and housing 36 in. high, on top of which is mounted a pivoted head operating in the horizontal plane which includes the horizontal shaft for the gate arm. This head rests on a central roller bearing that is supported by a spider attached to and cast with the housing. The roller bearing permits the head, together with the gate arm, to be moved around horizontally through 120 deg. in the direction away from the track. This feature was provided so that if the gate is lowered when a vehicle is on the tracks, the arm will swing outward if the vehicle is driven into it. A special latch attached to the housing near the top, carries a roller that engages a slot in the pivoted head, so locking the gate to prevent side motion on to the track, yet so designed to allow the arm to be swung away from the track if a lateral pressure of 25 lb. is applied midway of the arm. This feature prevents wind pressure from swinging the gate out of position whether up or down. A helical torsion spring returns the gate to its normal position if it is swung around by a vehicle.

Each gate arm is operated by a mechanism including a cylinder of 4-in. inside diameter and 12 in. long, the piston of which operates a connecting rod extending to a crank on the shaft to which the gate arm is attached. Hydraulic pressure, for operation of the mechnism, is developed by a rotary oil pump driven by a 1/6-hp. electric motor. The piston,

pump, reservoir, valves, piping, etc., are mounted in a cage supported directly from the rotating head of the machine so that the entire mechanism is complete in so far as piping or mechanical connections are concerned.



Wires are run from a pot-head through a hose to the pivoted head of the gate mechanism

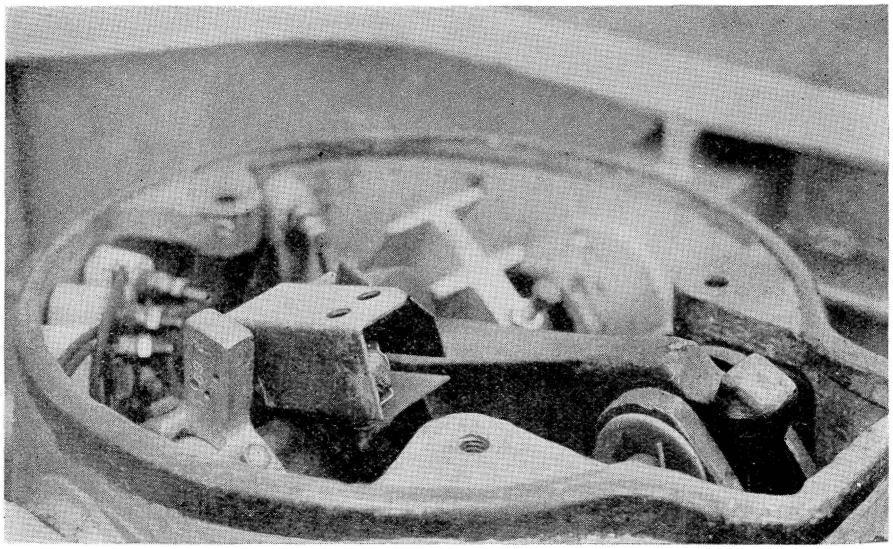
This feature has an additional advantage in that maintenance is facilitated, because all parts are readily accessible when the two cover plates on the sides of the housing are removed.

When the gate arm is in its raised position, all parts of the mechanism are at rest and de-energized. When a train enters an approach circuit, the motor is started and the solenoid valve is energized. A rotary pump driven by the motor draws oil from the reservoir and forces it through a one-way valve, then through a cross T directly to the bottom of the cylinder. When an oil pressure of approximately 80 lb. is reached in the supply line, the piston and vertical connecting rod transmit motion to a crank attached to the horizontal shaft to which the gate arm is secured, thus forcing the arm downward.

One degree before the extreme downward position is reached, the motor circuit is automatically opened by a mercury contact operated by the horizontal shaft crank. The arm is held in its downward position by the constant pressure against the piston which is maintained by the closing of the solenoid valve. If the downward movement of the arm is arrested before the desired position is reached, the pressure in the supply line increases due to the continuous action of the pump. At approximately 10 lb. above normal working pressure, a pressure valve, inserted in a by-pass line between the third opening of the cross T and the reservoir, reduces the excess pressure by allowing the oil to escape back to the reservoir.

In addition to relieving the pressure and preventing the possible stalling of the motor, this feature is especially desirable should the arm, in its descent, come to rest upon the top of an automobile, as very little resistance is needed to impede the downward progress of the arm. After a train has passed over the crossing, the restoration to normal of the control circuits immediately de-energizes the magnet of the solenoid valve, which is inserted in the return line between the remaining opening of the cross T and the reservoir, permitting a free flow of the oil back to the reservoir. The arm is so counterbalanced that as soon as the pressure is relieved, it is returned to its upward position by gravity in approximately five seconds. This quick raising of the arm expedites the movement of highway traffic over the crossing after it has been stopped by trains.

The gate is not locked in the down position, but if for any reason it should be raised out of this position a few degrees, the motor would automatically cut in and restore it to the down position. When in the raised position, 70 deg. above horizontal, the gate is locked so as to prevent mischievous persons from lowering the gates by force, as well as to prevent the gates from being forced out of the normal position by wind pressure. This normal-position lock feature consists of a U-shaped stirrup which normally fits into a notch in the crank on the shaft of the gate arm. The piston-rod jaw connection, which operates on the pin in this crank, is specially formed and slotted. As pressure is applied to raise the connecting rod, the special jaw moves



View with cover of gate head removed to show crank arm, shaft and mercury switches

upward and disengages the stirrup before contacting the pin to transmit motion to the crank.

Automatic Control

This double-track line is equipped with automatic block signaling, and no serious difficulties were encountered in arranging track circuits to effect automatic control of the gates. A signal location is located 58 ft. south of the crossing, so that the only additional track circuit needed was a short one over the crossing on the northward track to hold the gates down until the rear of a northbound train cleared the crossing, this feature being also in effect for southbound trains without additional track circuits because the existing signal and track location is south of the crossing. Some of the trains in regular service operate over this crossing as fast as 90 m.p.h. Therefore, the control sections extending 4,430 ft. to the south and 4,500 ft. to the north start the warning 33 sec. and cause the gate to be fully lowered 18 sec. before the fastest train arrives at the crossing. The control to lower and raise the gates is effected by line and local control neutral relays in combination with stick relays.

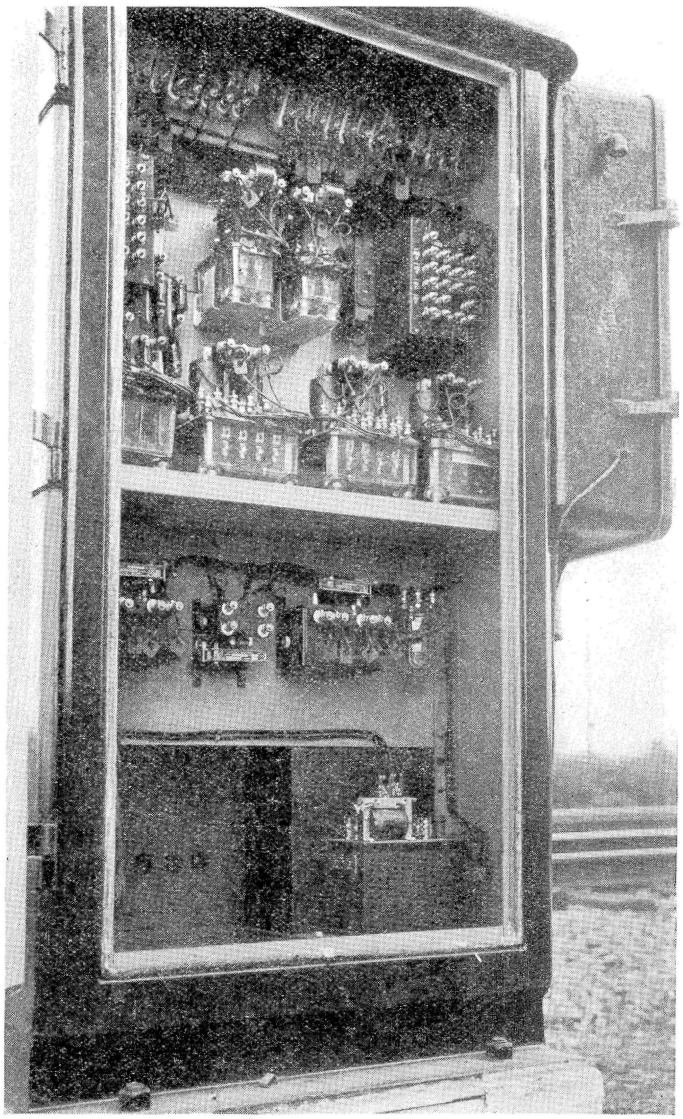
Just south of the northward approach control section, 4,440 ft. from the crossing, there is a main-line switch which is often used when making switching movements. To prevent unnecessary delay to highway traffic, on account of the gates being held down during such a switching operation, a special release arrangement was provided. The northward approach consists of two track sections, the southerly one of which is 2,800 ft. in length adjoining the switch. This section operates a thermal relay so adjusted to raise the gates after a period of 1½ min. has elapsed, provided the train has not passed into the 1,630-ft. section next to the crossing and no other control section is occupied. When the train completes its switching movement and again proceeds toward the crossing, the 1,630-ft. track circuit effects operation of the gates in plenty of time for the protection of such a movement.

Circuit connections between the gates and the instrument and battery housings are made by means of Okonite parkway cables, which pass under the pavement between the tracks in conduit to concrete pull boxes on either side of the street. The cable ends terminate in potheads near the gate posts. Stranded conductors extend from each pothead through a conduit made of rubber hose which, as shown in the illustration, runs outside the mechanism housing directly to the head of the machine. This type of construction was used to allow plenty of freedom for the head to turn without damaging the wires, which might result if they were brought up inside the housing. Connections are made from the gate posts to the lamps with two-conductor Okocord stapled to the gate arms. The track leads are single-conductor, No. 9 Okojute underground cables.

The two pump motors operate on 20-volt d-c. energy and together with the two General Electric solenoid holding valves, which require about 1 amp. each, use approximately 16 amp. for normal operation. The motor circuits are opened, when the gates are down, by mercury tube contacts attached to the shaft of the gate arm. No. 6 motor leads are run from the 24-volt Exide EMGO-9 storage battery so that ample operating voltage is assured at the motors.

All of the relay and power supply equipment is housed in a large-size welded sheet-metal case located south of the crossing; the relays for the adjacent automatic signals are housed in the same case. Two Type-U, Size-1 lighting transformers normally serve the gate lights and those on the automatic signals, through separate power-off relays. A General Railway Signal Company Type-BUX, Size-248 copper-oxide rectifier provides d-c. charging energy to the storage battery from a separate tapped transformer and an adjustable control reactor. The track circuits are floating primary-battery type, using Type-BX½ individual rectifiers and Edison primary cells. The batteries are housed in a concrete well near the control case. All of the controlling relays are General Railway Signal Company Type-K.

This installation of automatic crossing gates was planned and installed by the signal forces of the Chicago & North Western under the direction of the assistant signal engineer.



A new sheet-metal case was provided for housing the relays, rectifiers and other instruments at the crossing location