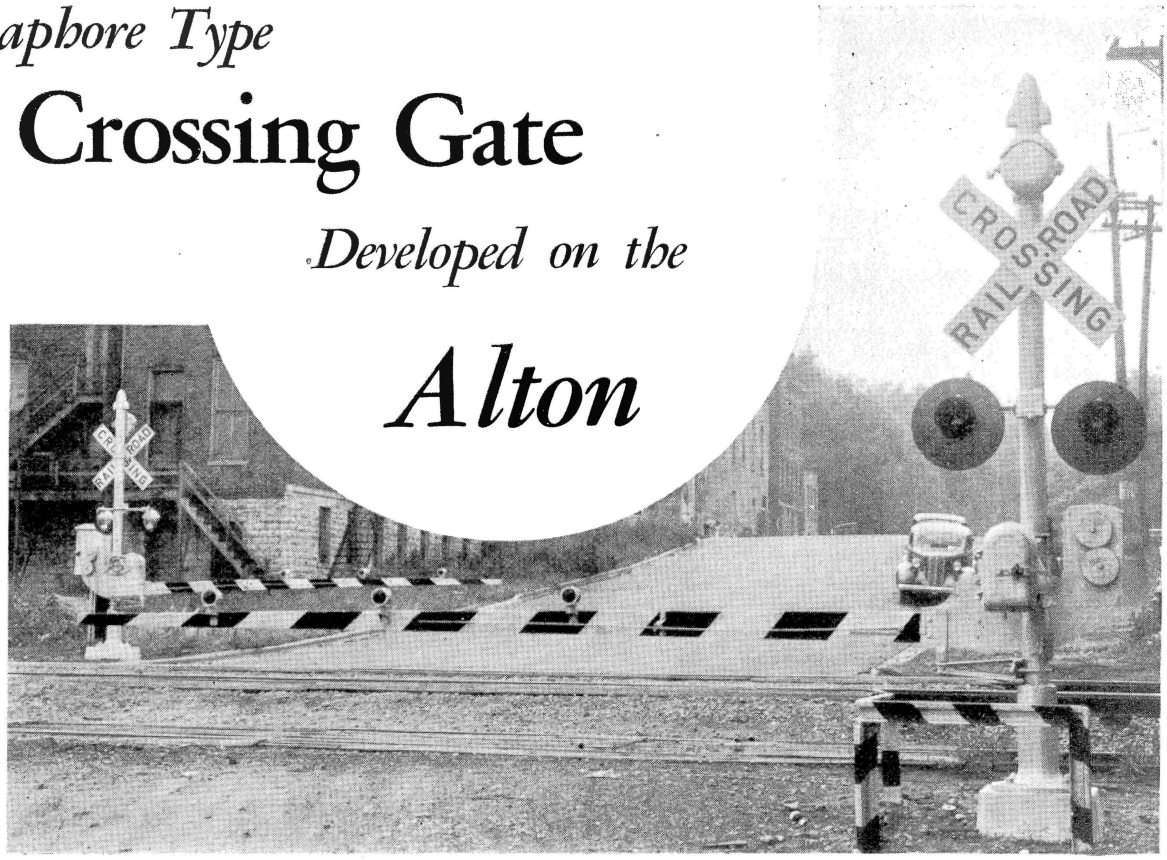
Semaphore Type Crossing Gate *Developed on the* *Alton*



Installation at Lockport, Ill., includes 20-ft. gate arms operated by top-post semaphore signal mechanisms

IN THE investigation of accidents at highway-railroad grade crossings, during the past year, the Illinois Commerce Commission noted that accidents continued to occur at certain crossings where standard types of signals were in service. The hazard seemed to be maximum at crossings of multiple-track railroads with busy paved highways, especially where the view of approaching trains is cut off by buildings or other obstructions.

In the meantime, H. C. Sampson, assistant superintendent of telegraph and signal engineer of the Alton, had set up a test arrangement of a 20-ft. gate arm operated by a regular General Railway Signal Company Type-2A, d-c. upper-quadrant semaphore signal mechanism. Engineers of the Illinois Commerce Commission investigated this test and encouraged the Alton to complete the development because, in the opinion of the commission, there was a definite need at certain crossings for such a gate if it could be installed and operated at a cost which could be justified on the basis of benefits to be rendered. The thought expressed was to provide some gate operating arrangement that could be attached to the mast of an existing crossing signal, the gate extending over the approach half of the highway to serve as a barrier to enforce obedience to the signal aspects.

In view of the favorable attitude of the Illinois Commerce Commission, the signal department of the Alton gave special attention to the further development of the gate, and a test arrangement was set up in the signal shop at Bloomington, Ill. A Type-2A, d-c. top-mast upper- quadrant semaphore signal mechanism was attached to a 5-in. mast at the proper height to bring the gate arm, when lowered, about 30 in. above the level of the highway. The regular spectacle plate was removed from the hub casting and a piece of ¼-in. boiler plate, as a mounting for the gate arm, was attached to the hub casting in place of the old spectacle.

Development of the Mounting

The important factors to be considered in designing this plate were, to effect the proper torque to lower the gate when released, and yet arrange the weight, for counterbalancing the arm, in such a position that the torque load, while raising the arm, would be uniform and within the capacity of the signal mechanism. Two counterweights on each side of each gate mounting plate are held in place by a ¾-in. through bolt. These bolts pass through slots in the plate so that the weights can be shifted to balance with the gate arm. The weights are made of lead, so as to reduce the size as compared with cast-iron. The four weights on each arm weigh a total of about 200 lb. The total weight carried by the mechanism shaft, including the gate arm, mounting plate, counterweight, etc., is approximately 225 lb.

With this arrangement, the torque for release as well as for clearing is approximately the same as for a semaphore signal. The arm moves from the lower position to the clear position in about 10 sec., the motor requiring about 3.0 amp. at 12 volts. When being lowered, the movement of the gate arm is controlled by the usual arrangement of dynamic buffing, using a rectifier, adjusted so that the arm is lowered in about 10

sec. No change was made in the gearing or direction of operation of the mechanism. The 45-deg. control was eliminated so that the arm operates directly from 0 to 90 deg. The only change from ordinary practice is that the mechanism is mounted on the approach side of the mast so that the gate arm really operates in the upper left-hand quadrant rather than the upper right-hand quadrant.

A Light-Weight Arm

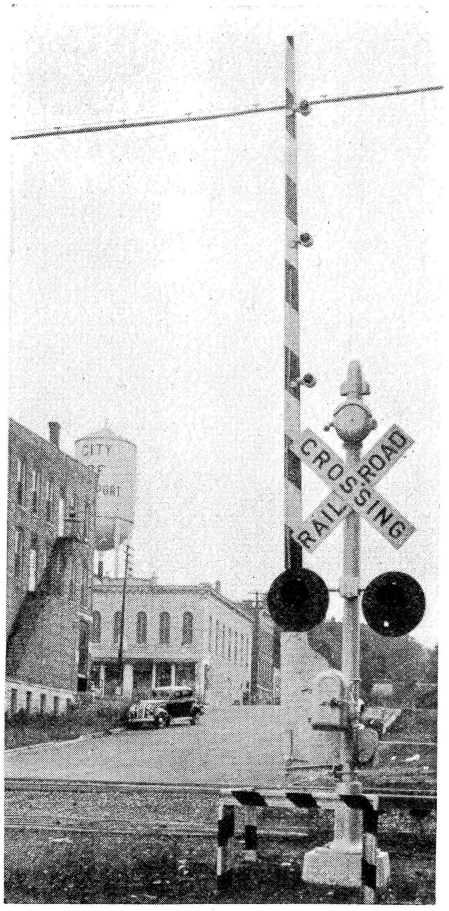
The gate arm itself was, of course, developed simultaneously with the mounting arrangement. One requirement was that the arm must be light in weight in order not to require too much counterweighting, which would result in excessive inertia. The next consideration was to design the arm so that if it were struck by a highway vehicle, the arm would break off readily without damaging the mechanism or mounting plate. With this thought in mind, the arm was constructed of a single piece of 1-in. pine board tapered from 8 in. at the mounting end to 3 in. at the outer end. The gate arm fits in a channel made by two 1-in. angle irons riveted to the mounting plate, the arm being held by four bolts.

In order to prevent the board from bending under wind pressure, a truss rod of ⅜-in. round iron extends along each side of the arm. Each truss rod is 9 ft. long, one end being 6 in. from the mounting plate. At each end, the truss rods are held by a bolt through the gate arm, and at the mid-point each rod is held out 4 in. from the arm by an I-bolt.

A guide or rest, for the arm, when in the lowered position, was provided by mounting an open slot bracket on an arm consisting of a mounting bracket for a color-light signal. This bracket arm extends at an angle from the mast so that the point for supporting the gate arm is about 17 in. horizontally from the center of the shaft of the mechanism. This bracket not only supports the arm in its lowered position, but also prevents the arm from swinging sidewise in either direction, when in the lowered position.

Keeping in mind the fact that the construction of the arm is such that the weakest point is just beyond the rest bracket, it is logical that, if a vehicle strikes the arm when in the lowered position, the arm will break off at or near the rest bracket, and that this stress will be taken by the bracket without harm to the mounting plate or shaft of the mechanism.

The next problem was to provide electric lamps on the gate arm. As each gate arm extends only half way across the highway, it was desirable that the lamps shine in both directions along the highway; thus, when both arms are down, presenting a row of lights all the way across the highway. No such lamp made in a



When in the raised position the gate arm is vertical

light-weight mounting was available. Based on the idea of the lamp mounting in the banner of a wig-wag signal, a two-way lamp body was developed and arranged on a pivot base so that it could be turned in a horizontal plane to direct the rays. A base with holes for bolting to the gate arm was provided. The lamp body and bracket were made of cast aluminum so that the total weight of each is only 2¾ lb.

Type and Number of Lamps

Tests were then made of different types of red lenses. A spreadlight lens gave a good close-up indication but not a good distant indication and, therefore, after extended tests, a 3-in. optical type lens was adopted. Each lamp is equipped with a 10-volt, 18-watt bulb.

Investigations were then made as to whether the lamps should be burned steadily or flashed. The thought was that a steady-burning red lamp might, at a distance, be mistaken for the tail light of an automobile, whereas a flashing lamp would give a more distinctive aspect. For this reason, it was decided that there should be three lamps on each arm, that the one three feet from the tip end should be steady burning to mark the end of the arm, and that the other two lamps on each arm should be flashed alternately 30 times per minute. The lamps are spaced four feet apart.

First Installation at Lockport

Having made considerable progress in the development of these gates, an investigation was made to locate a crossing for a test installation in actual service. At Lockport, Ill., the double-track main line of the Alton crosses four streets—Eighth, Ninth, Tenth and Eleventh—at which manually-operated gates had been in service for years, being in operation part time. Eighth street handles local traffic, Ninth street is a through paved highway, Tenth street is a secondary highway and handles considerable local traffic to and from a flour mill, while Eleventh street handles local traffic to and from certain other industries.

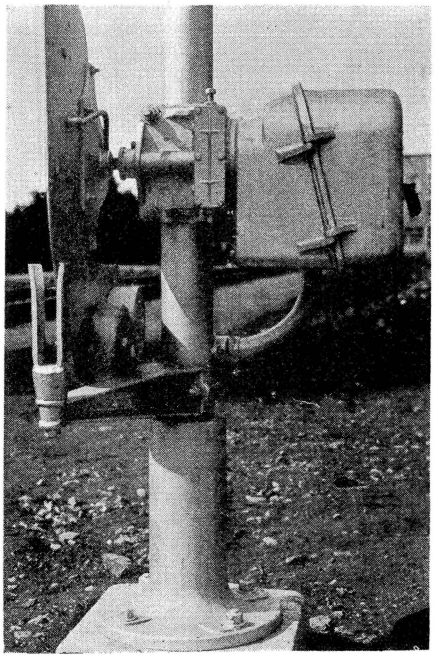
Under the existing arrangement, the manually-operated gates at Eighth and Ninth were operated from one tower, and the gates at Tenth and Eleventh were operated from another. At the request of the city council, to the effect that uniform protection in service full 24 hr. be provided, the Alton agreed to revise the gate layout and control arrangement.

Auto-Manual Control

The old pneumatic gates at Tenth and Eleventh streets were replaced by electrically-operated gates, using Type-2A mechanisms, as previously explained in this article. The gate tower for operation of the pneumatic gates at Eighth and Ninth streets is used as the control point for all gates, and the gate arms at the two last mentioned streets were equipped with electric lamps.

On account of the fact that the local freight switches in this area and the passenger station is located in the eastbound control limits, it was not considered practicable to use a straight automatic control for the power-operated gates. Therefore, it was decided that the most practicable method would be to have the gateman at Ninth street control the power gates at Tenth and Eleventh streets, as well as the pneu-

matic gates at Eighth and Ninth streets. However, the Illinois Commerce Commission required that the control be arranged so that if the gateman neglects to lower the power-operated gates, they will be lowered automatically by the approach of a train, and when the train passes, will again be raised automatically.



The rest bracket for the arm in the lowered position also prevents side swing

Study of the existing circuits showed that the control of the annunciator for the Ninth Street gate tower extended practically a full automatic block in each direction. This annunciator circuit was, therefore, utilized also for the control of the gates at Tenth and Eleventh streets. The approach controls are about 7,000 ft. long so that about 50 sec. elapse from the time the fastest train enters an approach until it arrives at the crossing. When a train enters one of the approach circuits, the annunciator sounds, and if the gateman does not push the acknowledging button within five seconds, the gates are lowered automatically. If the gateman does acknowledge within five seconds, he then has charge of the operation of the gates by means of knife switches. If a fast passenger or express train is approaching, he lowers the gates promptly, but if a low-speed train is approaching, he waits until the proper time to lower the gates. Likewise, if a switching move is being made, he can control the gates as required.

When a train enters an approach circuit, or when the gateman opens the control switch. the lights on the gate arms and the bells start operation at once. Then after a delay period of 5 sec., the gate arm starts to lower, requiring 10 sec. to reach the lowered position. The warning period of five seconds was introduced to allow a driver of a vehicle on the tracks, or closely approaching, an opportunity to get off the crossing before the gates are lowered. This delay period is accomplished by an Adams Westlake No. 480 mercury-type time-element relay which controls the hold-clear circuit of the gate mechanisms.

A standard size crossing bell is mounted on the mast of each gate. Both bells start operation when a train enters a control circuit or when the gateman throws his switch. When the arms reach the lowered position, the bell on the south side of the track ceases operation but the other one continues to operate until the gates again start to rise, this ringing being continued primarily as a warning to pedestrians.

Power Supply

In order to reduce the power demand from the battery, the clearing circuit for the gate on the south side of the track is broken through contacts on the other gate mechanisms, closed at 90 deg. In other words, the gate on the north side clears first and then the other one clears. The lamps on the gate arms continue to be illuminated until the gate arms clear, so that if an arm fails to clear, its position will be plainly marked at night. This result is accomplished by controlling the lamp circuits through contacts on the circuit controllers of the mechanisms, this feed being parallel with that through the relays.

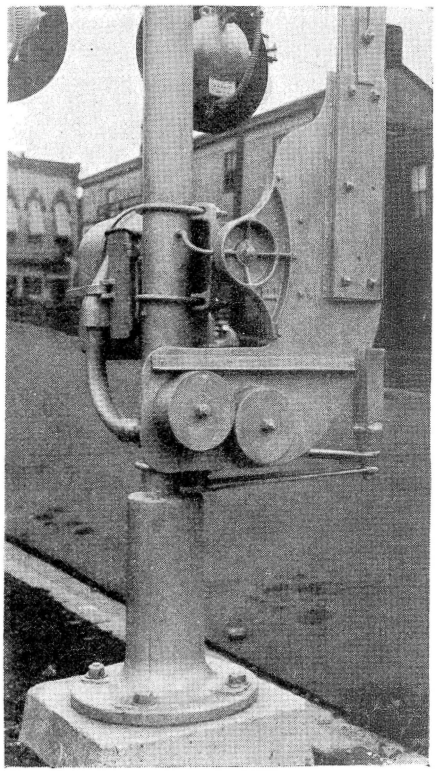
The masts are 5-in. inside-diameter pipes set in standard cast-iron signal post bases, on concrete foundations. As will be noted in the illustrations the masts are so located that the gate and mounting, when in the raised position, are clear of the curb line. Standard flashing-light signals are attached to the mast in the proper location so that the signal is complete, in addition to the gate protection.

The gates at Tenth and Eleventh streets are all operated from a set of seven Exide lead storage cells, Type EMGS-9, rated at 160-a.h. on the 8-hr. discharge rate. Each track circuit in the approach sections is operated by three cells of 500-a.h. Edison primary battery.

The control relays, transformers and battery charging apparatus for the gate installation are located in a large-size wooden case just east of the crossing. The circuits to the gate masts are run in Okonite underground parkway cable, No. 6 conductors being used for the motor feed circuits. The cable is brought up through a hole in the foundation, through the mast and out through a conduit made of an old air-brake hose, which extends to the mechanism. The wires from the mechanism case extending out on the arm to the lights are in metal conduit.

These electrically-operated gates were placed in service on May 22, 1936, and to date have given satisfactory service. None of the gate arms has been struck by a vehicle. The city authorities and the state officials are well pleased with the revised protection, in that gate protection is now in service the same as before at all the crossings, and this protection is in operation 24 hr. daily, whereas part-time service was in effect previously.

The installation was made by the signal forces of the Alton. The principal items of signal equipment,



The counterweights are so mounted as to result in uniform torque

including the mechanisms, line control and power-off relays, are of General Railway Signal Company manufacture. The Western Railroad Supply Company assisted in the development of the gate arms, the plates for mounting the arms and the gate lamps, and also furnished the flashing-light signals, bells, arresters and terminals.