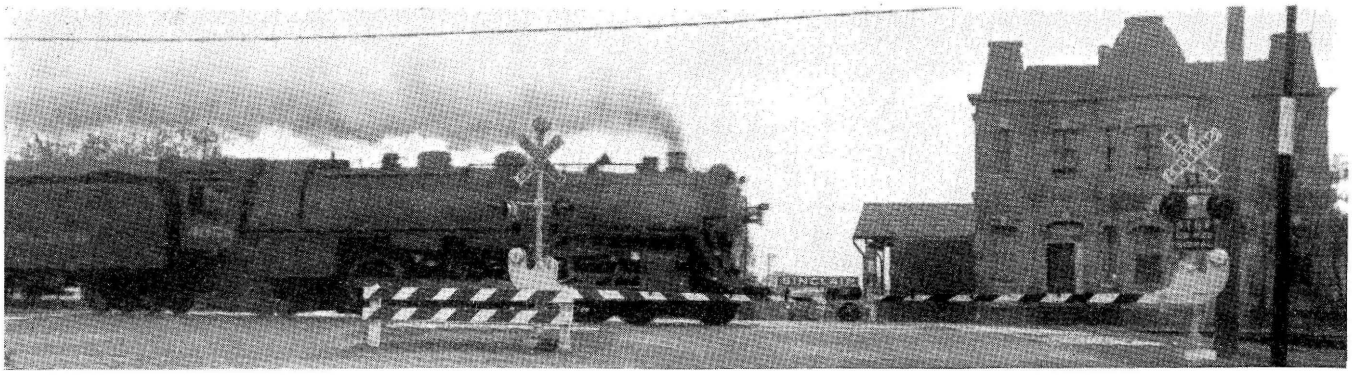


Gates and flashing lights protecting eastbound lane on 95th Street

Automatic Gates on the Rock Island

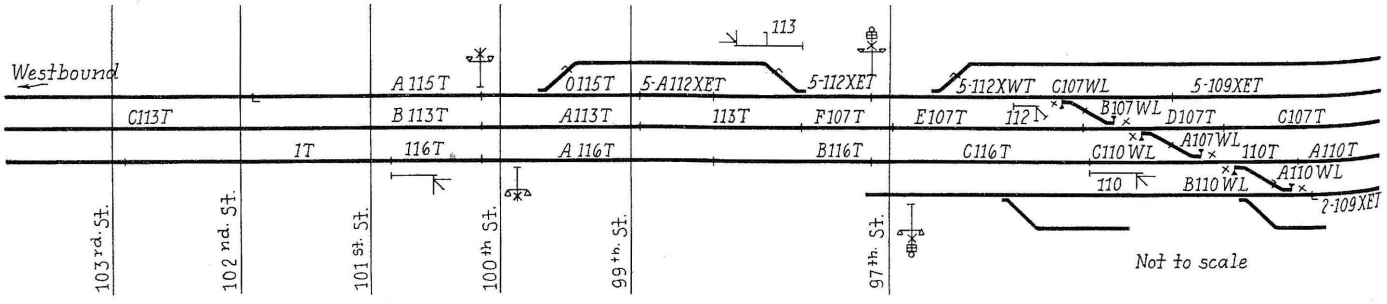
New installation is placed in service at 95th Street, Chicago —Flashing-light signals, bells, gates, and traffic lights are operated by a train approaching crossing used by 35,000 automobiles daily — Complicated track layout requires many cutout features

THE Chicago, Rock Island & Pacific has recently completed the substitution, for manually-operated gates, of flashing-light units, bells, and automatic gates, all interconnected with street traffic signals, at the 95th Street crossing with the four-track main line in Chicago. The four-track line at this point consists of an industrial lead on the east, an eastbound main and a westbound main in the center, and a freight main on the west. Two-block automatic and home signals are in service in this area, with d-c. neutral track circuits and neutral line circuits. Railroad traffic consists of 100 train movements over the crossing daily, while actual counts of highway vehicles indicate an average daily highway traffic of 35,000. Automatic control of the equipment for either-direction operation was complicated by the existence of Vincennes avenue paralleling the tracks and intersecting 95th street at grade on the west, and by the presence within the control approaches of Gresham interlocking on the north, and manually-operated, electrically-locked, crossovers on the south. In this connection, a special two-position, color-light dwarf signal was set up on the freight main to permit eastward trains to make switching movements without operating the gates. In addition, there was quite a variation in the speed of trains coming into Chicago on the eastbound main, so that it was necessary to set up a form of speed control of the crossing devices for eastbound movements on this track.

Crossing Protection

The crossing at this point is level as are both highway and track approaches. The traffic lanes in 95th street, each 30 ft. in width, are separated by 16 ft., the intervening strip being earth fill. A set of automatic gates is provided in each direction mounted on the flashing-light signal masts, which are located on each side of each traffic lane, 4 ft. from the pavement and 14 ft. from the nearest running rail. The gate arms are 18 ft. in length, with a steady burning lamp mounted on each arm 30 in. from the gate tip, and with two other lamps 6 ft. and 9 ft. from the end of each gate. These latter lamps flash in synchronism with the flashing-light units. All the gate lamps give indications in both directions. Comparatively short gate arms, with one on each side of each lane, were used in preference to a single long arm, because previous experience had indicated that they would give more satisfactory operation.

The flashing-light units on the masts on the right-hand side of the road facing approaching traffic are double units, giving indications both to front and rear. The units on the left-hand



The track layout in the vicinity of the crossing is quite complicated

side of each lane are single units, giving indications only to the front, with direct-current bells mounted on each mast. The light units on the mast west of the tracks, on the left-hand side of the eastbound lane, were alined to give indications at an angle of 45 deg., one light thus being visible to automobiles making right- and left-hand turns onto this lane from Vincennes avenue. Right-hand masts are equipped with "4-track" and "Stop on red signal" signs.

Four three-lens traffic signals are located at the intersection of Vincennes avenue and 95th street, one on each corner, giving indications in the directions indicated by the black semicircles in the symbols in the accompanying diagram. Special attention should be given to the signals located on the northwest and southwest corners, since these signals provide for the special railroad operation. Two additional traffic signals are located on 95th street east of the tracks, one on each side of the westbound lane. The traffic signals governing movements along Vincennes avenue are designated "A"; those giving indications along 95th street are designated "C", and, in two cases, "B."

The controller which operates the traffic signals is of the traffic-actuated type. Under this system, detectors are placed in the righthand approaches of the street pavement on both 95th street and Vincennes avenue. It will be noted that two street car tracks of the Chicago Surface Lines parallel the railroad on the west. After stopping to load and unload passengers, the street cars operate trolley contactors which affect the traffic signal controls in the same manner as an automobile does in passing over a detector. In other words, if an automobile approaches a red traffic signal on either street, its passage, over the detectors in approach thereto, closes a contact and sets up the control circuits so that, in the absence of traffic on the opposing street, a green indication will be displayed authorizing the automobile which actuated the detector to proceed through the intersection. The length of time that a proceed indication is displayed depends upon the amount of traffic on both streets, up to a predetermined maximum. For instance, the first vehicle to get the proceed indication on 95th street holds it for a predetermined time and each succeeding vehicle passing over the detector holds the proceed indication for an additional increment of time, up to a certain predetermined maximum, providing there are waiting vehicles on Vincennes avenue. The proceed indication of signals governing traffic on Vincennes avenue is controlled in the same manner by the Vincennes avenue traffic. Thus, the length of time during which a traffic signal displays a proceed indication, in normal operation, increases in increments up to a certain maximum, according to the amount of street traffic approaching that signal. This operation insures an absolute minimum time cycle throughout the day to efficiently clear the traffic on all approaches. During normal operation, traffic indications B and C are identical, but during the passage of a train, they are controlled as explained below.

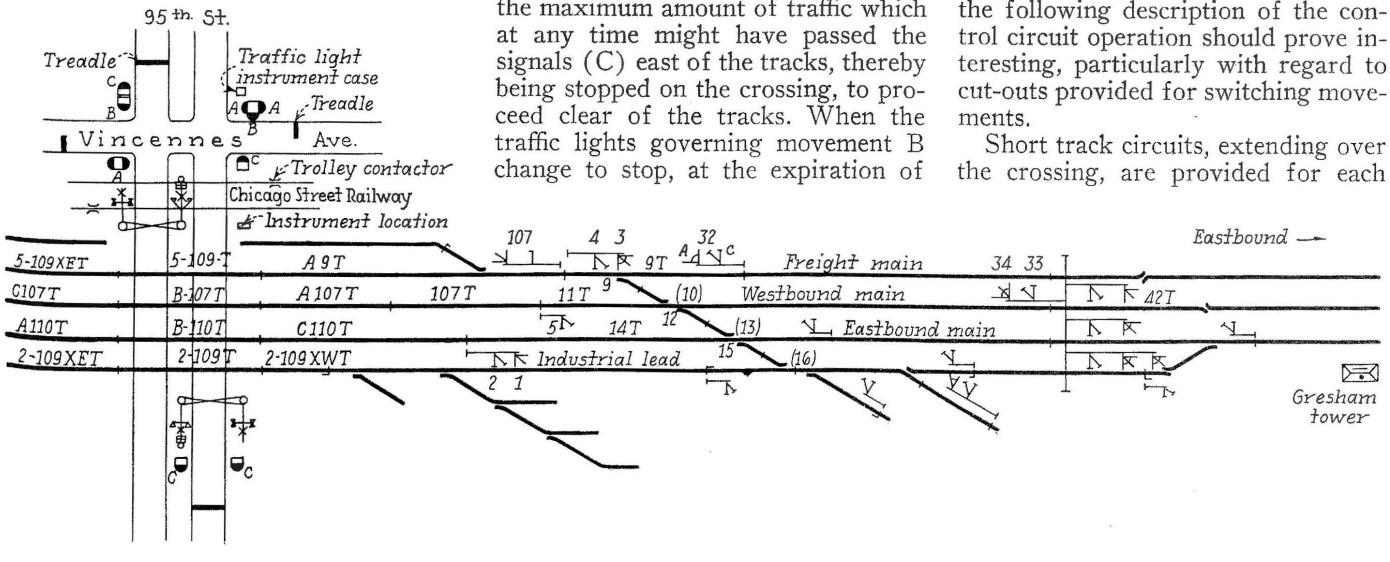
When a train enters an approach section and de-energizes the Rock Island's master crossing relay, an impulse is transmitted to the traffic control signal system, which causes the traffic signals governing A and C movements to display stop indications, and those governing B movements to display proceed indications. These indications are continued for a period of approximately 23 seconds. The provision of the proceed indication for movement B for this period of time is considered adequate to allow the maximum amount of traffic which at any time might have passed the signals (C) east of the tracks, thereby being stopped on the crossing, to proceed clear of the tracks. When the traffic lights governing movement B change to stop, at the expiration of 23 seconds, the traffic signals for movement A on Vincennes avenue indicate proceed, and hold this indication as long as the train is approaching or passing over the crossing.

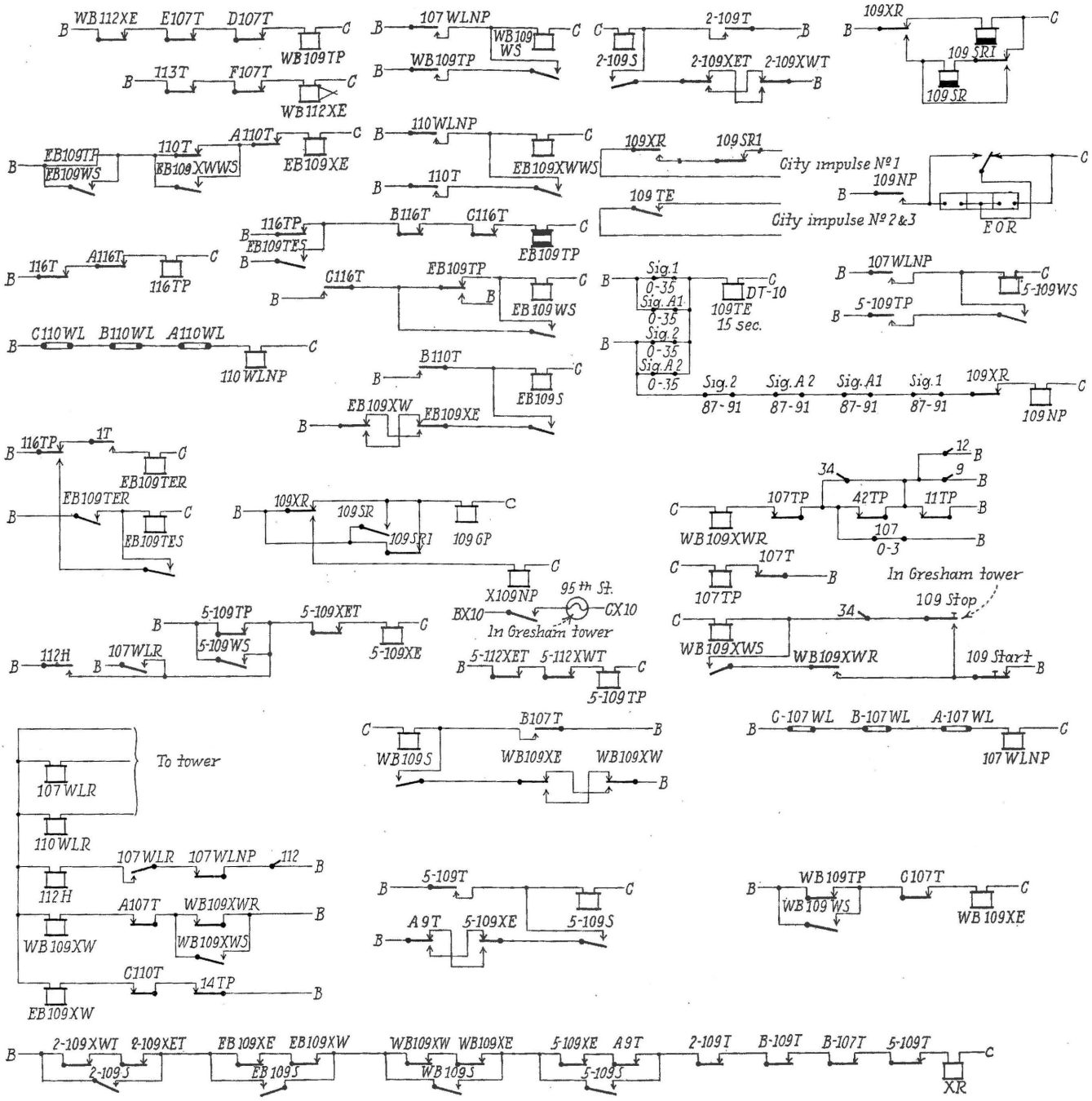
A minimum warning time of 40 seconds is provided for the fastest train. Upon the entrance of a train into a control block, dropping the master crossing relay, operation of the flashing-light signals, the gate flashing lamps, and the bells, is initiated, and the traffic signals are operated as described above. Five seconds after the flashing-light signals start to function, the gates start to come down and are fully down in 11 seconds, placing the gates across the road a minimum of 24 seconds before the fastest train reaches the crossing. After the passage of a train, all flashing lamps continue to operate until the gates are clear. When the gates reach 35 deg., on the upward movement, the traffic signal system is actuated so that proceed indications are given for movements B and C on 95th street (movement A indicating stop), traffic being so heavy on this street that it is assumed that normally there would be a great accumulation of vehicles during the approach and passage of a train. Following the display of a proceed indication on 95th street, the traffic control system is restored to normal operation. The installation is the first to be made within the city limits of Chicago, in which traffic-actuated signals have been interconnected with railroad crossing circuits.

Special Circuits Are Provided Due to Complicated Layout

Since electrically-locked hand-thrown switches are located within the controlling track circuits for normal movements south of the crossing, with Gresham interlocking on the north, and since Vincennes avenue intersects 95th street just west of the tracks, the following description of the control circuit operation should prove interesting, particularly with regard to cut-outs provided for switching movements.

Short track circuits, extending over the crossing, are provided for each





Principal control circuits for 95th Street crossing protection

track. Positive protection when trains are occupying the crossing is given by inserting front contacts on the crossing track relays directly in the control of the master crossing relay. In the circuit diagram, it will be noted that front contacts on 5-109T, B-107T, B-110T, and 2-109T are placed in the controls of relay XR.

The control circuits for this installation are designed fundamentally so that operation of the protective devices results when a train approaches the crossing on any track from either direction, with automatic cut-out provided for each track, as the rear of a train clears the crossing, by a stick relay which is picked up when the train enters the crossing track circuit and which remains up as the train leaves the crossing. The manner in which the circuits operate for normal straight track movements may be appreciated by referring to the diagrams and noting the operation with trains approaching the crossing on the industrial lead, the track on the east side. For a westbound train, 2-109XWT will drop, breaking the controls of relay XR, and initiating protection. When the train enters the crossing track circuit, 2-109T, the controls of XR will again be broken, giving positive crossing protection, and relay 2-109S will be picked up over a back contact on 2-109T, remaining stuck up as the train leaves the crossing through a back contact on 2-109XET and a front contact on 2-109XWT. A front contact on 2-109S cuts around front contacts 2-109XWT and 2-109XET in the controls of XR. Thus, after 2-109T picks up, when a train clears the crossing, relay XR will be picked up and the operation of the crossing protective devices will be stopped. An important feature to note is that a following train would drop relay 2-109XWT and thus destroy the holding circuit for 2-109S, eliminating the contact cutting around 2-109XWT and 2-109XET in the controls of XR, dropping XR and establishing protection at the crossing for the following train. A similar explanation applies to the operation initiated by an eastbound train on the industrial lead.

It will be noticed that, for the other

tracks, protection for through moves is established in the same manner, the automatic cut-out stick relays being EB109S, WB109S, and 5-109S, respectively. However, due to the presence of crossovers and turnouts in the tracks south and north of the crossing, the approach control of XR by a train occupying the control sections on the other three tracks is reflected, with the exception of A9T, in special XW and XE relays, which also are controlled so as to eliminate false operation of the crossing protection during switching moves.

An example of this may be found in 5-109XE, the relay controlling XR for an eastward move towards the crossing on the freight main, the track on the west side. It will be noticed that an eastbound train occupying 5-109XET will always drop 5-109XE, thus dropping XR and establishing crossing protection. Crossing protection will also be established by a train occupying 5-112XWT or 5-112XET, opening the front contact of 5-109TP in the controls of 5-109XE, unless 5-109WS or 107WLR are picked up or 112H is de-energized. If 112H is de-energized, it means that signal 112 will be indicating stop, preventing moves toward the crossing, in which case protection is not needed.

Relay 107WLR is a relay controlled from Gresham tower, which, when energized, picks up locks A107WL, B107WL, and C107WL on the crossovers. Thus, with these switches unlocked, indicating a switching move, false operation of the crossing protection is prevented by the front contact on 107WLR maintaining 5-109XE energized. Relay 5-109WS is a switch stick relay which is picked up by the breaking of normally closed contacts on either A-107WL, B-107WL, or C-107WL, the opening of which drop 107WLNP. Once picked up by the operation of the locks, relay 5-109WS remains stuck up over a back contact on 5-109TP until track sections 5-112XWT and 5-112XET are cleared. Thus, the crossing protection is cut out both when a switching movement is indicated by the towerman picking up 107WLR and during actual switching movements as checked by 5-109WS.

A similar arrangement is used to cut out protection during switching moves on the eastward approach on the westward main. The eastward approach relay on this track is WB109XE, which is de-energized at any time that C107T is occupied. It is also de-energized, setting up protection at the crossing, when relay WB109TP is down due to a train occupying either D107T, E107T, F107T, or 113T, unless switch stick relay WB109WS has been picked up. WB109WS is picked up over a back contact on 107WLNP, which drops when a normally closed contact on locks A107WL, B107WL, or C107WL is opened, and WB109WS remains stuck up as long as a train is on track sections D107T, E107T, F107T, or 113T.

Train Timing Feature

The controls applied to the eastward approach on the eastward main have, in addition to switching cut-out features similar to those described above, a train-time feature which adjusts the time of operation of the crossing protection to two values, depending upon whether eastbound trains approaching the crossing are traveling faster or slower than 30 m.p.h.; if faster than 30 m.p.h., a control section of 3,890 ft. is set up giving a total minimum protection time of 41 seconds; if slower than 30 m.p.h, a control section of 2,190 ft. is set up giving a minimum protection time of 40 seconds. It will be noticed that XR is de-energized by the dropping of EB109XE, which is always de-energized when a train is occupying A110T. Also, EB109XE is de-energized when a train is occupying 110T unless a switching move is indicated by EB109XWWS being picked up by 110WLNP down.

Assuming that EB109WS remains de-energized, the dropping of EB109TP will also drop EB109XE. Relay EB109TP repeats track sections C116T, B116T, and also A116T and 116T through 116TP if EB109TES is not picked up. EB109TES is a stick relay picked up when a train traverses the special timing section 1T, 1,447 ft. in length, between 103rd and 100th streets. Referring to DT-10 time-element relay EB109TER, it will be noted that an eastbound train entering track section 1T will close the controls to EB109TER and that, providing the train has not entered 116TP before the pick up time of 35 seconds has elapsed, in other words if the train is traveling slower than 30 m.p.h., relay EB109TER will pick up and close the controls of EB109TES, which will pick up and remain stuck up when the train occupies 116T and A116T. Thus, operation of the crossing protection for an eastbound train traversing timing section 1T faster than 30 m.p.h., is initiated when the train enters circuit 116T, and, for a train traversing 1T slower than 30 m.p.h., when the train enters circuit B116T. As mentioned above, it was assumed that relay EB109WS remained de-energized. This relay, EB109WS, is energized only by a westbound train leaving circuit 110T and entering circuit C116T. Referring to the description given previously regarding relay EB109WWS, it will be noted that on such a movement, away from the crossing, relay EB109XWWS will pick up to cut around 110T in the controls of EB109XE. Relay EB109WS is used to eliminate false ringing when such a train pulls onto track circuits C116T, B116T, A116T, and 116T. The westbound train on such a move will shunt track circuit C116T before it shunts the other track circuits controlling EB109TP, and since EB109TP is sufficiently slow-drop-away, the back contact on C116T will close before the front contact of EB109TP, in the controls of EB109WS, breaks, picking up relay EB109WS. Relay EB109WS will then remain stuck up over the back contact on C116T or over the back contact on EB109TP, while the train is occupying C116T, B116T, A116T, or 116T, and will cut around the open front contact on EB109TP in the controls of EB109XE, thus preventing false operation of the crossing protection for such a train movement.

Circuits for Westbound Moves

For westbound moves on the freight main protection is established by the dropping of A9T. Protection is set up for westbound moves on the eastbound main when the train enters 14T track circuit dropping 14TP relay and EB109XW. Nothing of an unusual nature is involved in these circuits. However, the controls initiating operation for westbound moves on the westbound main have several interesting features included. This control is effected by relay WB109XW.

Relay WB109XW is de-energized at any time that a train shunts track circuit A107T. It is also de-energized at any time that a train shunts track circuit 107T, through the action of 107TP in the controls of WB109XWR, unless relay WB109XWS has been picked up by the operation of a cut-out push button by the operator in Gresham tower, as would be desirable if a train occupied 107T but was not going to move over the crossing. A normal contact on lever 34 in series with the cut-out push button assures that the crossing protection is not cut out when signal 34 is cleared for a through movement on the westbound main. Relay WB109XWR is also de-energized when the interlocking approach relay 42TP is de-energized, unless signals 34 and 107 are displaying stop. If a movement is made up to signal 107, and signals 107

and 34 are cleared, relay WB109XWR is de-energized, and crossing protection is given as soon as the train enters the track circuits controlling 42TP. False operation by an eastbound train leaving the fright main and occupying 11T or 42T track sections is prevented by the reverse contacts on switch lever 9 and slip lever 12, in parallel with the front contact of 11TP, and the normal contact on lever 34 in parallel with the front contact of 42TP, in the controls of WB109XWR.

Control of the Crossing Devices

The flashing-light units, and the flashing gate lamps are controlled over 109NP, which in turn is controlled by XR and contacts in circuit controllers on each of the four gates, made from 87 to 91 degrees, so that operation takes place when XR drops and continues until the gates are back in the clear position. The five-second delay in the operation of the gates after XR is de-energized, is accomplished by the use of two slow-drop-away relays, one, 109SR1, normally energized, another, 109SR, normally de-energized. When XR drops, 109SR picks up while the front contacts on 109SR1 are still made. When 109SR1 drops, 109SR is de-energized. The effect of this action in the controls of 109GP, the gate control relay, is to maintain 109GP energized for approximately five seconds after XR drops.

Operation of the traffic signals at the intersection of 95th street and Vincennes avenue is controlled by the transmission of an impulse over a back contact on 109XR and a front contact on 109SR1. This impulse causes the traffic controller to affect the traffic signals in such a manner that a stop indication is displayed for movement A and C, and a proceed indication is displayed for movement B. After the gates have reached the 35 deg. position, approximately 8 seconds after the first impulse, the control circuit of 109TE is closed, and after 15 additional seconds 109TE closes its front contacts and closes a second circuit to the traffic control equipment, which causes the traffic signals controlling movement B to indicate stop and allows the traffic signals controlling traffic on Vincennes avenue to clear. Holding the Vincennes avenue traffic and eastbound 95th street traffic at stop and displaying a proceed indication for movement B in this manner for 23 seconds, gives the traffic on the crossing on 95th street a chance to proceed off the tracks. De-energization of this circuit when the gates clear, dropping 109TE, restores the proceed indication to 95th street, after which the traffic signal system controls act in the normal manner.

Equipment

The crossing gates and flashing-light units and bells were supplied by the Western Railroad Supply Company. The gate arms are operated by General Railway Signal Company Model 2A 10-volt signal mechanisms.

An interesting feature of the application of these mechanisms is that they were reconstructed by the Rock Island signal department forces, so that all mechanisms face towards the railroad. In order to do this it was necessary to change half of the mechanisms from upper right hand type to upper left hand type.

Power for the railroad installation is obtained commercially at 220-110 volts, both sides of the line being used, to guard against power failure, in conjunction with a W-20 transformer and eight 225-a.h. cells of Edison G-9 battery floating on an RX-42 rectifier. The flashing-light lamps and gate lamps are normally fed with a-c., but upon a power outage an ANL-30 power-off relay drops and transfers the light load to the battery.

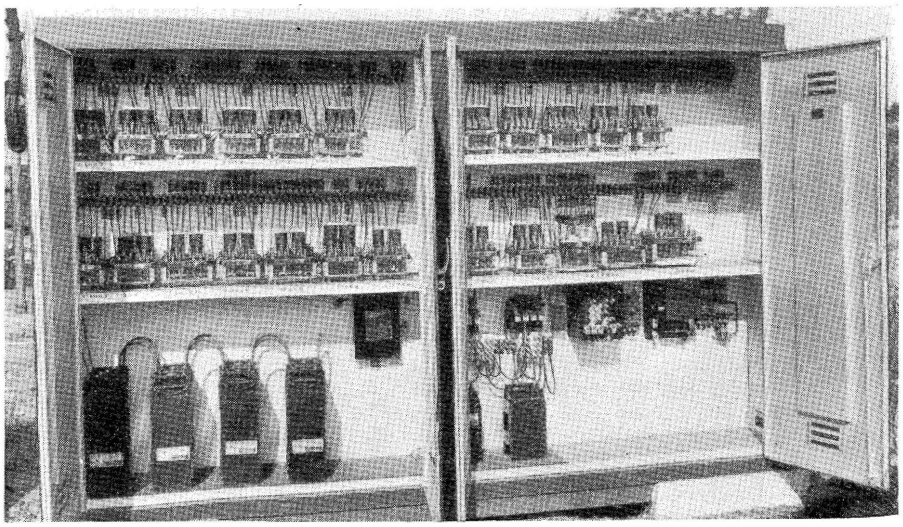
All track relays are 4-ohm Union DN-11 relays, the track circuits being fed by 112.5-a.h. cells of Edison BH-6 battery floating on an RX-10 rectifier, or one Edison primary cell with an RT-5 rectifier. Track leads consist of No. 9 parkway cable with Union bootleg outlets.

The instruments controlling the crossing protective devices are housed in a sheet-steel, double-door instrument case, with a plywood back board and bakelite terminals in strips of six, manufactured by the Union Switch & Signal Company. Relays are of the DN-11, DN-18, DN-19, NF-2, and DT-10 types. White fibre tags with designations in india ink were used in tagging.

Ten-conductor No. 14 lead-covered, rubber-covered, color-coded cable was used by the City of Chicago. This cable is routed through continuous iron pipe laterals, which were pushed under the street pavement to tie together all signals and controls, except the detection pick-up, where 2-conductor No. 14, L.C.R.C. cable is used. Parkway cable was also used from the instrument case to each of the flashing-light and gate units. The line wires consist of No. 14 rubber-covered wires made up in cable form and carried on 3/8-in. Copperweld messenger. A telephone connected with the Rock Island's P.B.X. system is located in a box on a pole next to the crossing instrument case.

A special arrangement is provided for emergency manual control of the gates, flashing-light crossing signals, and bells. In case of a track circuit failure or other trouble, a signal department employee can protect the crossing by operating the gates and flashing-light signals by means of this emergency switch. The circuits are so arranged that this switch cannot be left in the wrong position when returning the installation to normal automatic control.

The traffic signal controller and auxiliary relay equipment was manufactured by the Automatic Signal Corporation. The traffic signal installation was designed by the Bureau of Electrical Engineering and installed by the Bureau of Construction, Department of Streets and Electricity, of the City of Chicago. The railroad portion of this installation was designed in the office of the signal engineer, L. Wyant, and installed by signal department forces under the direction of J. P. Zahnen, supervisor of signals. It was placed in service on August 20, 1937.



The railroad instrument case presents a neat appearance