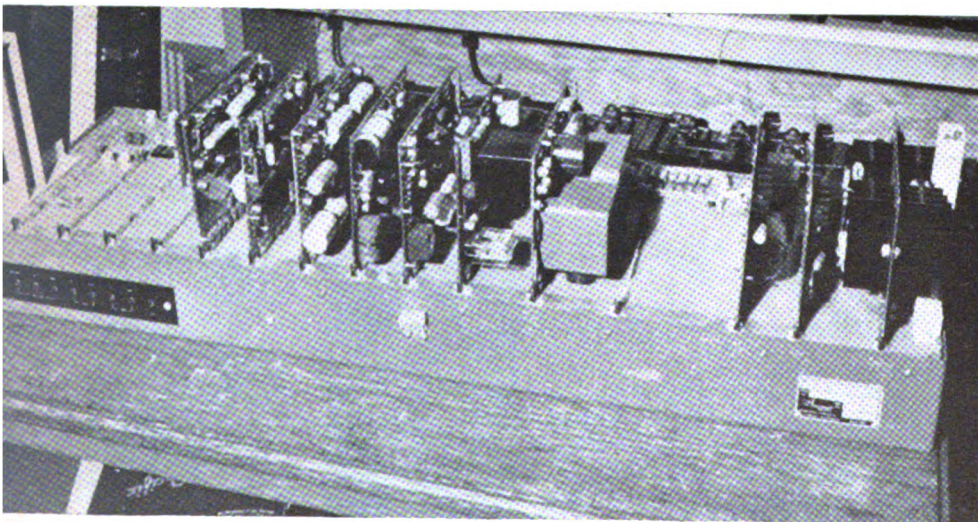


CP installs automatic gates and flashers at N. Queen St., Toronto, Ont.

Gate Control is by GCPs



Four model 200 Grade Crossing Predictors are used at this crossing.

In an industrial area of southwest Toronto, Ont., the Canadian Pacific has installed flashing-light signals and short-arm gates at the North Queen street crossing of its Canpa subdivision. To provide fully automatic operation without resort to pushbuttons for manual control during switching operations, CP installed model 200 Grade Crossing Predictors made by the Marquardt Corp.

North Queen, a 45-ft, 2-lane, road (4 lanes at the crossing) crosses the double-track mainline and two side tracks at the west edge of Islington service yard. This 5-track yard is used for the make-up of local trains doing industrial switching in the area. A normal practice is for a westward train to set off the caboose clear of the yard switch and then proceed to build the train on the main track. Cars are shoved back on the main track until the train is complete and then it proceeds westward. Eastward trains and industrial assignments frequently stop in the vicinity of the crossing to telephone the yardmaster to establish whether there is more work for them to do. Cars are frequently left standing on all approaches to the crossing for long periods of time, and all switches within the approach circuits are used daily. Often there will be two engines working in the vicinity of the crossing, one on each main track, and on occasion there have been three. Of the total of 80 train and engine movements over the crossing daily, 8 to 10 of them are through freight trains. Maximum speed in this territory is 25 mph.

To add to the railroad activity at the crossing, there is considerable vehicular traffic, particularly trucks serving plants and ware houses in the area. Vehicular traffic is particularly heavy around 8 am and 5 pm. Prior to the installation of automatic crossing protection, switch crews had to flag the crossing. "You took your life in your hands to get out and flag the street at rush hour," commented one switch crew member. This man reported that the automatic protection has not only made it safer for them, but now there is less delay to switching moves and vehicular traffic.

Four Grade Crossing Predictors were installed at insulated joints on the two main tracks. These joints are opposite and just off the west edge of the N. Queen street pavement. A pair of GCPs is on each main track looking away from the insulated joint. DC track circuits, approximately 200 ft long, were installed on the two side tracks (spurs). DC circuits were installed on the two main tracks on either side of the insulated joints as part of a proposed CTC system, al-

ough they were also to form part of the crossing project.

The N. Queen street approach circuits for the GCPs are 1,050 ft long in the two main tracks, and are de-energized electrically by narrow-band units. These shunts are tuned circuits completely encapsulated and buried in the ground adjacent to the tracks. The insulated joints at the approach point or the protection of the nearby crossing of the Queensway are by-passed by AC wide-band shunts (completely encapsulated). The approach circuits in both main tracks provide a 30-second warning time for the crossing, in addition to an allowance of 2 sec equipment time for the GCP. For a normal straight-through move, the flashing lights are set into operation 30 sec before the train arrives at the crossing. About 3-5 sec after the GRS flashers begin operation, the Griswold gates are lowered. The GCP equipment provides a positive ringing section or "minimum distance" which is set for approximately 35-40 ft beyond the pavement edge (width of the pavement at the crossing is 45 ft).

The DC track circuits east of the crossing extend well beyond the 1,050 ft approach circuits for the crossing. The track circuits west of the crossing, when combined with the adjacent circuits for the crossing protection at the Queensway, also extend beyond the 1,050 ft GCP circuits.

An Esterline-Angus 20-pen recorder was installed in the bungalow at the crossing to provide a graphic record of the operation. Pens record the following information: dropping of the track relays for the eight DC track

circuits; "prediction" and "self-check" relays of the four GCP units; and two of the four "minimum distance" relays; the XR relay for the gates and the ECF relay for the flashers.

The recorder chart is normally running at the very slow rate of $\frac{1}{4}$ " per hr and in order to provide accurate measurements of the operating times, the recorder shifts to $\frac{1}{4}$ " per min when an approaching train occupies one of the DC track circuits. These track circuits have another role in the crossing protection operation. The GCP equipment is self-checking, that is, every four or five seconds a self-check circuit completely proves the correct operation of all circuits in the unit. If for any reason the check is not successful, a relay releases which would normally lower the gates. In this instance it was felt undesirable to tie up traffic in case of a failure. Therefore, the DC circuits are arranged to provide a "backup" for the GCP equipment. If for any reason, the GCP equipment does release its self-check relay, the gates will remain up unless the DC track is occupied by a train.

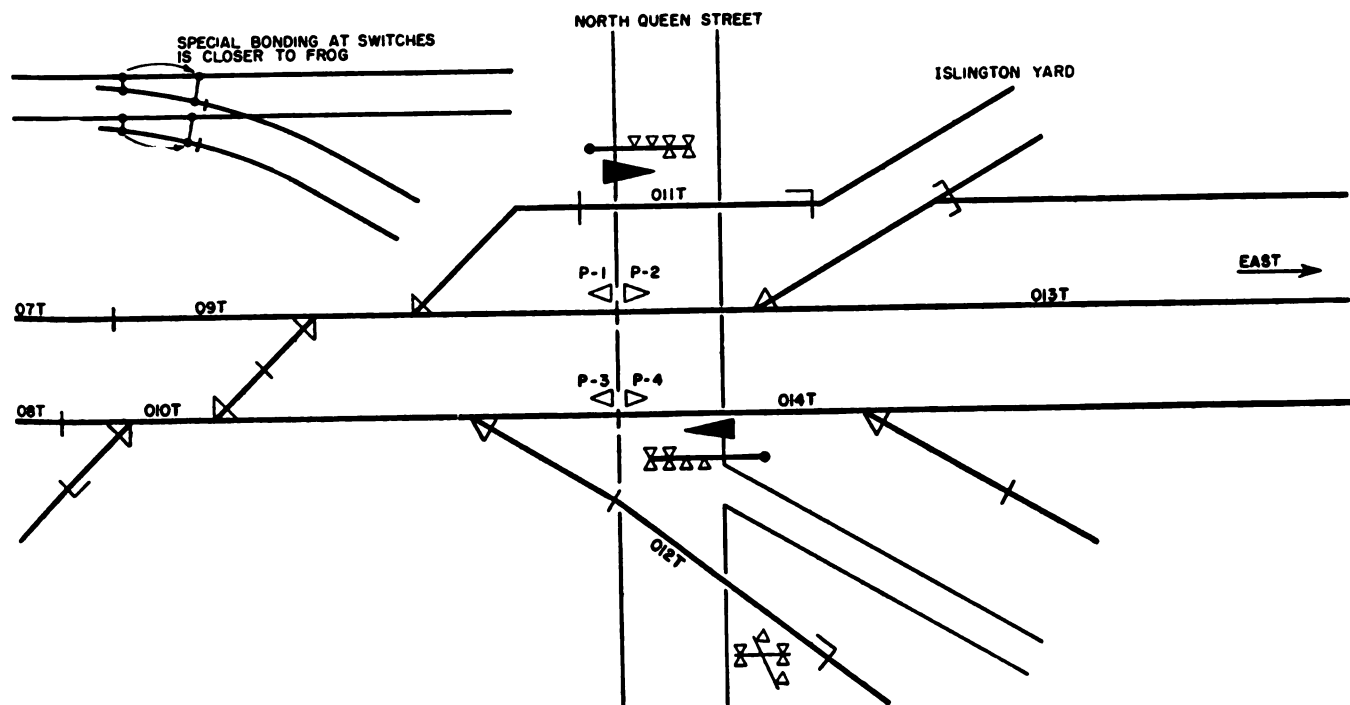
TO LOWER GATES

In other words, to lower the gates, the GCP equipment must have either detected the approach of a train or have failed at the same time the corresponding DC track circuit is down. There are no stick circuits provided for operation with the DC track circuits nor are there any other relief circuits whatsoever. This means that if under a failure condition the appropriate DC track circuit is occupied, the

gates will be lowered regardless of the direction of the train movement and regardless of what movements it happens to be making.

The GCP units apply a constant 200 ma AC current to the rails. With the circuit unoccupied, the unit measures an inter-rail voltage of approximately 7½ volts at the crossing. A train approaching the crossing causes the measured voltage to be lowered more or less proportionate to the distance the train is away from the crossing. By using the rate of change of the distance, the unit can also determine the train's speed, and thus can determine when the train is 30 sec away from the crossing. To provide prediction for the two spurs, or sidetracks, the switches are insulated and bonded in such a way that the GCP units "look down" the fouling section away from the crossing. The bonds are closer to the frog than in conventional switch bonding. This bonding arrangement has been generally successful and works satisfactorily for trains approaching the crossing on the spurs at 10 mph, a normal speed. However, if the engine or train approaches at a lower speed, the protection equipment may operate intermittently until the DC track circuit is reached. This idiosyncrasy is well known to the crews and experience to date indicates no difficulty is encountered.

The why of this discontinuity of operation for a slow move over the switch is as follows: Experience at this N. Queen street crossing indicates that a train or engine moving over a switch and frog presents a complex electrical circuit, which causes slight discon-

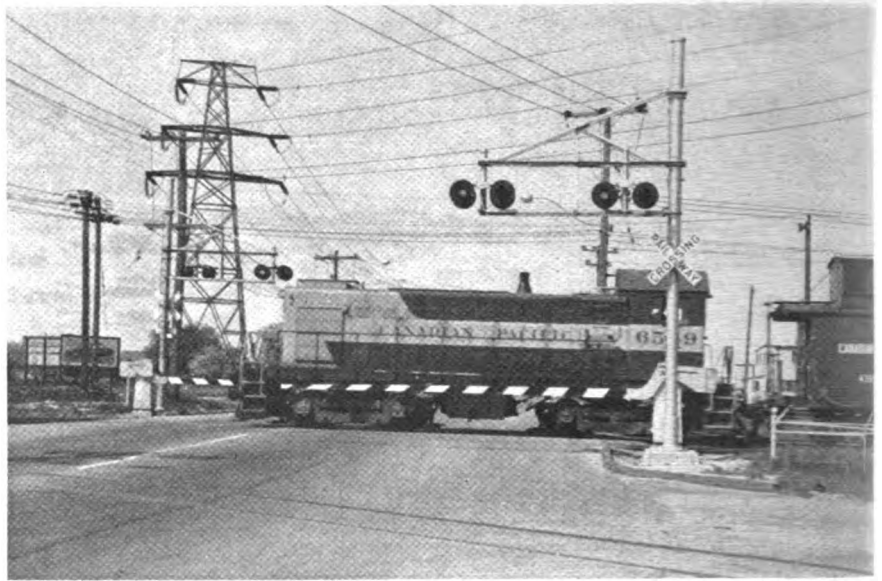


(Continued from page 32)

Nife battery were installed of sufficient capacity to handle a power outage, one bank for each track. A third bank is used to handle gates (operate on 12 volts DC) and lights.

A test panel on the side of the bungalow is for the section foreman or signal maintainer to test the crossing protection equipment operation. Pressing a button causes the equipment to operate, and the gates go down. Release of the button raises the gates and cuts out the flashers. A test is made at least once a week.

A shunt or short circuit on the rails is no more of a problem, than with conventional equipment reports CP signal engineers. The shunt appears to the GCP equipment as though it were a stationary train. This means that the equipment will operate the crossing protection for a second or so and then cut out. Since the flashers normally operate 3-5 sec before the gates are lowered, this momentary operation will be observed as only one or two flashes of the lights and two or three rings of the crossing bell clapper. However, an approaching train will not operate the crossing pro-



Initially, power lines caused interference with GCP track circuits.

tection thereafter until it is closer to the crossing than the shunt. If it is moving sufficiently fast to reach the crossing in less than 30 sec, it will immediately start the protection at the moment it passes the shunted point. With conventional circuiting, when a short on the track caused a timing circuit or directional stick to be retained, the train would not cause the

protection to operate until it reached the next restart point closer to the crossing.

A broken rail within a reasonable distance of the crossing (although not determined, but assumed to be at least 500-600 ft) will cause the equipment to saturate and release the self-check relay. For example, if the DC track circuit is down or is dropped by a

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train, the protection equipment will immediately operate.

CP engineers point out that as soon as a train slows or stops so that it is more than 30 sec away from the crossing, the gates will immediately raise. If the train again moves toward the crossing and is close to the crossing, the gates will immediately lower, or if it is further away from the crossing flashers and gates will be operative as soon as the train reaches the speed such that it is 30 sec from the crossing. This, of course, is a major feature of the equipment because with normal DC track circuits the protection would not operate until the train had reached the next "start" point. For practical purposes, says CP signal engineers, the GCP equipment provides an infinite number of start points.

STARTING POINT ANYWHERE

This feature of a starting point anywhere, was one of many reasons for selecting GCP equipment for this crossing. A study made to provide automatic protection with conventional DC controls indicated that at least 12 separate timing circuits would be required on the mainline. Additionally, pushbuttons and key switches would be necessary in order to minimize unnecessary operation of the signals. It was felt that the operation of manual control devices by train crews would inconvenience train traffic and still, there would be considerable unnecessary operation of the crossing protection equipment which would lead to highway traffic delay and/or non-observance of the warning devices. The total cost of such installation was estimated at close to \$60,000. (Canadian prices are approximately 15-20% higher than in U.S.)

All equipment for this crossing was fitted into a 6 x 8 ft bungalow, including the four GCP units, three banks of batteries, several relays, rectifiers, the operation recorder, etc. Except for the fact the installation was new and therefore unfamiliar and that much experimentation had to be done, CP engineers report that labor charges for such an installation would be quite low, as there is very little wiring work to be done and a negligible amount of underground cable, etc. to be installed. The final cost for the job was approximately \$43,000. Of this, the GCP equipment including one complete set of spare equipment, and including two constant voltage battery chargers totaled approximately \$12,000.

The installation work was directed by Garnet Pinkney, signal supervisor under the jurisdiction of Douglas H. Walkington, regional signal engineer.

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