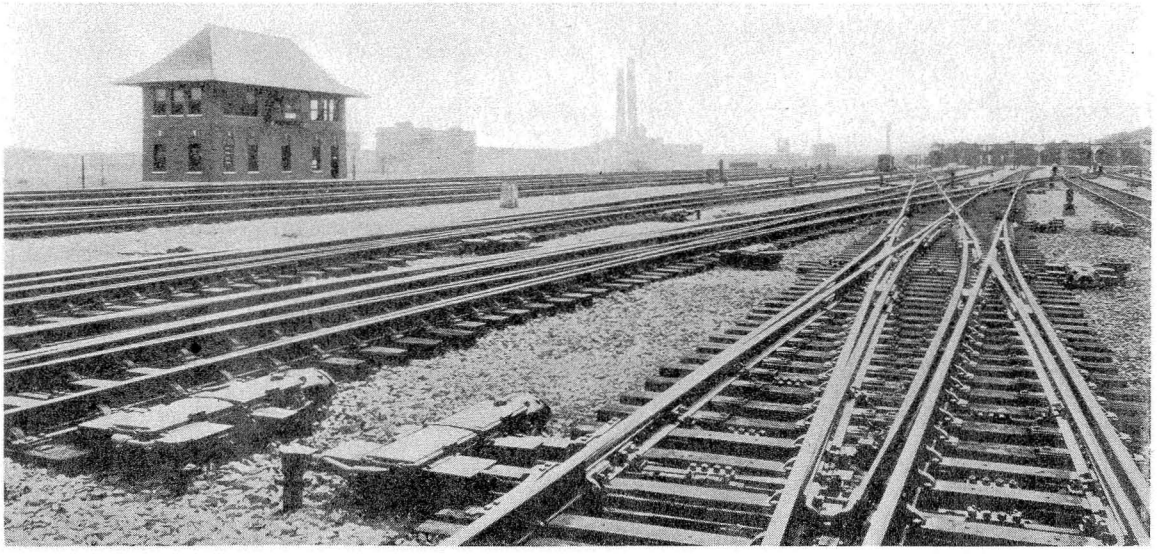
Railway Signaling

Interlocking System Installed at Toronto Union Station

New design of interlocking machine, extensive use of dwarf signals, are features of installation involving 409 working levers for control of layout 2.4 miles long



The Scott Street interlocking station at left, and a portion of the track layout, looking west toward the Union Station

By H. L. Black

Superintendent of Signals, Toronto Terminals Railway Company, Toronto, Ont.

THE Toronto Terminals Railway Company, representing the Canadian National and the Canadian Pacific, recently put in service three large interlocking plants which are interconnected to form one large interlocking system. Although the terminal building and part of the station tracks have been in use for some time, the installation of the interlocking was delayed while the ultimate track layout was being constructed. Early in 1926 the elimination of level crossings along the water front of the terminal area at Toronto was started, which necessitated the elevation of tracks, the construction of nine subways, the erection of one overhead bridge, and the rebuilding of one overhead bridge. A fill of approximately 16 ft., extending over four miles of terminal area and requiring 3,000,000 cu. yd., was completed late in 1930. The field construction of the signal facilities was started in October, 1930, and was completed in August, 1931. As shown on the accompanying plan of the track layout, the entire controlled area is approximately 4.5 miles long.

During the period when the interlocking was under construction, six tracks were in service to handle traffic from Cherry street west through the terminal to a point near John street. About 60 switchmen were required to handle the large number of hand-thrown switches in this area. By means of a loud-speaker telephone system with speakers at various points on the layout, the switchmen were directed by two signalmen, one located in a small temporary cabin at the east end and the other in a similar cabin at the west end of the layout. This arrangement proved to be satisfactory during the construction period. After the interlocking was completed, the loud-speaker system was installed for direct communication between the train directors located in the Scott Street and John Street interlocking stations.

Control 546 Units with 409 Levers

The three new interlocking machines have a combined total of 409 working levers controlling 546 operated units. The increased number of units as compared with the number of working levers was accomplished by controlling two switches, such as for a crossover, from one lever and, furthermore, in some cases as many as three signal units are controlled from one lever. The machine

arrangement for the three plants is shown in the tables.

The Scott Street machine, which was placed in service in June, controls an area three fourths of a mile long, extending from the center of the station platform east to Sherbourne street.

Scott Street Interlocking Machine

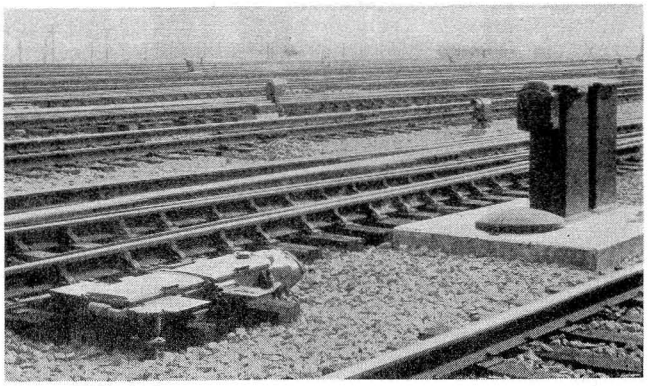
169	Total working levers of which there are:
	47 levers for single switches and movable-point frogs
	35 levers for crossovers
	2 levers for high signals
	77 levers for dwarf signals
	7 levers for check locking
	1 lever for outlying switch lock
23	Spare lever spaces
192	Space frame

The John Street machine, which was placed in service in August, controls an area eight tenths of a mile long, extending from the center of the station platform to a point west of Spadina avenue.

The Cherry Street machine, which was placed in service in March, controls an area 2.8 miles long, extending from Sherbourne street to the extreme north end of the track layout as shown on the track plan.

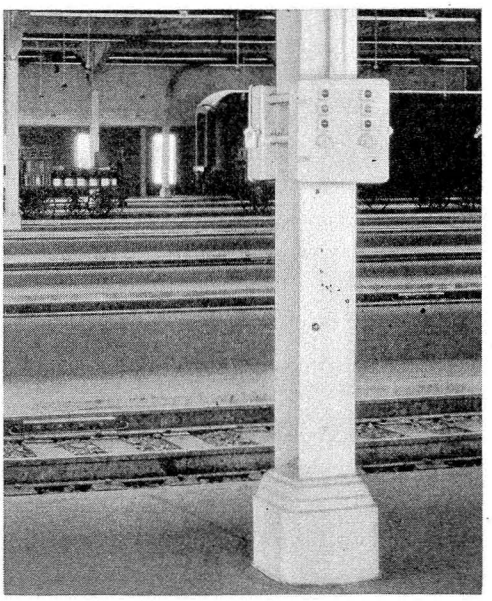
The Station Area

At the present time the traffic through the station area includes approximately 125 trains daily, almost all of



Sheet metal junction boxes on top of concrete manhole

which originate or terminate at Toronto, as only a few of the passenger trains operate on through schedules. The switches and signals throughout the station area are controlled by the John Street and the Scott Street interlocking stations. The layout in this area includes 10 tracks inside the train shed and 2 just south of it, these tracks leading into 6 main tracks extending east and west from the station layout. Trains approaching from the west are controlled by the John Street interlocking from a point west of Spadina avenue to the center of the station platform in the train shed, and, beginning at this point, the area controlled by the Scott Street plant extends east to Sherbourne street. By means of the loud-speaker system, the train director in the John Street interlocking station advises the man



Push buttons and light of train-starting system on post in train shed

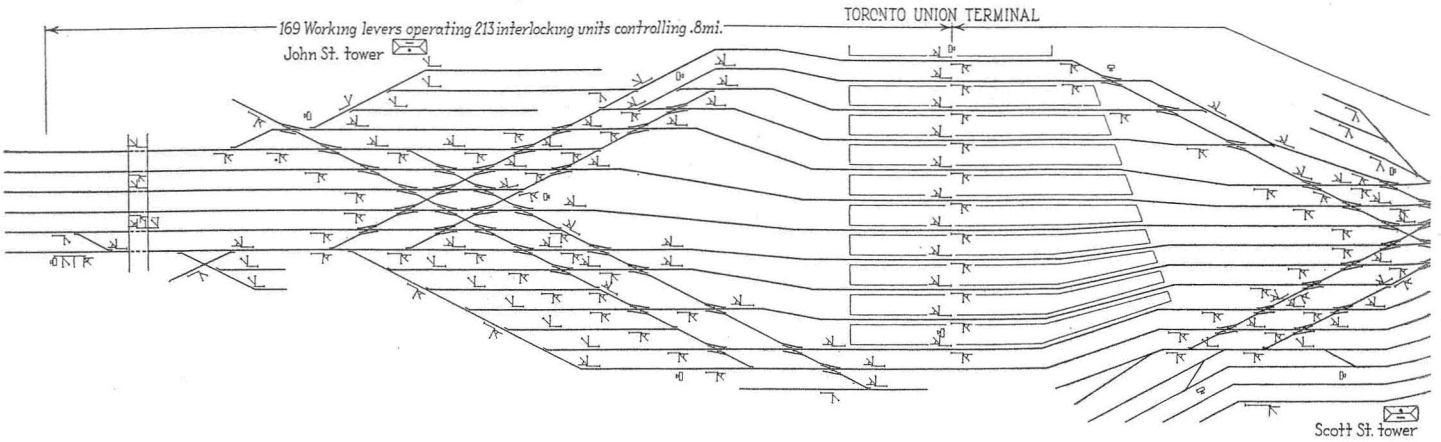
at the Scott Street station as to the approach of each train from the west, giving the number of the station track on which it is being routed.

The area controlled by the John Street interlocking

John Street Interlocking Machine

169	Total working levers of which there are:
	49 levers for single switches and movable-point frogs
	35 levers for crossovers
	3 levers for high signals
	75 levers for dwarf signals
	7 levers for check locking
23	Spare lever spaces
192	Space frame

includes a total of 29 double-slip switches, 29 single switches, 89 dwarf signals and 2 three-unit high signals. The double-slip switches comprise two ladders running in each direction and extending almost the entire length of this area. Practically the same general track layout



Track and signal plan of the interlocking

exists at the east end of the station, the switches and signals in this area being controlled from the Scott Street interlocking, which includes 33 double-slip switches, 17 single switches, 85 dwarf signals, 2 three-unit high signals, 3 single-unit high signals and 1 switch lock which is used on the switch leading to the harbor track.

East Approach to Station Area

The switches and signals in the area approaching the station from the east are controlled by the Cherry Street interlocking, which extends from Sherbourne street to the extreme north and east points of the layout. This interlocking includes 7 double-slip switches, 21 single switches, 2 Hayes derails, 1 movable-point frog, 18 dwarf signals, 17 three-unit high signals and 6 single-unit high signals.

Cherry Street Interlocking

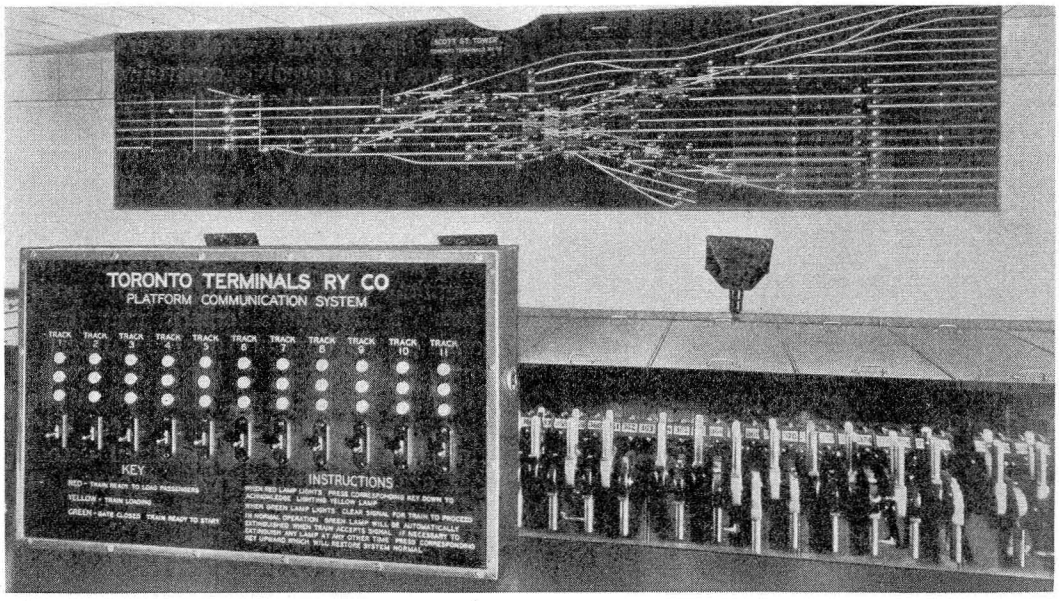
71	Total working levers of which there are:
	11 levers for single switches and movable-point frogs
	17 levers for crossovers
	17 levers for high signals
	16 levers for dwarf signals
	10 levers for check locking
41	Spare lever spaces
112	Space frame

The Tower Construction

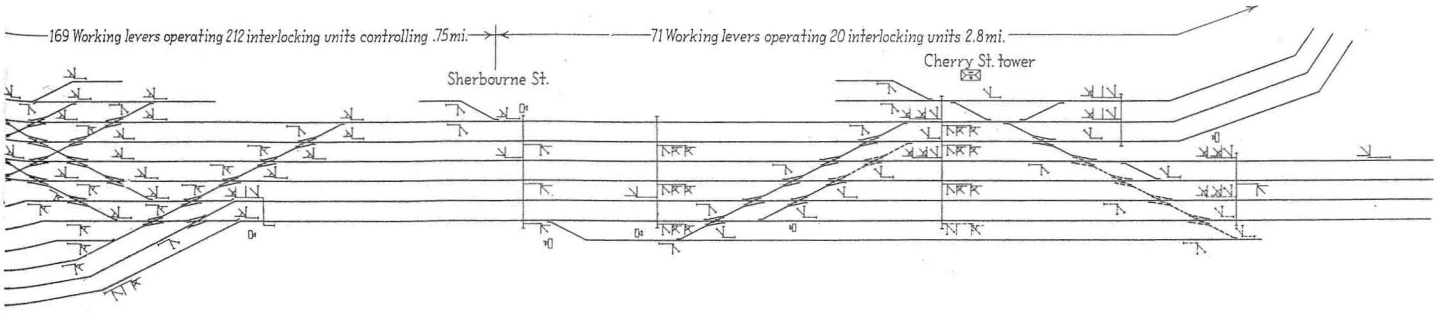
Each of the three towers has two stories and a basement, and all are of the same type of reinforced-concrete-and-brick construction, the inside walls being lined with tile and plastered. The Scott Street and the John Street stations are steam heated from the central heating plant at the Union Station, but the Cherry Street tower is heated by a hot water system, the boiler being located in the basement.

At each station, the interlocking machine is located on the top floor with the levers toward the track. The ceiling in each tower is covered with acouste-celotex in order to reduce noise disturbance. A large bay window on the track side of each station affords an excellent view of the track layout in both directions. In both the Scott Street and the John Street stations an elevated platform was constructed in the bay window for the accommodation of the train directors.

The interlocking machines are of the General Railway Signal Company's latest design, Model-5 Form-F. Each is mounted over a pit which allows ample head room and permits the maintainer to have ready access to all parts inside the machine. The low-voltage circuit controllers are of the rotary type, using the relay type of contact, and are so mounted as to be readily accessible from the pit. The pit is so constructed that when the doors at the end of the machine are closed, it is entirely dust proof.



Control board of train starting system on desk at Scott Street tower, with interlocking machine in the background



Installation at Toronto Union Station

A voltmeter and two ammeters, mounted on top of each machine at the rear, are used to indicate the voltage and current used by each lever function. Latch-lever locking and forced-drop electric locks are employed on the switch levers. With this equipment the switch must be over and locked before the full stroke of the lever can be completed. In order to simplify operation and conserve equipment, at some locations such as cross-overs, two switch machines are controlled by a single lever equipped with double safety-indication magnets. No indication locking is used on the signal levers, the route locking being broken down through the "red" repeaters of the signals and through the time contactors on the signal levers. For some locations, as many as three signals are controlled by one lever through switch-repeating relays.

All the levers are equipped with lamp cases behind the blue etched number plates. The lamp behind a switch lever is lighted when the lever is locked electrically. Signal levers are not equipped with light indications on the levers, but the indication for this purpose is repeated on the track diagram, which is supported from the ceiling at the rear of the machine. The face of the chart was made of sheet formica, a drawing of the track and signal plan being moulded into its surface. The diagram is constructed of short panels so that, if any of the track layouts are changed, the affected section can be replaced without disturbing the remainder of the panels. Each track circuit represented on the panel is of a color different from the adjacent circuit. The movement of a train over a track circuit is indicated by a red light in the panel, each home signal being indicated by a yellow light and a distant signal by a green light. The panel is also equipped with lights behind arrows for each track to indicate the direction of traffic—the lights being governed by the check-lock levers. The diagram is illuminated by flood lights mounted on the top of the interlocking machine.

Relay Equipment

The second floor of each interlocking station is used exclusively for relay housing, the relays being mounted on racks directly underneath the machine. Alternating-current relays are used for the track circuits, but the polar relays used exclusively for the SS control circuits and the neutral relays used as repeaters and for the neutral control circuits are all of the d-c. type. A total of 1,350 d-c. relays and 181 a-c. relays were used in the three plants.

All track relays, with the exception of those located at the distant signals, are housed in their corresponding towers. This arrangement necessitated the use of three separate types of track circuits. For track circuits located fairly close to the tower, a directly controlled track relay is employed. Where the resistance of relay leads exceeds 5 ohms, however, a step-up transformer is used at the relay end of the track circuit and energy for operation of the track coils of the relay is carried into the tower at 175 volts. In addition, where the track circuit length exceeded 1,500 ft., it was necessary to introduce reactance in the local circuit of the track relay. The use of step-up transformers, as mentioned above, permitted the use of No. 14 wire for all track circuit wires in main cable.

Dwarf Signals Used Extensively

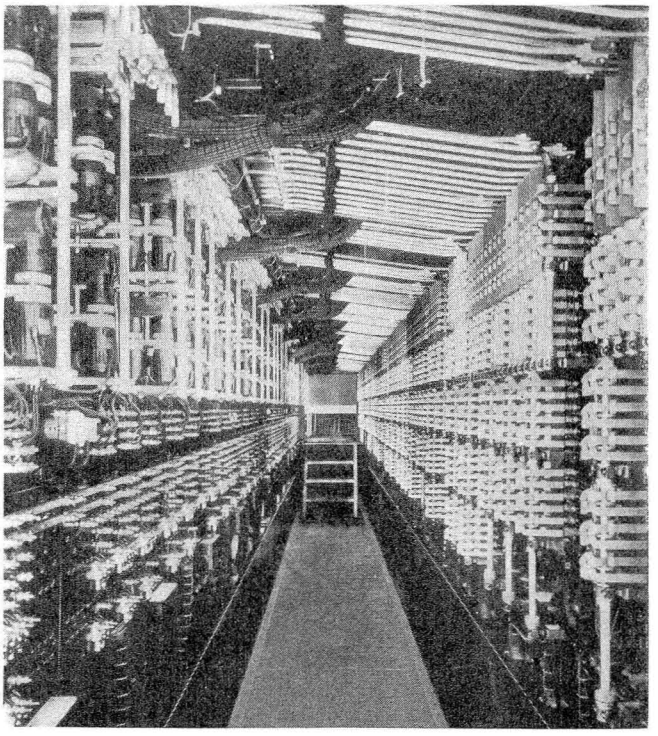
Dwarf signals have been used extensively throughout the installation. A special feature is the mounting of the dwarf signal on a bracket attached to a small iron case located on top of a concrete foundation. This case houses not only the transformers for the track and light circuits, but also the terminals for the signal-control-circuit cables.

All of the signals are of the SA type, controlled in the ordinary manner, with a two-wire circuit as far as the interlocking lever, and a one-wire selected circuit of the net-work type from the signal-control levers on through the various switch levers and WP relays. A three-arm high signal is controlled from one lever, the control being such that the two top arms will clear if the proper route is lined up and the track circuits are unoccupied. The third, or call-on, arm clears automatically when other than a high-speed route is set up, or this arm may be cleared for a high-speed route, if the track circuits are occupied, by pressing the stick push-button, located over the lever. Most of the dwarf signals in the station area are of the three-position type, the "yellow" being non-automatic and the "green" semi-automatic, the control for the "green" being carried through track circuits as far as the second signal ahead.

The switch machines are G. R. S. Model 5A arranged for operation on 150 volts direct current, and are equipped with lock rods and point detectors. The machines are controlled directly through contacts on the interlocking machine levers, a central battery supply being provided in each signal station.

Outside Wiring

All the outside wire distribution is underground, the main runs from the stations to the main junction boxes being in lead-covered cables run in fiber conduit laid



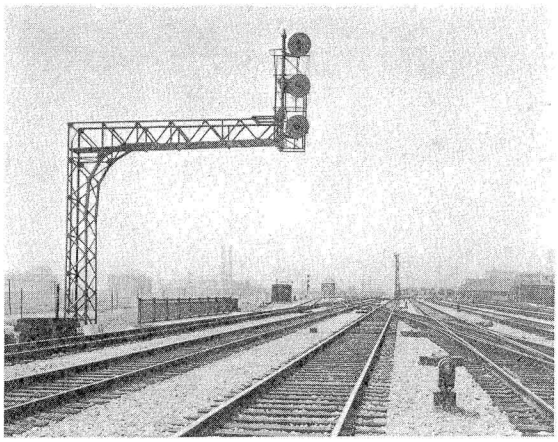
View through the pit under the interlocking machine

in concrete. Concrete manholes located at different points on the layout are used for splicing the lead-covered cables, the cables extending up to sheet-metal junction boxes located on top of the manholes where all wires terminate on terminals or lightning arresters. Parkway cable extends from these junction boxes to small junction boxes at each switch or on each signal. Single-conductor No. 9 parkway cable is used for the track

circuit connections, using cast-iron risers with a bootleg box near the rail.

Power Supply

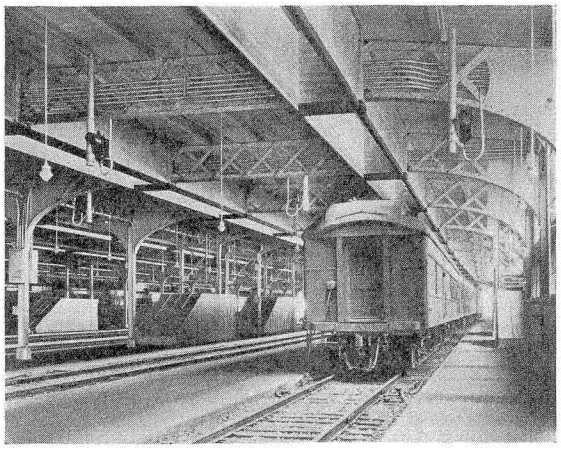
At the Union Station commercial power at 13,200 volts and 25 cycles is available and is reduced through duplicate transformers to 2,200 volts, which is then distributed through cables run in the main duct lines to the power rooms of the three interlocking stations. It is then transformed to 110 volts to be used throughout



Type-SA signals mounted on cantilever bridge

the plants for various circuits, the track circuits, signal lights, etc. being fed from the a-c. supply through the proper transformers and distribution system. In the event of a failure of the commercial supply, current is furnished directly from a steam-turbine plant of the Toronto Terminals at the station.

The power equipment is housed in the basement of each interlocking station. A set of 75 cells of 120-a. h. lead storage battery is provided for the operation of the switch machines, and six 250-a. h. cells of the same type are used for the control circuits. These batteries are

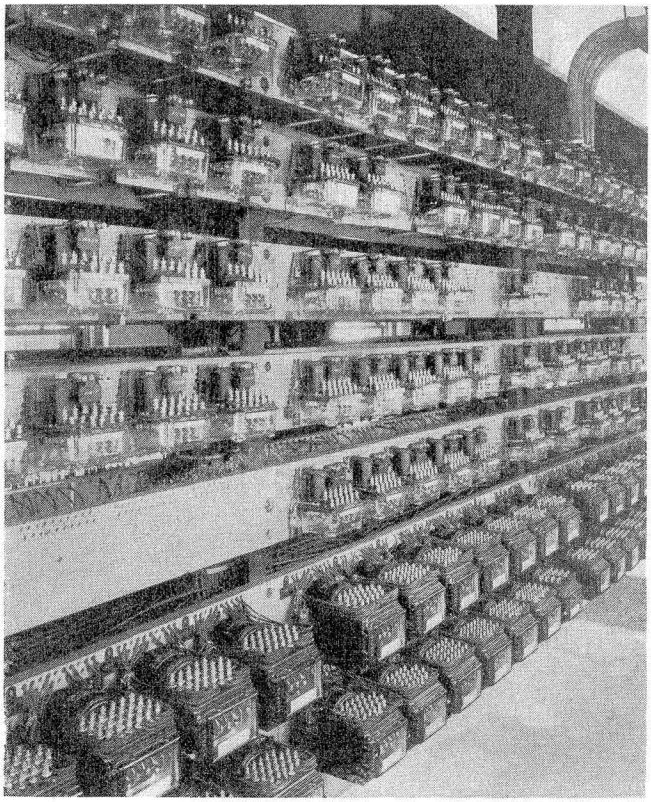


Type-SA signals mounted in the terminal train shed

on a-c. floating charge using duplicate dry-plate rectifiers which are so connected that one or both rectifiers may be used.

Train Starting System

A "train-starting" system involving the use of red, yellow and green lights for communication between the conductors, gatemen and train directors, was installed as a part of the interlocking facilities. Each set of lamps, together with the necessary push-buttons, etc. is mounted in a small cabinet mounted on the train director's desk in the interlocking stations at John street and at Scott street. At the Union station, these lamps are located at four different locations on each passenger-loading platform and one yellow lamp is located at each platform gate. When a train is ready to receive passengers, a button is pressed by a platform man, using the east or west button in accordance with the direction in which the train is to go. A red lamp will light at the train director's desk and at the conductor's station on the platform. The train director then presses his acknowledging button, thereby extinguishing the red lamp and



A section of the relay rack in the Scott Street tower

lighting a yellow lamp at the gate, at the conductor's station and at the train director's desk. The yellow lamp notifies the gateman to open the gate for passengers. When it is time for the train to depart, the gateman closes the gate and presses his button, thereby extinguishing all yellow lamps and lighting a green lamp at the train director's desk and at the conductor's station; these green lamps notify the director and conductor that all passengers are through the gate. When the train accepts the signal, by passing it, the train-starting system is automatically restored to normal.

A large part of the material which was used in connection with this signal installation was purchased from Canadian manufacturers by the General Railway Signal Company. The cable was supplied by the Canada Wire & Cable Company, the batteries were furnished by Hart Battery Company of Canada, and the fiber conduit was supplied by the Northern Electric Company, while the bootleg castings and parkway junction boxes came from the Dominion Cutout Company. The interlocking plants were supplied and installed by the General Railway Signal Company under the jurisdiction of J. R. W. Ambrose, chief engineer of the Toronto Terminals Railway Company, and under the immediate supervision of H. L. Black, superintendent of signals.