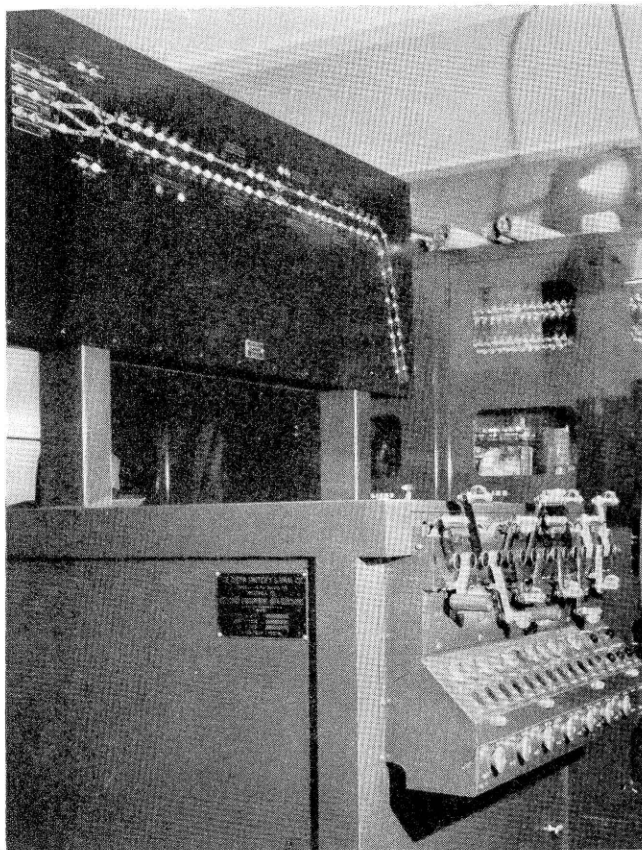




The illuminated track diagram is mounted above the Model 14 interlocking machine in 33rd street tower

Interlocking on

Installation planned to reduce failures to a minimum, and to keep trains moving safely in case of failures

THE Hudson & Manhattan has installed a new underground track layout and terminal including a new interlocking at Thirty-Third Street and Sixth Avenue in New York City. This railroad is a subway system which operates multiple-unit, electrically-operated trains. A second terminal in New York is located at 30 Church Street in the downtown section of the city. From these two terminals, lines extend through tubes under the Hudson river to points in New Jersey. Trains handled in the Thirty-Third Street station, run from and to Hoboken or Journal Square, which are points on two separate lines of the New Jersey side of the river.

The new Thirty-Third Street terminal is of the stub-end type with four platforms, served by three tracks. Within the limits of the interlocking, these three station tracks con-

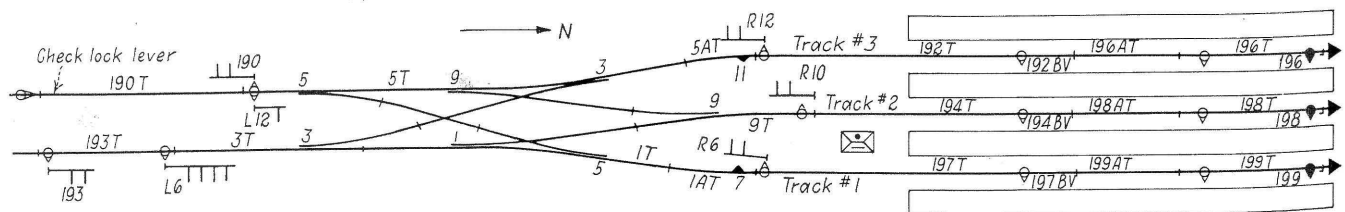
nect with a double-track main line, which extends southward for a mile or more before curving to the west to pass under the river. Each track is signaled for single-direction train operation, right-hand running. During the morning and evening rush hours, a train is operated into the Thirty-Third Street station every 90 sec., and at the same intervals a train departs. In the course of a normal 24-hour period, about 800 train movements are made in each direction through the interlocking, or a total of 1,600 trains.

On account of the dense traffic and short headway between trains, a failure of any important part of the interlocking, for even a few minutes during the rush hours, would result in serious train congestion. For this reason, every known means of preventing failures was taken into con-

sideration in the design of this plant, and, furthermore, special features of control are provided to permit trains to be moved with safety in case of a failure of a track circuit, locking circuits, or the air pressure supply.

Duplicate systems of incoming a-c. power supply are arranged with automatic cut-over switches to maintain power at all times. Duplicate sets of transformers and other apparatus are on hand to meet almost any emergency. All wiring is in galvanized iron conduit so as to be protected from fires. The sections of the cables and wires beyond the ends of conduits are wrapped with asbestos tape. Insulated joints are included in the conduit lines to isolate grounds and reduce chances for electrolysis. If the normal air pressure supply should fail, a standby compressor is cut in and controlled automatically, so that pressure should be available at all times for operation of the switch machine.

The track layout within the interlocking, as shown in the accompanying diagram includes switches and crossovers, so arranged that an incoming train can be routed from the northward track to any one of the three station tracks, and, likewise, a departing train on any station track can be routed to the southward track.

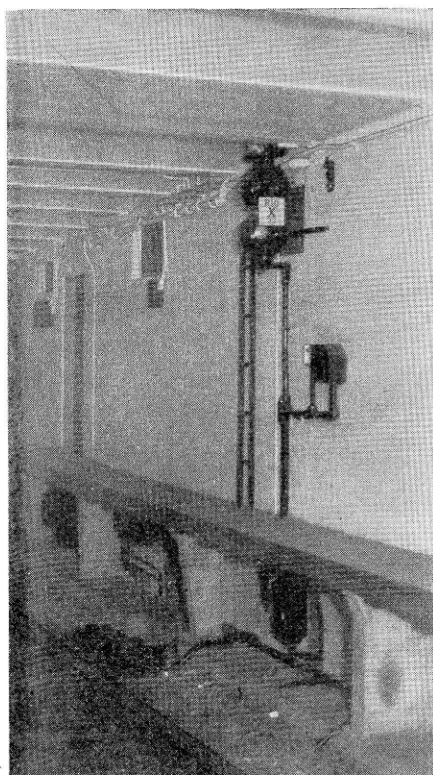


Signal L6 displays the aspect "Proceed with Caution" for moves to tracks 3, 2 or 1 when track sections north of cut sections 192, 194 or 197 for respective tracks are occupied. Signal L6 displays the proceed indication for moves to tracks 3, 2 or 1 only when respective tracks are entirely unoccupied. The approach locking for switches 3 is effective from signal 193 to signal L6. Track Section 5AT must be unoccupied to clear signal L12 for moves to tracks 2 or 1. Track section 9T must be unoccupied to clear signal L6 for moves to track 3. Track section 9T must be unoccupied to clear signal L6 for moves to track 1, only when the two switches 9 are normal. Track section 1AT must be unoccupied to clear signal L6 for moves to track 2.

the Hudson & Manhattan

Switch No. 1 is a single switch, and the remaining six switches are operated in pairs which are in effect the equivalent of crossovers, thus four levers control the seven switches.

The tracks within the length of the platform are on a descending grade of 0.5 per cent southward, and between the south ends of the platforms and the switches, the descending grade is 1.6 per cent. During the late hours of the night when comparatively few trains are operated, cars are stored on tracks No. 1 and No. 3. In order to provide protection in case these cars should lose their brakes and drift toward the interlocking track layout, a derail was located on each of these tracks, the derails being numbered No. 7 and No. 11. Each derail is operated by a switch machine. A separate lever controls each derail.



Above—Suspended color-light signal and emergency key-hole switch controller mounted on wall. Right—A-10 E.P. switch movement, impedance bond, pipe conduit, and emergency key-hole switch controller

The signals are of the color-light type, of the design used in subways where no background is required. The locations of the signals are indicated on the accompanying plan, while the footnotes explain the special signaling features. Four levers in the interlocking machine control seven signals, three of the levers being operated to the right or the left from the normal center position.

Normal Operation of Switch Machines

The power switch machines are the A-10 electro-pneumatic type with two 5-in. cylinders, one for operating a switch normal and the other reverse. Type "CP" electro-pneumatic valves, operated by a-c. magnets with Z type armatures, are used. Each switch is equipped with a point-detector and the usual arrangement of lock rods. The compressed air for the operation of the switch machines is normally furnished from the main air line extending the entire length of this subway system. In case this supply should fail, a standby 25-cu.ft. compressor is cut in and controlled automatically to feed the Thirty-Third Street interlocking. The local air line distribution in the interlocking is laid out on the loop principle with cross-leads and valves so arranged that if any section fails, valve can be closed

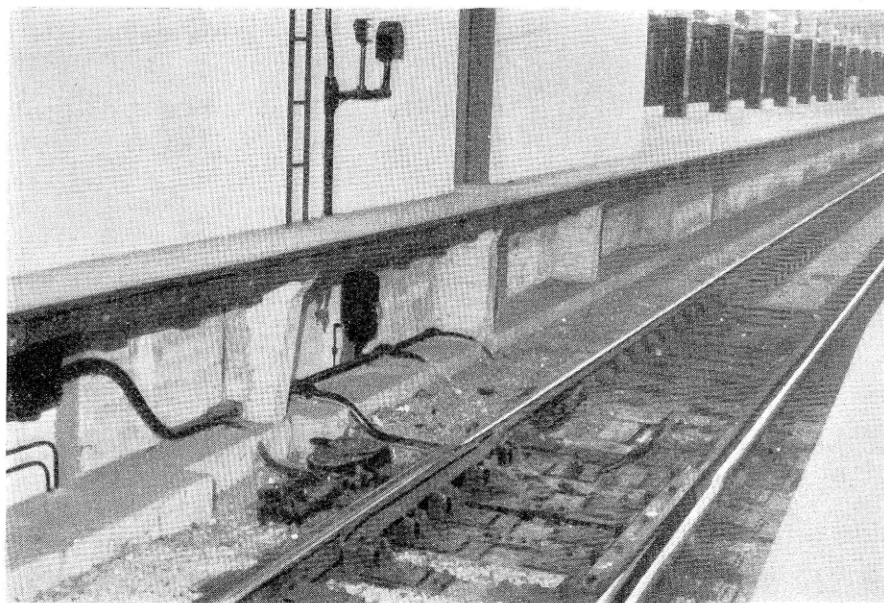
and pressure will be available at all switch machines.

An adjustable "stop" cock is used in each pipe leading from each "CP" valve unit to the cylinder of a switch machine. Some switches operate more easily than others, and some switches operate to the normal position more readily than to the reverse position. By adjusting these "stop" cocks, all switches can be operated in either direction with prompt and positive action, but without destructive banging.

Interlocking Machine

The Model-14 interlocking machine in the control station has 4 levers to control 7 signals, 4 levers to control 7 switch machines, 2 levers to control 2 derails, 2 levers for traffic locking, and one lever to control a train-announcer ball machine. Two spares are provided, thus making a total of a 15-lever frame. The usual arrangement of lever indication lamps are provided in a case below the levers, and on the front of this case is a row of push buttons used in the control of the call-on aspects of the signals, as will be explained later. A large illuminated diagram, mounted over the interlocking machine, has track occupancy indication lamps, not only for the interlocking limits and approaches but also for the double-track main line as far as 19th Street, so that the operator on duty can readily watch the progress of trains, and telephone for help in case a train stops on the line. A total of 38 track indication lamps are provided on this diagram.

In this interlocking, all circuits are operated by 25-cycle alternating current. The track relays are of the Model-15. The KR switch-repeater relays are the TV-40 motor-disc type, which is the equivalent of a polar



relay. The signal control relays are the SLV-13 type. All relays, including track repeaters, signal control, switch control, locking, and traffic-direction relays, are all located in a room adjacent to the control room in the tower. By thus locating all the relays at one central point, any failures can be located and corrected quickly, without the hazards occasioned by men going out on the tracks.

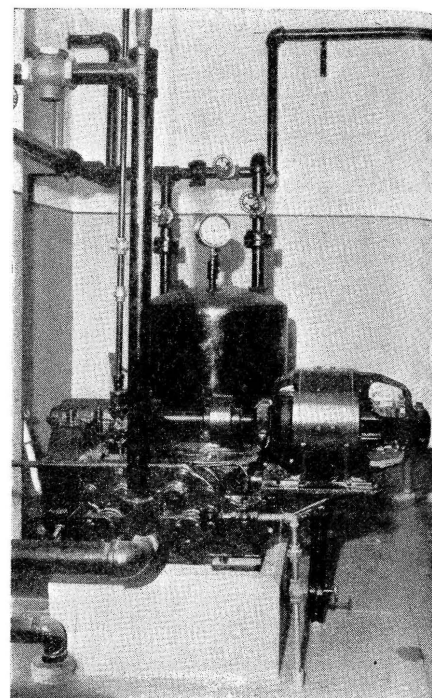
Train Stop System

A trip-type automatic train stop system is included as a part of the automatic signaling and interlocking. Each trip device is operated pneumatically, and is controlled electrically. If a signal is indicating Stop, the wayside trip at that signal and also the trip in approach, are in the raised position, such that a train attempting to pass would have the brakes applied automatically. The station entering home signals and trip stops are time controlled, so that an incoming train must consume an allotted time, in other words, reduce the speed to a certain average in the approach block, otherwise the signal and the trip stops will not clear. This special arrangement is provided to

A standby 25-cu. ft. air compressor is located at 33rd street and is automatically cut into service if the main air supply fails

prevent a train from entering the interlocking and station tracks at a speed that is too high for safety.

In addition to the wayside trips at the signals, additional inbound wayside trips are located at two points on the platform tracks. These trips are provided to prevent trains from pulling into the station tracks at too high a speed. By means of timing relays, controlled through contacts in track relays, the speeds of trains are checked by requiring that a train consumes a certain amount of time while the front wheels are traversing the length of a track circuit or a series of track circuits. If the speed is more than 12 m.p.h. on arrival at the first trip on a platform track, the trip does not lower, and the brakes are applied. Likewise, if the speed is above 8 m.p.h. when arriving at the second trip, the brakes would be applied. Likewise, trains departing from the station tracks must observe certain speed restrictions within the inter-

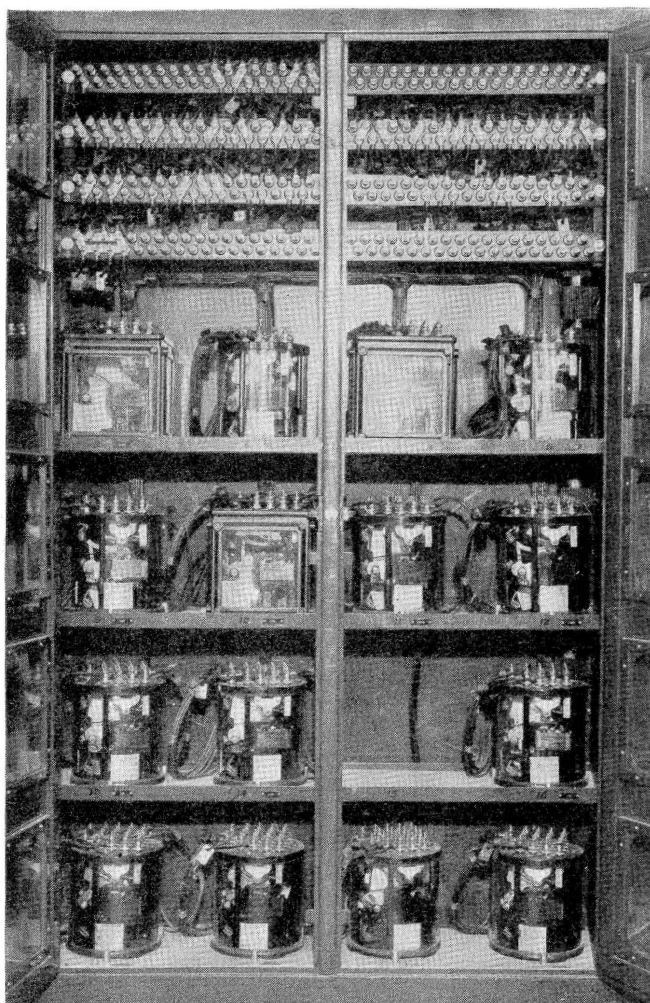


locking home signal limits including the switch area, otherwise automatic trips will cause the brakes to be applied at the departure ends of the interlocking routes, as, for example, at signal No. L12. In such instances a home signal must be cleared to direct the train to depart, therefore, an auxiliary aspect had to be provided to indicate whether the trip at the signal was cleared. This additional aspect consists of a lunar-white unit which is illuminated when the trip is in the raised position, but is extinguished when the trip is lowered to the clear position.

Emergency Operation

In order to prevent the congestion of trains in case any important part of the interlocking fails, certain special features are provided to permit the movement of trains with safety. If a track circuit has failed, as indicated by the lights on the track diagram, and the fact that the green indication lamp for a switch lever is extinguished, arrangements are provided so that the switches can be operated to line up routes and call-on aspects can be displayed to permit trains to move.

The following procedure applies for outbound trains governed by home signals R6, R10 or R12. An emergency release is placed in the full reverse position. This release is of the hand-screw type, and requires approximately 20 sec. for operation. It performs the purpose of preventing a leverman from inadvertently throwing a switch under a train, in case the mechanical locking would otherwise



All of the relays are located in a sheet metal case in a room adjacent to the control room in the tower at 33rd street

permit operation of the lever. After operation of the emergency release, the electric lever lock on the switch lever is released, and the lever can be moved to the opposite position and the red lever indication lamp is lighted, *but* the switch does not operate. At this time, a special lamp unit adjacent to the main signal is lighted, which is an indication to the motorman of an approaching train that the plant is not in normal operation. He stops his train short of the signal. With his car controller in the "off" position, he can remove a key from his controller and place it in a key-hole controller on a box so located on the wayside that he can easily reach it when opening the door of his compartment. When the key is turned in this controller, circuits are completed to cause the switch or switches to operate to the position corresponding with the positions of the switch levers, as is indicated by the red lever indication lamp being extinguished. The leverman then returns the emergency release to normal position. Then the leverman reverses the signal lever and operates the push button corresponding to the signal; after which the signal displays the "call-on" aspect and the train-stop trip at the signal clears. In the meantime, the motorman removes his key from the wayside device and returns it to its normal position in his car controller, so that he is ready to accept the signal and proceed.

Emergency Operation of Switches

Although great care has been taken to prevent the failure of the air supply to this plant, nevertheless arrangements have been provided such that if the pressure does fail, the switches can still be operated to keep trains moving.

In case of an air pressure failure, the raising of the hasp on an A-10 electro-pneumatic switch machine, affords access to a receptacle in which a crank can be inserted to crank the switch from one position to another. Once the hasp has been raised, the openings to the normal air supply are cut "off" and locked "off" by a latching arrangement which cannot be reset until released by means of a key in a Yale lock device, and this key is retained in the possession of the main-tainer on duty at the plant.

This new interlocking was installed under the direction of Ed Blake, Superintendent of Way and Structures of the Hudson & Manhattan. The interlocking equipment was furnished by the Union Switch & Signal Company, which prepared the detail plans and performed the construction work.

New Interlocking at Windsor, Ont.

(Continued from page 637)

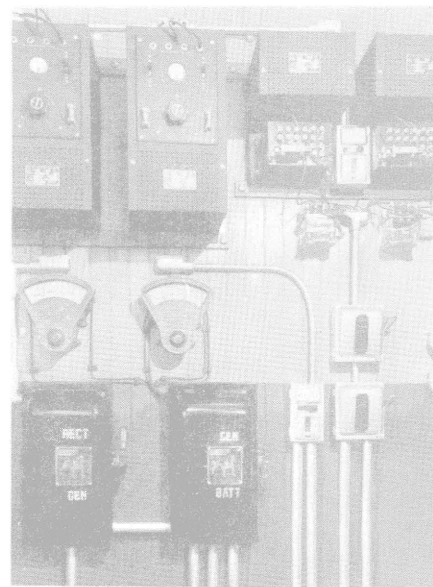
Underground parkway type cable was used to install an entirely new wiring distribution system between the signals, switches and the instrument room or house. Between the west end of the Electric Yard and Tower 3, aerial cables are used including two 19-conductor, one 12-conductor cable No. 12 and a single conductor No. 6. These cables are about 2,200 ft. long and are supported on poles spaced 100 ft. apart, using Copperweld stranded messenger and Raco cable strap hangers. The messenger is grounded at each end and at the middle point.

Instrument and Battery Housings

A room 18 ft. by 8 ft. 9 in., in the southeast corner of the Windsor station building was used to house the relays and other accessory equipment required at the control station of the Windsor plant. Another room 11½ ft. by 12 ft., which was partitioned off in one corner of the baggage room, is used to house the storage batteries. Near the location of old Tower 2, an 8-ft. by 10-ft. sheetmetal house was provided to include the relays, bat-

teries and accessory equipment required in the plant controlled from Tower 3.

On account of the fact that 600-volt d-c. traction energy is used on the rails, the track circuits are of the a-c. type. As a part of the improvements, the old galvanometer type a-c. track



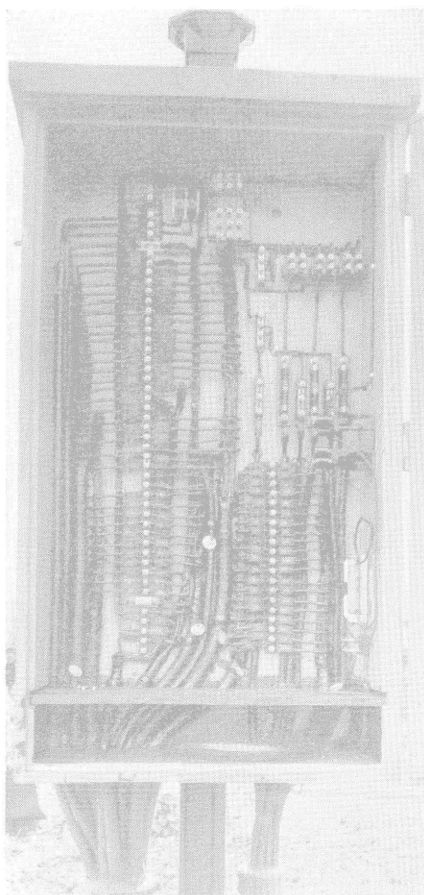
Battery charging apparatus

relays were discarded, and new Type-N vane a-c. track relays were installed. These track relays for the Windsor plant are all in outside relay cases and are repeated by Type-B d-c. plug-in relays in the relay room at the station, and those in the yard interlocking are all in the sheetmetal house.

Quick-Detachable Relays

The control relays of the interlocking systems are all of the G.R.S. Type-B quick-detachable plug-in type and are mounted in panels supported in angle-iron frames which rest in rubber shock absorbers on the floor. The small relays for the control of the NX networks and the various indications on the control panel of the Windsor plant are the G.R.S. Type-A, quick-detachable type, and are mounted in sealed cabinets with transparent covers.

These new interlockings were planned and installed by signal forces of the Michigan Central, under the direction of R. E. Green, assistant signal engineer. L. Rupert, circuit engineer, was assigned to this project to develop the plans and inspect the construction and installation. F. M. Brown, signal supervisor, had general supervision of the construction. The new control machines, signals, relays, rectifiers and replacement parts for the switch machines were furnished by the General Railway Signal Company.



Junction box near signal 12 LA