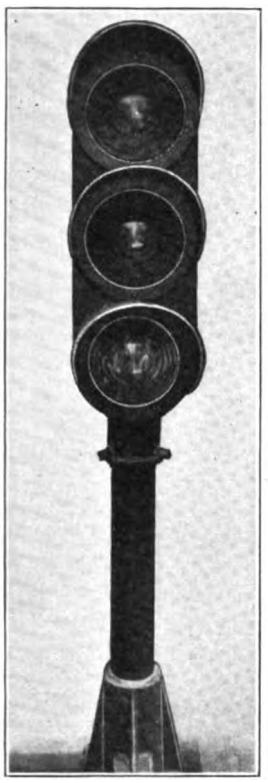
New York Elevated Signal Improvements

Rector Street Electro-Pneumatic Plant on Ninth Avenue Line of the Interborough Rapid Transit Has Recently Been Reconstructed

By Charles McGregor



A Three-Lens Light Signal

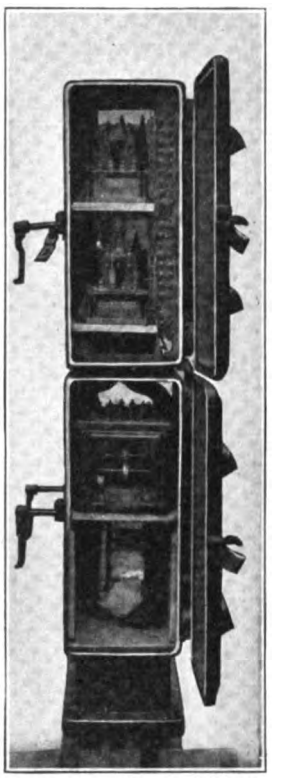
THE recent third tracking of the Ninth avenue elevated line of the Interborough Rapid Transit Company, New York City, necessitated the reconstruction of the interlockings at Rector street and Cortlandt street. The switches and signals were formerly operated from mechanical interlockings at four locations adjacent to the functions operated, and near the ends of the station platforms. A centralization of control was decided upon, all functions to be handled from an interlocking tower located directly over the tracks near the north end of the Rector street station where the view in either directon is without obstruction. The station at Rector street is used as the down-town terminal for all express and some local trains, other local trains using it as a through station to and from South Ferry terminus. Provision is also made to utilize Cortlandt street station as a terminal for some express trains as traffic conditions require. The single express track operation is somewhat of an innovation in that during the morning rush hours it is used solely for down-town express traffic, the empty trains going back over the up-town local track, and in the late afternoon the reverse occurs, the empty trains coming down over the down-town local track, and going up over the express track. The express traffic is thus all south-bound at one portion of the day, and all north-bound at another, the empty trains being in each case sandwiched in with the local trains. Operation is further complicated by the fact that the south-bound station platform at Rector street is not long enough to accommodate the seven-car express trains, requiring them to cross over south of Cortlandt street, and run against traffic on the up-town local track to unload passengers at the north-bound station platform, and then draw out north-bound over the local track. The plan shows the general arrangement of the tracks, switches and signals, and this information is visualized by the two views from the elevated interlocking tower, looking towards South Ferry and north towards Cortlandt street respectively.

Train Movements

Train service is very heavy, during the early morning and late afternoon rush hours exceptionally so, and every facility for speed of operation with safety must be fully utlized during these hours. Local trains are run on a four-minute headway continuously during the day, these usually comprising seven cars, totalling 332 feet long. Express trains during the rush hours are run on a three-minute headway, and are all seven-car trains.

Thus during the busy period, 50 trains per hour are received, of which 20 are express trains requiring double movements, inasmuch as they pass in, reverse their control, and then pass out of the station. This necessarily occurs between the arrival of the north-bound local trains, as all express trains use the north-bound station platform to load and unload passengers.

The morning down-town express trains cross over at switches 35 and 19, to unload passengers at the north-bound station platform. The empty late afternoon express trains first cross over switch 25, and lay up in the stub end tracks M and N, then work out alternately over switches 9 and 7, to load passengers at the north-bound station platform, in between the local trains from South Ferry, then out over switches 19 and 35 to the express track. The local trains that turn at Rector street do so by means of stub track M and switches 13, 9 and 7.



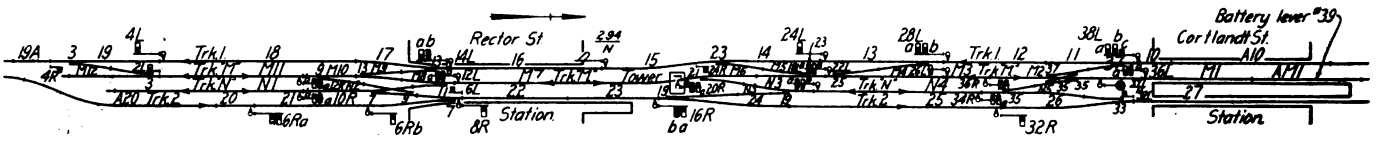
One of the Double Relay Boxes.

Interlocking System.

The interlocking system used is the electro-pneumatic, the machine being the Union Switch & Signal Company's type E. P. 14, of 39 levers, 8 being spare, and 1, No. 39, a battery control lever. All switch levers have lever lights adjacent to the lever, indicating when lighted that the lever lock circuit is complete, and the lever not electrically locked by any train movement. An illuminated track model also indicates by lighted and unlighted track sections the position of trains within the interlocking control. Attached to the track model is a train describer receiever operated from the despatcher's office informing the tower operator of the train despatcher's requirements.

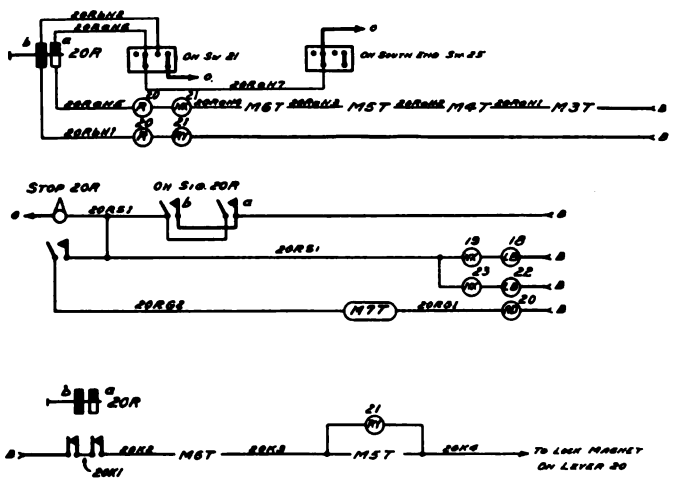
The interlocking signals are two-position electro-pneumatic, lower-quadrant, elevated railroad type, those for between tracks, unless dwarf for reverse moves, being of the "between-track" type. The automatic signals for the express track are three-indication color daylight signals. All home interlocking and automatic signals are supplemented by electro-pnuematic train stops. Each automatic signal is braking distance plus 50 per cent from the next signal in advance, or in other words, all automatic and interlocking home signals are so spaced that if passed at danger at any speed a train can obtain, the train stop will bring the train to rest, before it can reach the signal or fouling point in advance of the signal passed at danger. Switch movements are of the standard electro-pneumatic type, with remote control magnets. Automatic train stops are also of the standard electro-pneumatic type with enclosed circuit controllers, and with stop release boxes on pedestals.

As illustrated, the tower is elevated over the tracks, being a single-story building of large capacity, with the relay cabinet, resistance and reactance tube cupboards, motor-generator set, storage batteries and switchboards accommodated within the tower proper, instead of in the usual lower story. The floor is of concrete and the interlocking machine is slightly elevated so that when cleaning the tower floor with fluids, none of the fluid can come in contact with the interlocking machine or with the wires leading away from it, and cause deterioration of the insulation. The exterior of the tower is metal sheathed. The interior of the tower with the interlocking machine and illuminated track model is illustrated, the relay cabinet behind the interlocking machine being discernible. In another view is shown a corner containing the motor-generator set, storage batteries and the d. c. and a. c. switchboards.



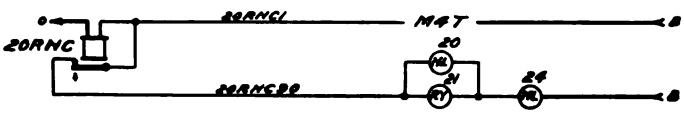
Track and Signal Layout of Rector Street Plant

Home signals for local tracks are controlled through track sections one block ahead, or to the next signal, without overlap; the distant signals are controlled through circuit controllers on the home blade above them, and on the home blade one block ahead, thus having one block overlap. Home signals for the express tracks, and the caution indication of the express track color daylight signal, are controlled through track sections for two blocks ahead, or have one block overlap; the distant signals and the clear indication of the color daylight signal are controlled through track relays for three blocks ahead, or have two blocks overlap. Express track automatic signals and those interlocking signals controlling entry into automatic territory, in addition are controlled by directional battery. This directional battery is controlled by the operator at the north end of the automatic territory, in this case at Fifty-sixth street, who sets up battery for north or for south-bound traffic at will, provided track sections between towers are unoccupied. This directional battery supplies current to the signal control relay at each location affected. The setting up of south-bound directional battery opens all north-bound automatic control circuits, and all control circuits of interlocking signals controlling moves north-bound into automatic territory, sending these signals to the danger position. Simultaneously it picks up a stop relay at each location affected, closing all the clearing circuits of the north-bound automatic stops, and holding the stops down in the inoperative position. When the battery is set for north-bound the result is opposite.



Typical Signal and Stop Control and Signal Lock Circuit

The diagram shows the signal and automatic stop control and the indication lock circuit for signal No. 20R which may be considered as typical, except that it should be understood that the local home signal controls are not taken through the track relays of any sections comprising an overlap; and also that where traffic is in one direction only, the supplementary clearing circuit of the automatic stop, by means of the lever-operated bands and contact springs, is not required. It will be noted that the stop clears in regular operation by the clearing of either of the signal blades 20Ra or 20Rb and is retained in the clear position by a back contact on the track relay M7T until the train has passed entirely off of section M7, provided lever 20R has not been restored to beyond the normal indication position. The supplementary clearing circuit through bands and springs on the lever-operated spring combination, is solely to clear the stop when about to be passed over by a train moving in an opposing direction to that which the signal controls. This is sometimes accomplished by means of a stick relay, as will be further described in connection with signal 26L. South-bound local automatic signal $\frac{294}{N}$ is at danger only when track section 16 is occupied, allowing a following local train to draw up to this signal at danger, while the previous train is in the station. All switches are detector and route locked by the train movements. In addition, the train where necessary opens a stick relay that in turn opens the control circuit of opposing signals, and closes the stop operating circuit for a move over the stop in an opposing direction. Thus when a north-bound train enters track section M4, stick relay 20RNC will open, for either lever 24R or 20R, with 21 reversed, will not have been restored to normal. To insure this being so, the normal indiction lock circuit of 24R is controlled through track relays 14T and M5T, and that of 20Ra through track relays M6T and M5T, as shown in the circuit plans. The signal control for signal 36La is taken through track relays M2T, M3T and stick relay 20RNC; thus 20RNC opening will prevent signal 36La going to clear, until the train that entered north-bound on track section M4 has passed off again. The supplementary stop operating circuit of 26L will remain down and clear until the north-bound train that entered track section M4 has passed off again.



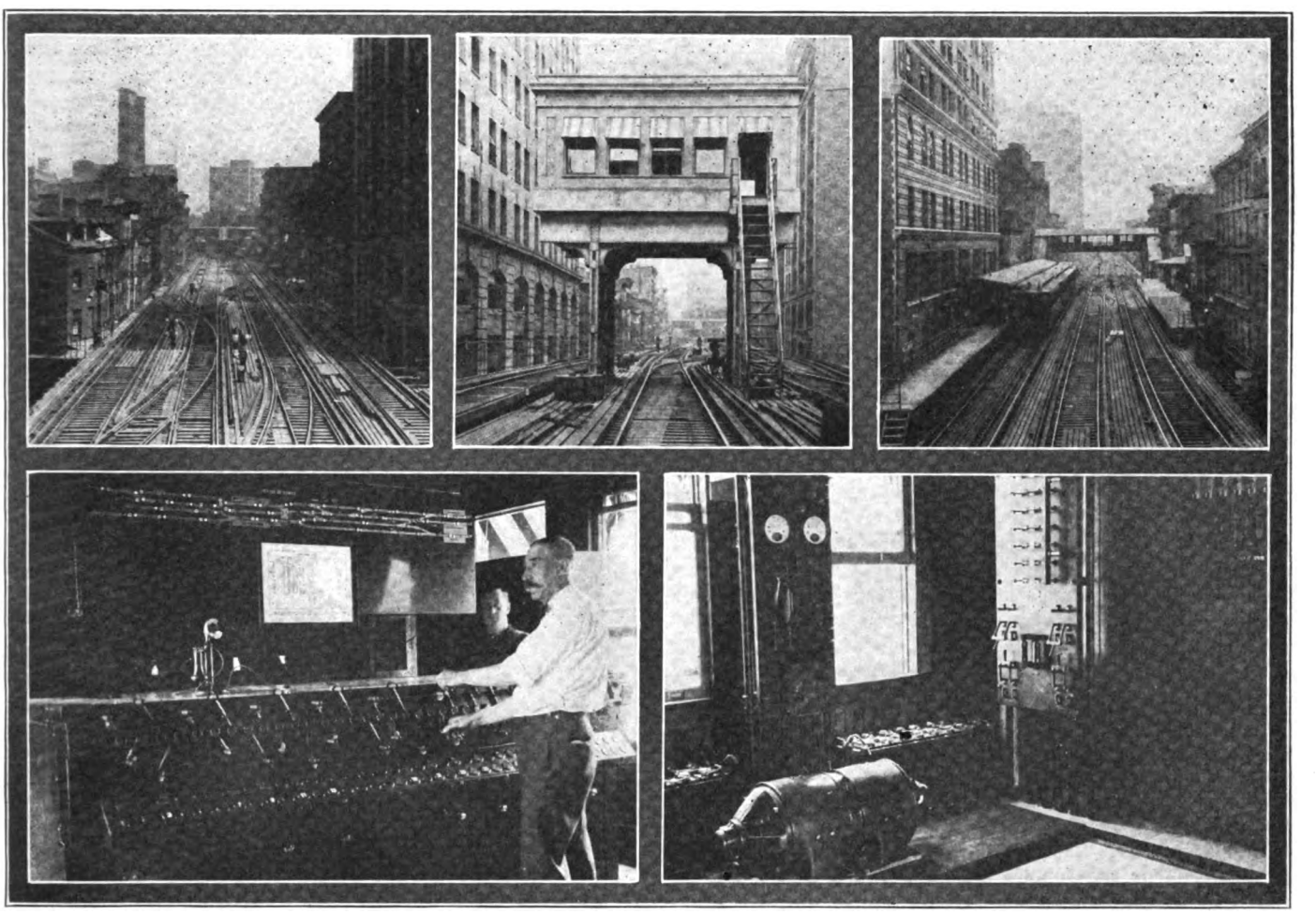
Typical Route Locking Relay Circuit

The single-rail track circuit is used throughout, one running rail being used exclusively for low-voltage single-

phase alternating current, the other being the common return for the d. c. train operating current, and the a. c. track circuit current. The track circuits are fused on both ends, furnished with resistance grids on the feed end to avoid short circuiting the transformer, and with resistance tubes and impedances on the relay end to limit the flow of a. c. current, shunt the excess d. c. train operating current and split the phase for the polyphase track relays. The track is bonded with two No. 6 B. & S. soft drawn copper wires, and insulated joints are Keystone.

All relays within the interlocking control except track relays MIT, AMIT and the color daylight signal control relays are housed in the tower in a steel-framed glass-fronted relay cabinet. Track relays are of the General Railway Signal Company's polyphase type, Model 2A, fitted with six front and two back, or ten front and two back non-independent contacts. Control, repeater and lighting relays are d. c. shelf type, Model 13, of the Union Switch & Signal Company's manufacture, wound to 1,000 ohms resistance, with four front and two back non-independent contacts. Relays MIT and AMIT are Union Switch & Signal Company's a. c. single-phase vane type, Model 15. Only these and the color daylight signal control relays are housed in cases at the signals, and because of the vibration of the elevated structure, are secured to spring supported shelves, as shown in the illustration of an instrument case. The resistance grids, impedances and resistance tubes for the track circuits are also housed in the interlocking tower.

The a. c. current is obtained from a 550-volt, single-phase, 25-cycle, transmission line, which feeds duplicate transformers located on the structure below the tower, one transformer being always in reserve. These supply current at 55 volts for the signal lights and the lever lights on the machine, and at approximately 10 volts for all track circuits, except sections MI and AMI which are fed from local transformers. The illuminated track model is supplied with current at 22 volts from a separate transformer, not in duplicate. The d. c. current is taken from the third rail supply at approximately 600 volts transformed down by a 1.35-kw. motor-generator set within the tower to charge 16 cells of Edison storage battery, in duplicate, one set being always in reserve. The storage battery delivers current at approximately 20 volts for the operation of the d. c. control relays and magnets. Switchboards for the control of the a. c. supply, the motor-generator and the storage batteries are also located in the tower.



Looking North from the Tower — The Tower Is Over the Tracks — Looking South Over Rector Street

Interior of the Operating Room — Power Equipment in Operating Room

Control wires are run to functions and junction boxes in cable form, of Kerite manufacture and are protected in trunking secured to the structure. Air is supplied at 70 lb. pressure by three sets of standard motor-driven, car airbrake compressors, located in a compressor house at Cortlandt street. This is temporary as both air supply and a. c. current will finally be connected in with the subway supply mains.

This interlocking was designed and installed complete by the Interborough Rapid Transit Company, signal department, under J. M. Waldron, signal engineer, and P. Looby, foreman in charge of construction.