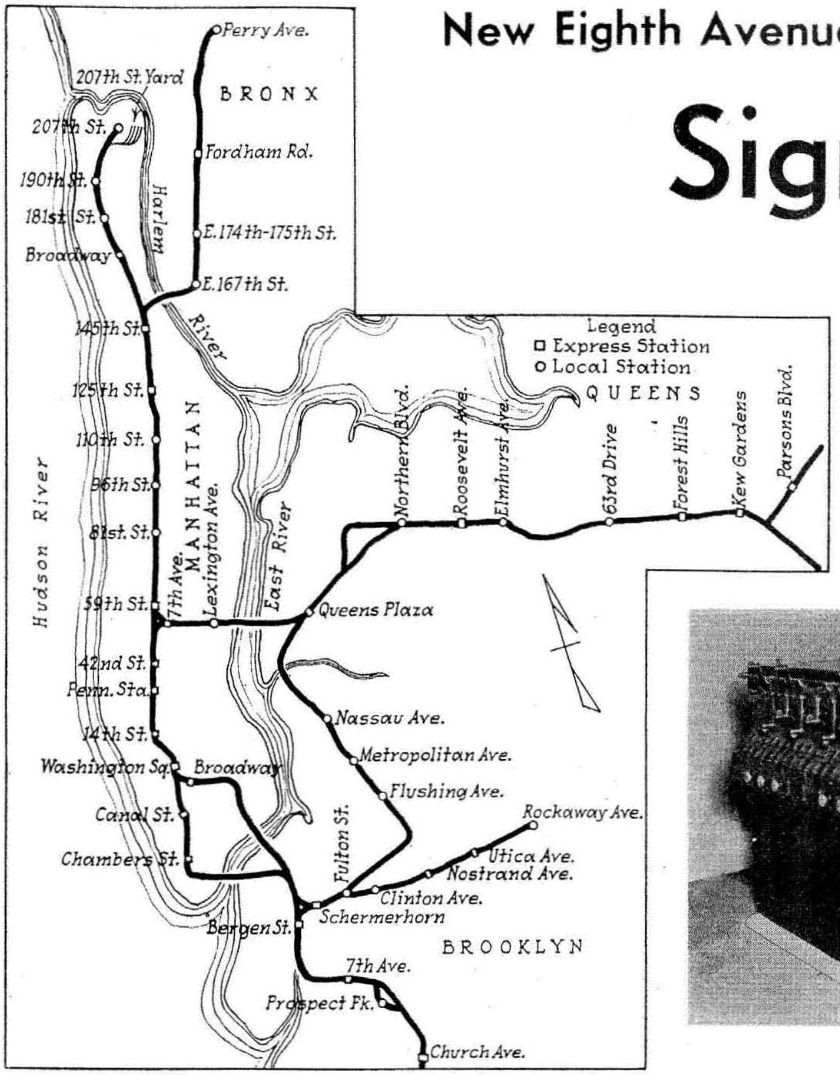
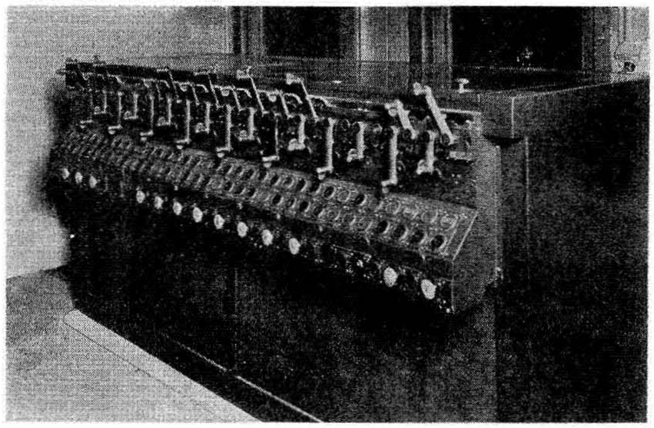
# New Eighth Avenue Subway

# Signaling and




Dense-traffic operating conditions responsible for many singular features of general and technical interest—Scientific location of signals provides for maximum safe utilization of track



Machine at the 200th street plant

FOR several years the city of New York, through its Board of Transportation, has been constructing an entirely new system of subways to serve Manhattan Island and the more populous sections of the Bronx, Brooklyn and Queens. This new system to a certain extent parallels the two subway systems now in service and is being provided for the purpose of relieving congestion on existing lines and to insure proper transportation for the city's ever-increasing population. The lines to these several boroughs are not as yet completed, but the section of this new system, known as the Eighth Avenue line, extending from Fulton street at the south end of Manhattan to 207th street at the extreme north end of the island, is now ready for service, and as the features of the signaling facilities for the entire project are in general the same, the following description will be confined to this section. This line has four tracks from Fulton street to 168th street, 10 miles; and two tracks from 168th to 207th street, 2.2 miles; or a total of 48.5 miles of single track on the main line, including 4.1 miles of siding track. The main shops and storage yard of the system are located at 207th street, and include about 14.2 miles of track, making a total track mileage of 62.7 miles, all completely signaled. All switches on the system are interlocked.

To the railroad man who ordinarily thinks in terms of 100-mile divisions, this subway may be considered as a small proposition. True, it is rather short, but due to the dense traffic which will be handled, and the numerous interlocking plants and stations, the signaling not only presented many new problems, but involves a vast amount of equipment. On this section of line there are 822 signals, or an average of 13 signals per mile of single track, including yards. Of these signals, 551 are equipped with automatic train stops. There are 837 track circuits, or an average of 13.3 per mile of single track. The 19 interlocking plants have 626 working levers. The relays, of which many types were used, total 2,957. About fourteen million feet, or 2,650 miles, of wire were used, equivalent to 42 wires per track. The total cost of the signaling and interlocking was over $5,000,000.

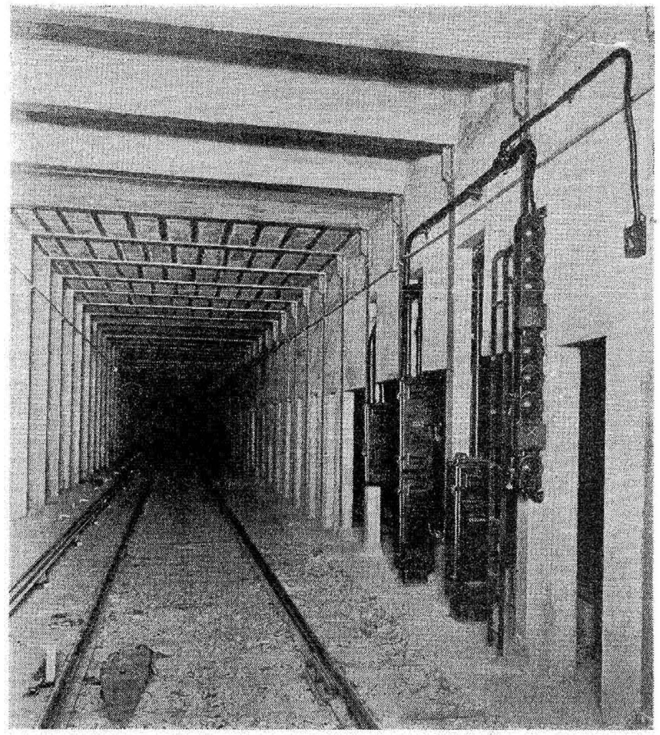
The signaling system was installed according to plans and specifications developed under the direction of R. C. Johnson, signal engineer of the Board of Transportation of the city of New York. On account of the extent of the project and the short time available, the construction was divided into two contracts. The Union Switch & Signal Company furnished and installed the signaling on the territory between 103rd street and 207th street, including the yards; while the General Railway Signal Company had a similar contract for the territory between Fulton street and 103rd street. About 54 per cent of the project was installed by the U. S. & S. Company and 46 per cent by the G. R. S. Company.

### Operating Characteristics of Line

In general, on the four-track section of the line the two outside tracks are for local trains and the two inside tracks are for express trains. Local stations are located approximately ½ mile apart, there being 29 such stations between Fulton street and 207th street. On the average,

# Interlocking

## in New York City



Signal and train-stop location

a local train during rush hours stands at each local station 30 seconds, and 45 seconds at each local-express station; 80 seconds are required for the run to the next station stop. The signaling on the local tracks is designed for 105-seconds headway with "green" signal indications. As the stations are close, there is no opportunity to attain a very high speed, the maximum operating speed being about 25 to 30 m.p.h.

Express stations are located at 10 points, as shown on the diagram, there being no standard distance between stations because such stations are located at certain transfer points, railroad stations and business centers. These express trains in rush hours make a station stop of 45 to 60 seconds and the headway is 90 seconds. Between stations these express trains attain a maximum operating speed of 45 m.p.h. The platforms at all stations are long enough to accommodate 10-car trains. The multiple-unit motor-power equipment is so designed that, with passengers, a 10-car train will accelerate from stop to a speed of 25 m.p.h. in 17.4 seconds in a distance of 365 ft. on level tangent track.

### Track Circuits Are A-C

However, for the most part this line is neither level nor tangent. The curves are numerous and some are rather sharp, having a radius of 370 ft. The crossovers and turnouts for emergency moves are No. 6, but those for regular operation are generally No. 8. Throughout the greater portion of the line the subway was constructed just beneath the street, the distance from the roof of the subway to the surface of the street being only sufficient to accommodate necessary subsurface structures, such as water and gas pipes, duct lines, etc. As a result, the grade of the subway tracks is approximately the same as that of the street, ranging up to 3.0 per cent. Between 175th street and 200th street, the subway passes under a high hill, so that it was necessary to bore a tunnel for the subway, which at some places is 170 ft. below the surface, with a grade of 3 per cent. At certain points, the subway is under or over other subways, etc., which also accounts for some of the 3 per cent grades.

In the new subways the electric traction circuit is 550 volts d-c. The track circuits are of the a-c. single-rail type, in which one rail of the track, called the signal rail, is used exclusively for the track circuits. Joints of this rail are bonded with duplex A. S. & W. Co. bonds, each cable consisting of six galvanized steel strands around a strand of copper. To each end of the strands is welded a ⅜-in. pin for driving into the rail. These bonds are placed on the outside of the rail along the upper edge of the angle bar and are held in place by P. & M. rail clips. Rail connections are made with No. 6 single-conductor insulated stranded wire run in trunking, the single conductor being connected by means of a solderless connector to a single pin bond similar in design to that above. The other rail is used in common by the signal track circuit and by the propulsion current return circuit. The average length of a track circuit is about 400 ft., with a minimum of 100 ft. and a maximum of 1,000 ft.

Each track circuit is end-fed by a transformer having a 110-volt primary and three secondaries, the one for the track feed having taps from 1 to 15 volts in 1-volt steps. One of the other secondaries is 110 volts for illuminated track indicators, and the third, 12 volts for the signal lights. The track relays are either the Union Vane Model-15 or the General Model-2, Form-A.

Typical electric switch layout at 42nd street interlocking

All of the signals are of the color-light type, the indications of block signals being; *Red,* instructing the motorman to stop; *yellow,* proceed with caution prepared to stop at the next signal; and *green,* proceed at normal speed. The top head of an interlocking signal is the "block" head and gives the same indications as an automatic block signal. The lower head is the "route" head, green for straight track or principal route, yellow for the diverging route, and red to indicate stop when the block head is also red. By this method a train never passes an interlocking signal (excepting call-on moves) which has a red light displayed. All interlocking signals are equipped with call-on signals. This call-on normally is not lighted. It consists of a yellow lens which will give a slow-speed indication when the track circuits are "out," but the signal lever, as well as the call-on button at the lever, must be operated.

### Signals

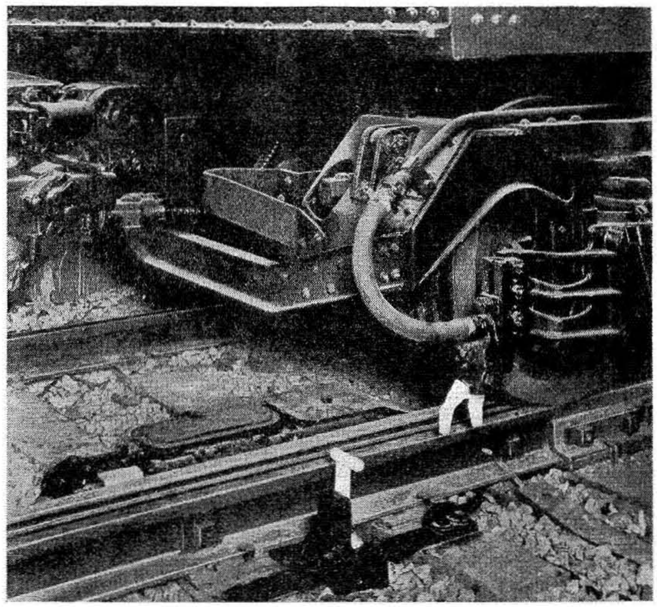
At certain locations, as at sidings or on yard leads, the "keying by" the call-on signal may cause traffic delays; in which case three yellow lights (yard indication signal), instead of the call-on signal, are displayed to indicate that the yard track is partially occupied and that the train may proceed prepared to stop. When this indication is given, the automatic stop will clear without "keying by." Indications in subway signals are provided by two 5-watt 10-volt lamps in multiple behind each lens. In case one lamp burns out, the other lamp will provide sufficient illumination to give an indication. Signals for out-door use in the 207th Street yard are similar to the subway signals, but have a special double-lens arrangement designed to utilize more of the light of the lamps. Lamps for these signals are 110-volts, 36 watts. The signal heads are fastened to the walls or columns in the subway section and on masts in the yard.

The location of all signals was determined by the use of speed-time curves, described later. Energy for the lamps is taken from a separate winding on the track transformer, taps being provided on this winding to give a variation in voltage suitable for the varying local conditions encountered. Sufficient light for the signal indication in the subway is provided by burning the 10-volt lamps at from 7 to 9 volts. All signals are located on the right-hand side of the track which they govern, and as nearly as possible at the height of the motorman's eye. Where it is necessary to locate signals on curves where they can be seen only for a very short distance, a longer view is provided by the use of repeater signals, placed on the opposite side of the track, approximately opposite the signal. Repeater signals are of the same type and repeat all of the indications of their principal signals.

### Automatic Train Stops

Automatic trains stops are used in connection with all interlocking and block signals which control main-track movements in the normal direction of traffic. These stops are of the mechanical-trip type in which an arm is so located on the roadway as to engage with a similar arm located on the cars. When a signal indicates "stop," the automatic stop arm on the roadway will be raised to a position which will operate the tripper arm on any car which attempts to pass it, and this action will open an air valve on the car, causing an emergency application of the brakes. When the signal is clear, the roadway arm will be lowered and a train may then pass over it without interference.

The roadway arms are operated by machines placed either on the ties of the track or on the bench between tracks, depending upon local conditions. The stop machines are of two kinds—the 110-volt 60-cycle a-c. induction-motor type in the section south of 103rd street, and the electro-pneumatic type, controlled by an a-c. z-armature valve in the section north of 103rd street. In both types, the design is such as to cause the arm to assume the stopping position by spring action as soon as power, either air or electric, is removed from the machine. The operation of the stop is synchronized with that of the signal, the same controlling circuits being used for both devices, except that while the signal will change to red as soon as the head end of a train passes it, the stop will remain clear until the rear end passes it, in order not to trip the brakes on the rear cars of the train. Furthermore, the controlling circuits are so arranged that if the



Automatic train-stop with roadway arm set to stop train

automatic stop for any reason fails to function properly, the signal will be made to indicate "stop," that is, the stop must be clear (non-tripping) before the signal will clear and must have returned to the tripping position before the signal can again clear.

The automatic stops for automatic block signals are equipped with an automatic release, by which a stop will be driven to the non-tripping position if the stop (red) indication of a signal has been obeyed and the speed of the train is approximately five miles an hour when passing the signal. This automatic release also occurs at automatic block signals when it is necessary to run trains in the reverse direction of traffic. Automatic stops of interlocking signals are equipped with manual releases. When a call-on indication is given, as previously described, these stops can be released only if the motorman has operated the manual release arm located about five feet from the signal.

### Method of Locating Signals

One feature of signaling on subway lines which is distinctly a development made necessary to meet the very exacting requirements of the dense traffic, is the method used in locating the block signals. These signals must be so located and controlled that they will provide free running of trains on the required headway, with a given length of station stop and under the physical and operating conditions prevailing at the various points on the line. The location of the signals can, therefore, be determined only after full consideration of the following elements:

(a) Motor and braking characteristics of car equipment, which determine the acceleration and deceleration rates.

(b) Grade and alinement of tracks, which factors have very decided effects on the speed of the trains for any given run.

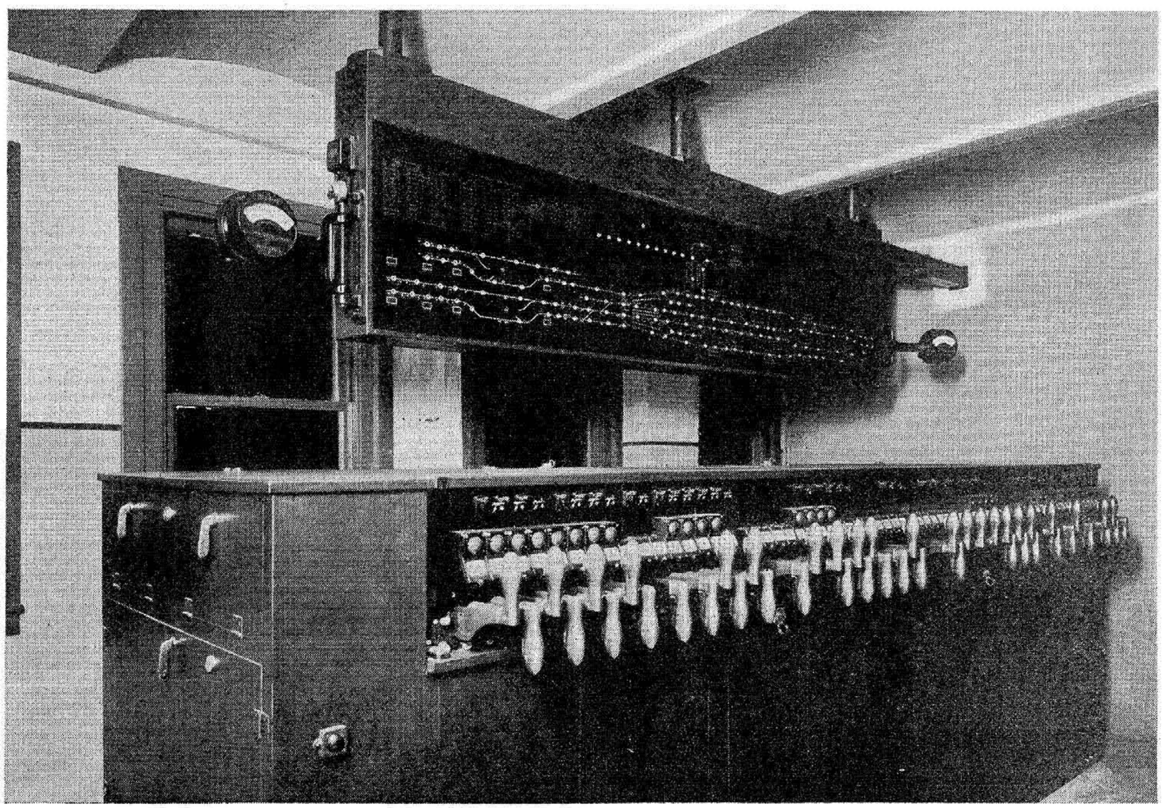
(c) Location of switches, stations and other physical characteristics of the railroad.

(d) The desired length of train, headway, length of station stops.

(e) The operating characteristics, such as operating speeds, demand for clear signals, and signal apparatus characteristics.

Most of these elements can be set down at fairly definite values, and the practice is to combine the known quantities in proper relationship, in the form of operating curves, these curves being plotted for the entire length of each track. By placing side by side the curves of two consecutive trains operating on the required headway, the signals between the two curves may be scientifically located so as to meet the operating requirements. In locating the signals, however, allowance must be made for the indefinite elements in the problem, and for the deficiencies in the car and roadway equipment. These curves represent the probable operating speed of the trains, on the required headway, which takes care of the capacity element of the problem, but the signal locations must also take into account the safety element, and the length of control of each signal spotted between the two operating curves must be such as to provide braking distance at maximum speed plus a factor of safety. In locating signals in this manner, as much leeway as practicable is provided, but it should be understood that as the saturation point with respect to track capacity is approached, a very great expenditure of money will result in a very small advantage, but in the subway a saving of a few seconds in each train is worth a great expenditure.

A signal system laid out on this basis will take care of the train movement for which it is calculated, and if any of the values used are not adhered to in actual operation, then something other than the desired train movement is liable to result. For instance, a train running behind schedule, or stopping too long in a station is almost sure to cause delays to following trains, and reduce the capacity of the railroad below that desired.



Interlocking machine and track diagram at 59th street plant

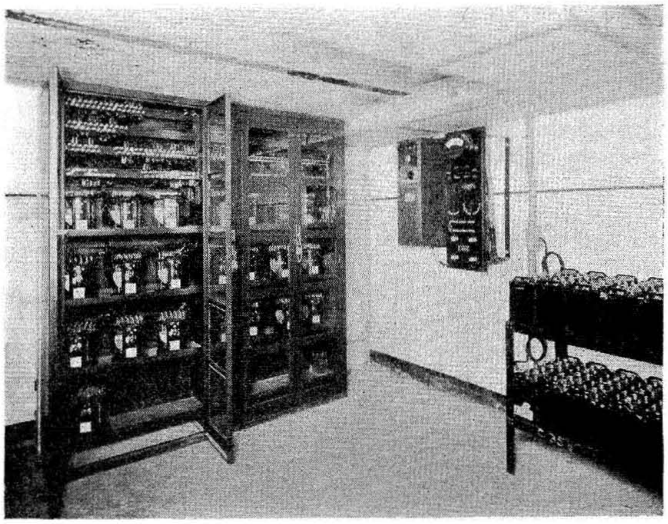
### Time Control Scheme

Another development which has resulted from the requirements of rapid transit operation is time control of signals, which is a scheme for aiding the motormen to maintain safe speeds at any point on the line. This scheme was developed to provide increased capacity at congested locations, as at a station. The normal length of the control of a block signal must be sufficient to provide braking distance for a train running at maximum speed, and this length of control is effective, since it is a fixed length of track circuit or circuits, even though the speed of a train may be considerably less than the maximum, with the result that trains are kept farther away from the train ahead than would be necessary for safety at a lower speed. The time-control scheme remedies this situation by reducing the length of the control of a signal to the braking distance necessary for some speed less than the maximum, and thus allows a train to approach closer to the train ahead under clear signals.

The reduced train speed is prescribed by the use of a time-contacting device which is inserted into the control circuits of the signal in such a manner that a train must consume a predetermined time (equivalent to the desired speed) in the track section lying in the approach to the signal. If the train runs faster than the allowable reduced speed, it will reach the signal before the time has elapsed for which the time contactor is set; the signal will then still have its long control in effect and will indicate "stop" and the train, if it attempts to pass the signal, will have the brakes applied and be brought to a stop before reaching the train ahead.

If the speed of the train has been properly reduced by the motorman to the prescribed speed, the time will have elapsed, and the time-contactor will have closed its contacts and shortened the signal control. The signal will then indicate "caution" and the train can move toward the next signal. The entire procedure is then repeated for the next signal. It will be seen, therefore, that a signal system in which this scheme of time control is used provides protection for trains operating at maximum speed, and the time-control scheme affords protection and capacity for speeds lower than the maximum.

This time control scheme is also used on long steep down-grades to regulate the speed of trains. It will be seen that the speed which a train could attain on such a grade, if unrestricted, would be very high, and the braking distances would be very long. The control of the signals would, therefore, be so long as to reduce the capacity of the track. Furthermore, excessive speed always carries with it the danger of accident, so that limiting the speed of trains in this way, increases both the safety and capacity of the railroad. For this condition the signals are normal-danger signals and the timing contactor is placed in the second block in approach to the signal, instead of in that immediately in approach. This is to obtain freer operation. The first signal beyond the train will indicate "caution" until the timing contactor has operated, at which time it will change to "green," and the second signal will change from "stop" to "caution." In order to give the motorman the information that the signal can clear if the correct speed is maintained (that is, that the track circuits to the limit of the control of the next signal ahead are clear) an additional aspect in the form of a white illuminated letter "S" is displayed when the signals are at caution. At other times the letter "S" is dark. The letter "S" is a repeater of the track circuit control of the signal ahead.



Interior of relay and battery room

## Interlockings

Ninteen interlocking plants were installed at various locations on the new lines between Fulton street and 207th street, the number of working levers, size of frame, etc., being shown on the accompanying table. The nine plants south of 103rd street are the all-electric type and the 10 plants north of this point are the electro-pneumatic type. The interlocking machines and control circuits employed on these plants are essentially the same as ordinarily used on steam roads, with some variations required for maximum flexibility and economy, consistent with safety. Complete electric locking is employed, one of the special features being that the approach locking is also applied to the approach signals, and is in effect from the time that a train enters the approach section until the detector circuit is occupied. Approach locking is used also with the home signals, and the approach locking for both approach and home signals is shunted out by mechanical-timer contacts when the signal levers are restored to their indicating positions. The purpose is to hold the route semi-mechanically until detector circuits come into effect and to provide a time release for use when necessary to change a route once set up.

**The Project Involved the Construction of 19 Interlocking Plants, Data Concerning Which Are Shown in This Table**

| Location | Size of Frame | Working Levers | Number of Switches |
|---|---|---|---|
| Chambers Street | 32 | 22 | 6 |
| Hudson Terminal | 12 | 9 | 4 |
| Canal Street | 24 | 20 | 8 |
| 30th Street | 40 | 30 | 11 |
| South of 42nd Street | 16 | 13 | 3 |
| North of 42nd Street | 32 | 23 | 7 |
| 59th Street | 64 | 53 | 16 |
| 81st Street Upper Level | 24 | 9 | 3 |
| 81st Street Lower Level | 24 | 10 | 3 |
| 125th Street | 43 | 27 | 14 |
| 135th Street | 39 | 33 | 13 |
| 145th Street Upper Level | 15 | 10 | 4 |
| 145th Street Lower Level | 19 | 13 | 8 |
| 168th Street | 23 | 19 | 12 |
| 174th Street Yard | 15 | 11 | 7 |
| 200th Street | 35 | 30 | 22 |
| 207th Terminal | 7 | 5 | 4 |
| 207th Street Yard Tower A | 107 | 92 | 69 |
| 207th Street Yard Tower B | 55 | 46 | 27 |
| Total 19 Machines | 626 | 475 | 241 |

## Switch Movement Control

The electro-pneumatic switch machines are the Union rack-and-pinion Model A-10, especially suited for use in the subway, or where space is restricted. It is supported on but two ties. Provision is made for hand cranking the movement. Cut-off of air supply and locking of the indicating mechanism is enforced prior to hand operation. Point-detection is provided; this controls the switch indicating contacts, thus giving point-detection without additional contacts and connections in the indicating circuit. Type-CP cut-off valves are operated by 14-volt d-c. control circuits direct from the lever without intervening contacts, so that the control is instantaneous. This type of control assures maximum safety, reliability, and economy of operation. Air is on the movement only during operation, the cylinders being open to atmosphere in the extreme positions. Retarding back pressure and momentary admission of air to the "last active" cylinder is avoided. Contacts actuated by the valves and included in the indicating circuit compel coincidence in position of the valve and switch movement with the lever.

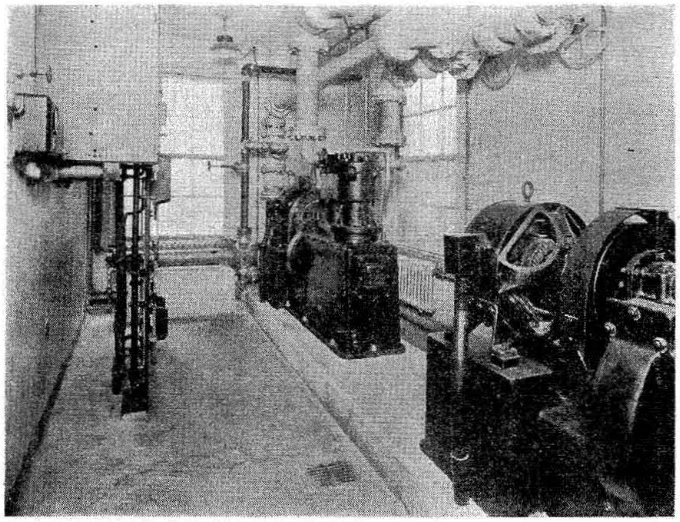
The switch machines at the electric plants are the G. R. S. Model-5, operating on 110 volts d-c. In addition to the lock rod, they are equipped with a magnetic brake which will hold the switch in position independent of the usual restoring circuit and lock rod. The control for these movements is also instantaneous, and switches can be stopped in any position. Dynamic indication is used, and switch-repeater relays check the position of the switch mechanism, the point detector, and the switch lever. The switch can be hand cranked by first releasing the magnetic brake and opening the control circuit. After hand cranking, a special key retained by the maintainer is required to reset the control circuit for regular lever controlled operation. Edison storage battery is used for the 110-volt supply for switch operation.

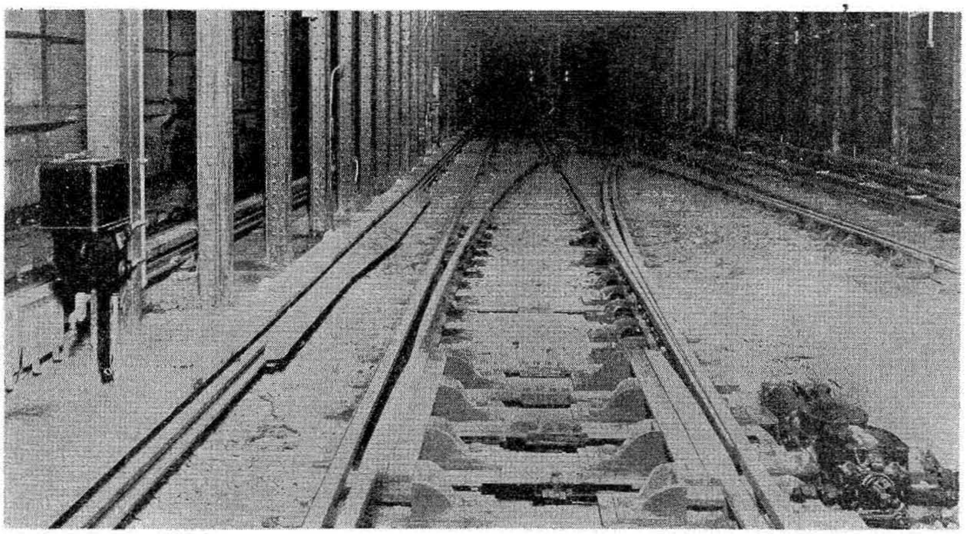
Both types of switch machines are equipped with the for emergency operation only. When used, an emergency release operation must be made for each emergency switch operation; and the emergency release must be in its normal position before a signal can be displayed for movement over a switch.

The illuminated track indicator at each interlocking is a reproduction of the track-and-signal layout of not only the immediate interlocking limits but also of a portion of the road in each direction so that every track circuit on the entire line is repeated on one or more indicators. With this arrangement the leverman and dispatcher know the exact location of every train in their territory.

## Electric Power Systems

Power for the signal system is alternating current at 60 cycles, and is obtained from the New York Edison Company's network by connections at all passenger stations on the subway lines. The signal power mains are divided into sections of about two miles in length, and three or more transformer locations are connected to each section of signal mains. Each transformer location consists of two transformers, one transformer being fed from the Edison power on the west side of the subway, and the other transformer from the Edison power on the east side. Signal line transformers with auxiliary switches and protective devices are usually located in compartments which were built in the subway, adjacent to cable manholes. The transformers have 120-volt primary and 110-volt secondary windings with taps on both coils to provide variations in voltage. The transformers are of





**Above — Automatically-controlled air-compresser plant**

**Right—Typical electro-pneumatic switch layout**

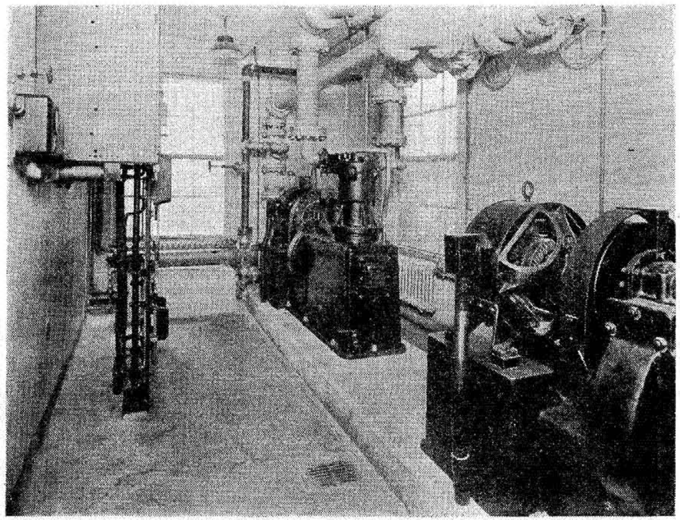
so-called "cut-off" circuit in which all track circuits in the detector circuit must be "clear," and all automatic train-stops adjacent to the switch must be in the tripping position before the switch lever can be unlocked and before the switch machine can be moved.

With trains operating on a 90-sec. headway, a track-circuit failure, that cannot be corrected within a few minutes, causes train delays and congestion that sometimes requires hours to smooth out. Therefore, in these subway plants some means must be provided so that, in case of a track-circuit failure the switches involved can be operated directly from the lever without the restriction of the detector locking. In order to effect this result, a sealed emergency release for each switch lever is located on the interlocking machine, and is so connected that when operated the electric locking controlled by the track circuit is cut out. These devices are operated by sealed handles or hand cranks and are intended

5, 7½, 10, 15 or 20 kv.a. capacity, depending upon the load on the respective sections of mains, and the transformers feeding each section have sufficient capacity so that in case of failure of any transformer, the other transformers on the section can carry the entire load, plus 25 per cent to take care of additional capacities which may be required in the future. These transformers were furnished by the General Railway Signal Company on the south section, and by the General Electric Company on the north section. Protective devices used in connection with the transformers are so arranged that in case of trouble either on the primary or secondary side of any transformer, the condition will immediately be indicated in an adjacent signal tower, where some one is on duty who can take the necessary steps to rectify the trouble. On four-track lines there are two signal mains, one for northbound and one for southbound tracks, so that the failure of one signal main will affect only one direction these movements is also instantaneous, and switches can be stopped in any position. Dynamic indication is used, and switch-repeater relays check the position of the switch mechanism, the point detector, and the switch lever. The switch can be hand cranked by first releasing the magnetic brake and opening the control circuit. After hand cranking, a special key retained by the maintainer is required to reset the control circuit for regular lever controlled operation. Edison storage battery is used for the 110-volt supply for switch operation.

Both types of switch machines are equipped with the for emergency operation only. When used, an emergency release operation must be made for each emergency switch operation; and the emergency release must be in its normal position before a signal can be displayed for movement over a switch.

The illuminated track indicator at each interlocking is a reproduction of the track-and-signal layout of not only the immediate interlocking limits but also of a portion of the road in each direction so that every track circuit on the entire line is repeated on one or more indicators. With this arrangement the leverman and dispatcher know the exact location of every train in their territory.

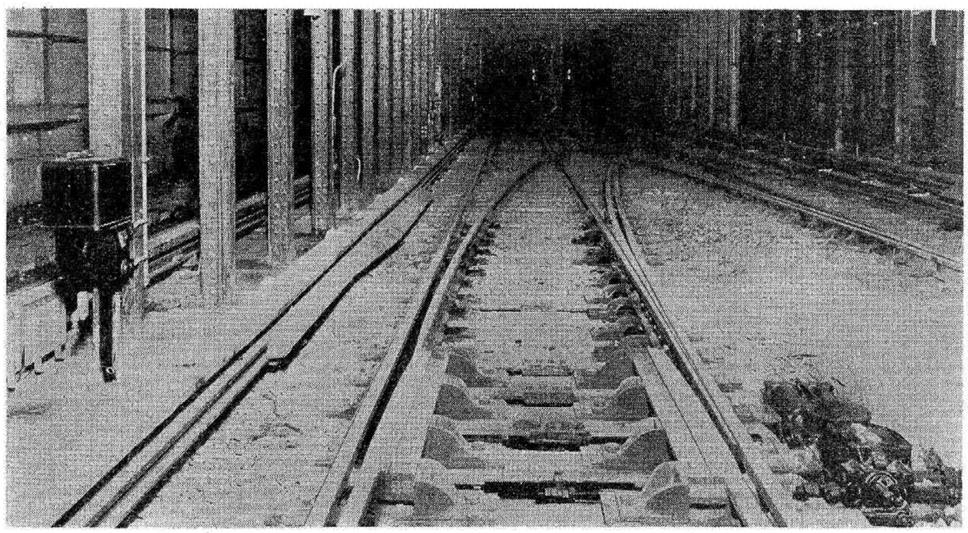


## Electric Power Systems

Power for the signal system is alternating current at 60 cycles, and is obtained from the New York Edison Company's network by connections at all passenger stations on the subway lines. The signal power mains are divided into sections of about two miles in length, and three or more transformer locations are connected to each section of signal mains. Each transformer location consists of two transformers, one transformer being fed from the Edison power on the west side of the subway, and the other transformer from the Edison power on the east side. Signal line transformers with auxiliary switches and protective devices are usually located in compartments which were built in the subway, adjacent to cable manholes. The transformers have 120-volt primary and 110-volt secondary windings with taps on both coils to provide variations in voltage. The transformers are of 5, 7½, 10, 15 or 20 kv.a. capacity, depending upon the load on the respective sections of mains, and the transformers feeding each section have sufficient capacity so that in case of failure of any transformer, the other transformers on the section can carry the entire load, plus 25 per cent to take care of additional capacities which may be required in the future. These transformers were furnished by the General Railway Signal Company on the south section, and by the General Electric Company on the north section. Protective devices used in connection with the transformers are so arranged that in case of trouble either on the primary or secondary side of any transformer, the condition will immediately be indicated in an adjacent signal tower, where some one is on duty who can take the necessary steps to rectify the trouble. On four-track lines there are two signal mains, one for northbound and one for southbound tracks, so that the failure of one signal main will affect only one direction

**Above — Automatically-controlled air-compresser plant**

**Right—Typical electro-pneumatic switch layout**



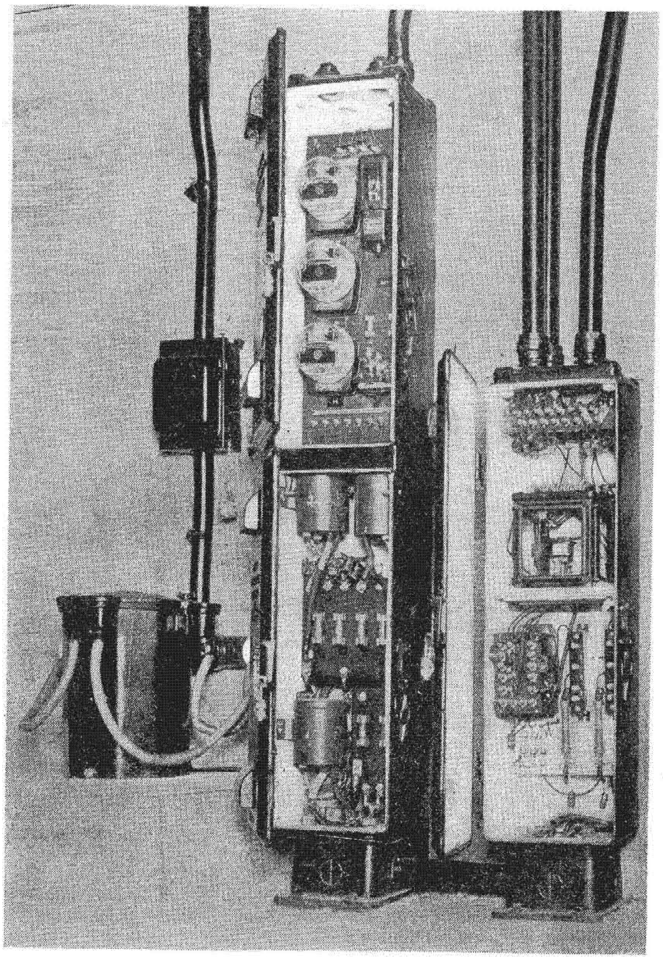
so-called "cut-off" circuit in which all track circuits in the detector circuit must be "clear," and all automatic train-stops adjacent to the switch must be in the tripping position before the switch lever can be unlocked and before the switch machine can be moved.

With trains operating on a 90-sec. headway, a track-circuit failure, that cannot be corrected within a few minutes, causes train delays and congestion that sometimes requires hours to smooth out. Therefore, in these subway plants some means must be provided so that, in case of a track-circuit failure the switches involved can be operated directly from the lever without the restriction of the detector locking. In order to effect this result, a sealed emergency release for each switch lever is located on the interlocking machine, and is so connected that when operated the electric locking controlled by the track circuit is cut out. These devices are operated by sealed handles or hand cranks and are intended laid in ducts, from the signal towers to central distributing points, and thence underground through parkway cable, protected by a lead covering and steel tape, to the switch machines, automatic stops, track connections, etc. All insulated wire and cable was furnished by the Okonite Company.

### Miscellaneous Devices

Included in the signal contracts, although not strictly speaking a part of the block signal and interlocking system, are a number of devices which are intended to assist the operation of the railroad by providing information of various kinds for the operating and maintenance forces. At certain principal stations, bells are installed on station platforms to start trains. These bells are operated by the dispatchers or towermen at the respective stations.

Signs are placed throughout the subway to instruct the motormen as to the allowable speed, as at curves, approach to a speed-control section, coasting points, etc.

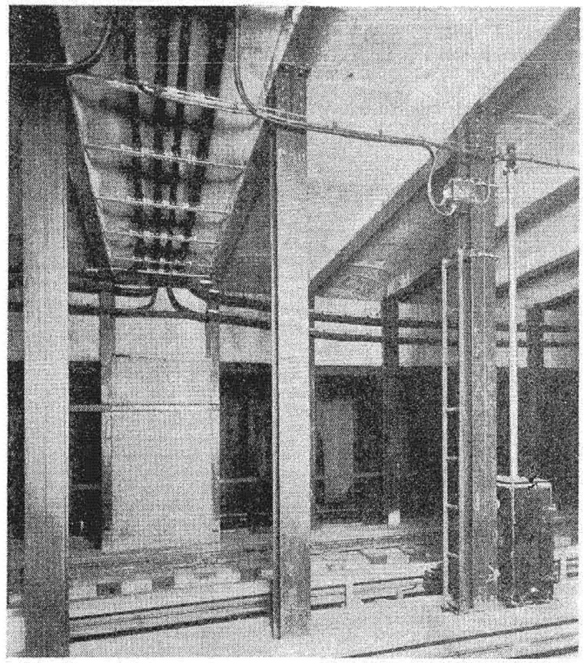


Special equipment is used for ground-detection and capacity protection

These signs are enameled-steel plates illuminated by hooded electric lamps obtaining current from the signal mains.

The location of emergency-alarm pull boxes and telephones is indicated by blue lights placed opposite the alarm boxes and telephones on all tracks, so that in case of trouble any employe can locate the nearest telephone merely by looking up or down the track. These lights are placed an average of about 600 ft. apart and are located on the left-hand side of the track so as not to be confused with the signal aspects on the right-hand side of the track.

In the 207th Street yard, which is in the open, the 90 switches are equipped with heating devices to keep the switches clear of snow and ice. The heating units are electric, obtaining power from adjacent contact rails, the nine heaters on each side of the switch being connected in series on the 600-volt third-rail circuit. The units are manufactured by the General Electric Company



The braided cable is mounted on overhead messengers

for the Brinard Sales Compa v and are located in a notch in the tie directly under he tie plate. The ties are protected from excessive heat b use of an aluminum reflecting shield.

---

# Hostler Disregards Signals

A HEAD-END collision between a freight train and a light engine on the Chesapeake & Ohio at Richmond, Va., on June 30, was caused by the failure of the hostler of the light engine properly to observe and obey signal indications. One employee was killed and two were injured. The accident occurred within interlocking limits at Rivanna Junction, at a movable-point crossing where the westbound track of the Rivanna subdivision crosses the eastbound track of the Piedmont subdivision, 193 ft. west of the junction point. The weather was clear at the time of the accident, which occurred about 9:40 p. m. The report of the I.C.C. Bureau of Safety follows, abstracted:

Westbound passenger train No. 43, hauled by engine No. 442, arrived at the Main Street station at 9:30 p. m. The engine was detached and moved by Purvis, a hostler, to the eastbound main track of the Piedmont subdivision, was then backed up on that track en route to Fulton yard, and collided with freight train No. 95 at Rivanna Junction while traveling at a speed estimated to have been between 6 and 10 m.p.h. The employee killed was the hostler of Engine 442, and those injured were the conductor and flagman of train No. 95.

The investigation developed that the route was lined properly for a movement of train No. 95, but that En-