Railway Signaling

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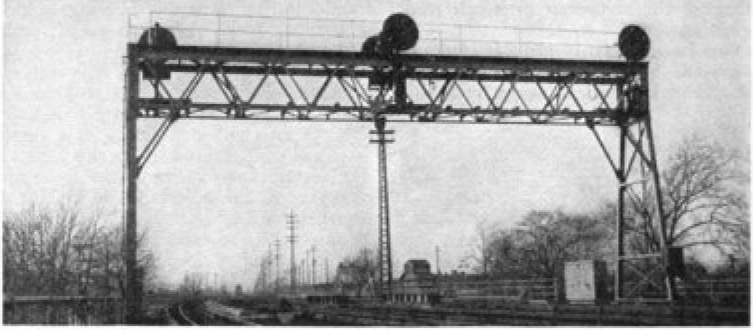


Westward home-signal bridge showing flashing-light train-order signal mounted between the top and bottom arms of each signal

Electro-Pneumatic Interlocking on the Long Island

Grade separation project at Valley Stream, involving numerous track changes, required temporary interlockings together with construction of new large plant

A 34-LEVER electro-pneumatic interlocking, which was recently installed on the Long Island Railroad at Valley Stream, L. I., is of interest because of the signal and interlocking changes which were necessitated by the various track changes made during the construction of the track elevation through this extensive junction layout.

On May 16, 1932, the Long Island Railroad, in conjunction with the State of New York, began a very important grade separation project at Valley Stream. The primary purpose of the separation was to complete a section of the new Sunrise highway that was laid out through the Long Island passenger-train storage-yard at Valley Stream. Since the opening of the Sunrise highway, which is one of the two main arteries along the south shore of Long Island, traffic through Valley Stream has been detoured one block south, then one block west, then back north to the highway again. This slowed up the through traffic and resulted in a general protest from motorists.

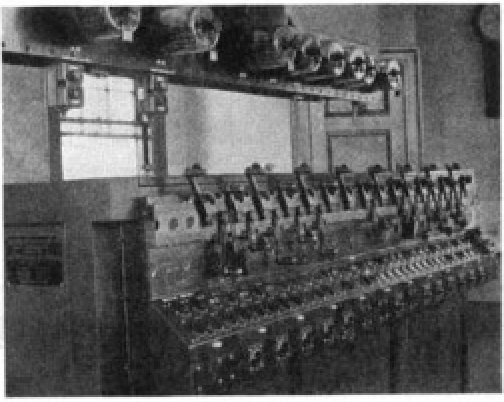
The main line of the Long Island through Valley Stream is made up of two double-track branches, over which an average of 340 trains are operated daily. Trains operating on the Montauk branch, the two tracks to the north, are not scheduled to stop at Valley Stream, and no platform is provided for these tracks. However, a platform is located between the two tracks on the south, which are the Long Beach branch tracks. Also, from these two southernmost tracks, the Far Rockaway branch double-track line turns off, making an interlocking plant necessary at this point. About 1,400 ft. west of the Far Rockaway Junction, the single-track of the West Hempstead branch turns off to the north, crossing the Montauk branch tracks. The grade separation required the raising of four tracks of the main line for a distance of approximately 7,640 ft., and the raising of the two branch tracks for a total distance of 6,500 ft. Also, by constructing a fill 800 ft. long, a local freight yard was built, which provides yardage for 20 cars.

In order to clear the way for erecting the elevated structure, temporary tracks were constructed, two of which were along the north side of the main line, and one connection for each of the branches. These tracks were signaled for traffic in either direction, and were controlled from temporary interlocking and block stations, these temporary interlockings being needed to route the heavy traffic over the temporary tracks. At

Track and signal plan of

each of these plants a Style-TC table interlocker was used. An interlocking plant, known as "CA," was located where the traffic from the four main tracks converged into the two temporary tracks. This plant had 14 working levers—6 for 16 signals, 6 for 12 switches, and 2 for traffic. Another plant was required at the point where the two temporary tracks returned to the original four tracks beyond the elevation. This plant, "HO," had 11 working levers—6 for 14 signals, 3 for 6 switches, and 2 for traffic. About midway between these two, another interlocking, "HW," was established. This plant, which was used to divert the traffic, scheduled for West Hempstead north, to the single track of the West Hempstead branch, had 11 working levers—5 for 14 signals, 2 for 3 switches, and 4 for traffic. The temporary signals were the position-light type and the switches were electro-pneumatic, Style A-1, with CP valves. At each of the temporary interlockings, two 35-cu. ft. air compressors, driven by 650-volt d.c. motors, were installed. Two 2-in. galvanized pipes were laid the entire length of the proposed elevation, so that the three sources of air could be connected together.

In addition to the three interlocking plants, two temporary block stations were established, the block operators throwing one hand-throw switch in each case. One block station, "RO," handled a switch where the Far Rockaway track branches off the main line, this station having two levers for six signals and one lever for traffic over the single track that handled the traffic for the Far Rockaway double-track branch. At the other end of this single track, where the traffic returns to its normal double-track, another block station, "GI," was established. This station had three working levers—two for six signals, and one for traffic. In view of the fact that a temporary right-of-way was available well outside of the construction area, it was a relatively simple matter to establish the temporary interlocking plants and eliminate the 56-lever mechanical plant that had previously handled the movement of the traffic through this layout.

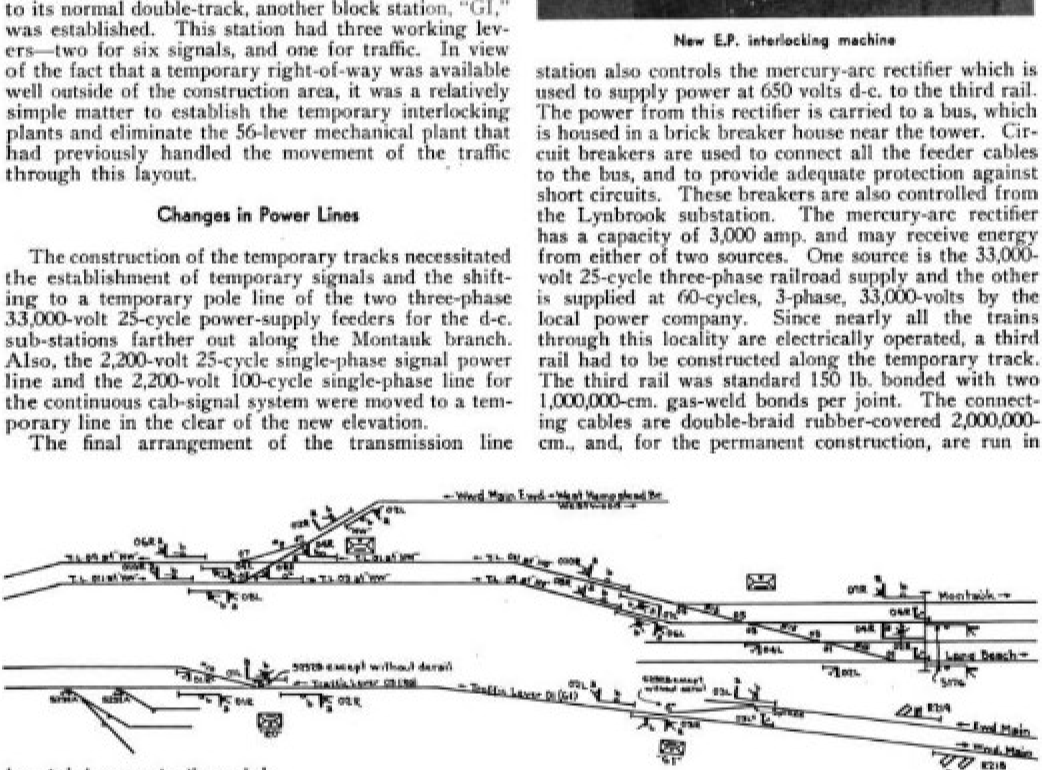


New E.P. interlocking machine

Changes in Power Lines

The construction of the temporary tracks necessitated the establishment of temporary signals and the shifting to a temporary pole line of the two three-phase 33,000-volt 25-cycle power-supply feeders for the d-c. sub-stations farther out along the Montauk branch. Also, the 2,200-volt 25-cycle single-phase signal power line and the 2,200-volt 100-cycle single-phase line for the continuous cab-signal system were moved to a temporary line in the clear of the new elevation.

The final arrangement of the transmission line through Valley Stream requires two three-phase 33,000-volt feeders along the main line, and one down the Far Rockaway branch. These feeders are connected to a switching rack, located near Valley Stream tower, which also supports the transformers for the wayside-signal and cab-signal supply, as well as the lightning arresters. The transmission feeders are carried along the elevation by steel lattice poles averaging 60 ft. in height, spaced approximately 300 ft. apart. Wood crossarms are used on all the steel lattice poles. Normally, the feeder from the Far Rockaway branch is not connected to the bus at the rack, but may be so connected by a three-phase remote-controlled oil-circuit-breaker, which is controlled from the substation at Lynbrook, 1.6 miles east of Valley Stream. This substation also controls the mercury-arc rectifier which is used to supply power at 650 volts d-c. to the third rail. The power from this rectifier is carried to a bus, which is housed in a brick breaker house near the tower. Circuit breakers are used to connect all the feeder cables to the bus, and to provide adequate protection against short circuits. These breakers are also controlled from the Lynbrook substation. The mercury-arc rectifier has a capacity of 3,000 amp. and may receive energy from either of two sources. One source is the 33,000-volt 25-cycle three-phase railroad supply and the other is supplied at 60-cycles, 3-phase, 33,000-volts by the local power company. Since nearly all the trains through this locality are electrically operated, a third rail had to be constructed along the temporary track. The third rail was standard 150 lb. bonded with two 1,000,000-cm. gas-weld bonds per joint. The connecting cables are double-braid rubber-covered 2,000,000-cm., and, for the permanent construction, are run in concrete-encased fiber duct line which terminates in concrete potheads equipped with black-and-white striped concrete pothead covers. For the negative return, the running rail was bonded with two 14-in. electrically-welded 250,000-cm. bonds at each joint. The manually-operated switches used for sectionalizing the third rail are the slate-base multiple-blade type having a capacity of 4,500 amp. The electric traction division of the signal department handled the third rail and high-tension line work, which required approximately 113,600 man-hours to complete.



layout during reconstruction periods

Steps in Construction Program

The first step in the grade separation was to elevate one track of the Far Rockaway branch. Since the property line was too close to the tracks to permit the construction of a temporary track at the side of the Far Rockaway line, the westward Far Rockaway track was taken out of service and the eastward track was signaled for traffic in either direction and shifted, as far as the property line would permit, away from the center

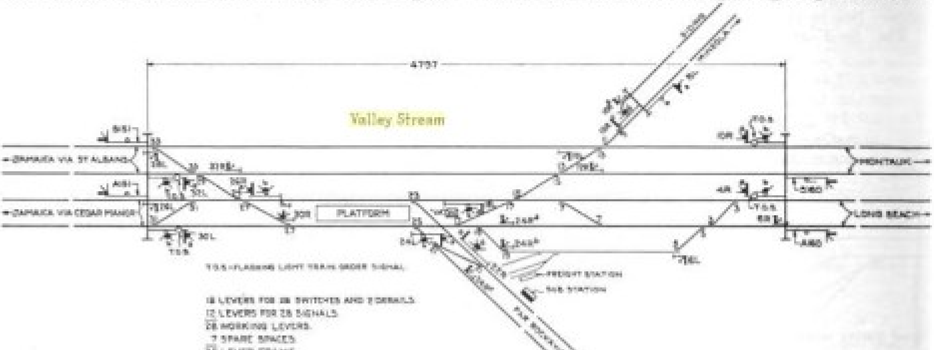
Impedance bond layout showing connections to neutral and to rail

line of the old westward track, to allow enough room for half of the elevated structure to be erected. The elevation of the first track, the westward Far Rockaway, was completed Feb. 7, 1933, and was signaled for traffic in either direction. The temporary track, the eastward Far Rockaway, was then removed in order to make room for the erection of the other retaining wall and the structures to support the second track to be elevated. The second Far Rockaway track was completed and placed in service May 2, 1933, and the two temporary block stations used during the construction were abolished, and the Far Rockaway branch signals on the elevation were made automatic to "CA." The next step was the elevation of the two Long Beach tracks and the eastward Montauk track. The eastward Montauk track was temporarily signaled for traffic in either direction, which was made necessary because the West Hempstead elevated connection could not be completed, owing to the two temporary main-line tracks, and the space of the second Montauk track was needed for making the permanent West Hempstead connection. A new 35-lever Model-14 electro-pneumatic interlocking machine was put in service with this step of the program, to control the switches and signals on the elevated tracks. This machine was housed in the new tower, "VA," a two-story 17 ft. by 24 ft. brick structure with a large sub-basement that houses the tower heating unit and two air compressors. This part of the program was completed on June 27, 1933, and the two temporary interlockings, "HO" and "HW," were abolished. The next step, which consisted of placing the elevated West Hempstead connection in service, controlled from "VA," was completed September 10, 1933. The final step, completed November 15, 1933, consisted of making everything permanent and putting in service the westward Montauk track with complete cab signaling on both Montauk branch tracks. A total of approximately 160,350 man-hours were required to complete the signal work, including the quite appreciable amount of temporary signaling required by the many changes of track alignment.

Details of Construction

The outside instrument cases are constructed of 16-gage steel with ¾-in. Transite board backs. These cases, which are conveniently located to terminate the control cables to the switches, signals and track, also house the relays, transformers and other wayside equipment. Each case is located on the parapet wall over a pull-box in the local cable duct line and opens toward the track. A platform was built back of each case to facilitate the wiring and the maintenance. Signal Section porcelain-based standard terminals are used throughout, and are bolted to the Transite terminal board with stove bolts, the heads of the bolts being in the back of the case and countersunk to prevent possible damage to the cross jumpers. The wires from the terminals to the relay are No. 16 flexible, with tinned copper-wire eyelets used to connect the flexible leads to the relay and the terminal. The adjustable resistance units, used in the signal lighting circuits, are separated by a strip of asbestos over the resistance wire, thus eliminating any possible danger from overheating or short circuits. The relays are all of the shelf type, rubber mats being placed on the shelves of the cases to dampen vibration. Each cable entering a case from the duct line has an insulated joint in its lead sheath, this being necessary in all territory where d-c. propulsion is used, in order to prevent any possible short circuit bringing the 650-volt d-c. propulsion current into the case. As a means of preventing electrolysis, the lead sheaths of all the cables entering the case are bonded together, on the duct side of the insulated

(Continued on page 147)

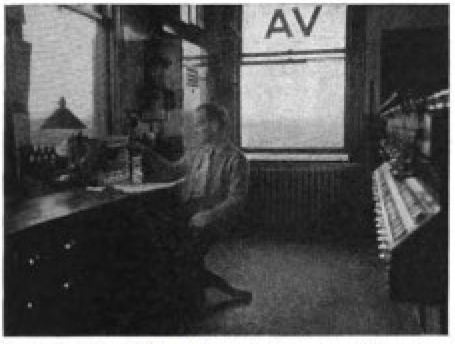


Track and signal plan of a completed plant now in service at Valley Stream

Electro-Pneumatic Interlocking

(Continued from page 130)

joints. Bronze-armored lead-sheath parkway cable is used for all control cables from the relay cases to the switches and signals. These cables, as well as the track wires, are buried at a depth of at least 30 in. below the tracks, being laid in and covered over with sand or clay. Then a protective covering, either of cresoted lumber or Elastite capping, was placed over the cables and the regular ballast was filled in. Elastite bootleg risers were used to bring, to the surface of the ground, the track wires and the position-light dwarf-signal control cables. The track wires are No. 6 A. W. G. copper, while, for the signal control and lighting circuits,

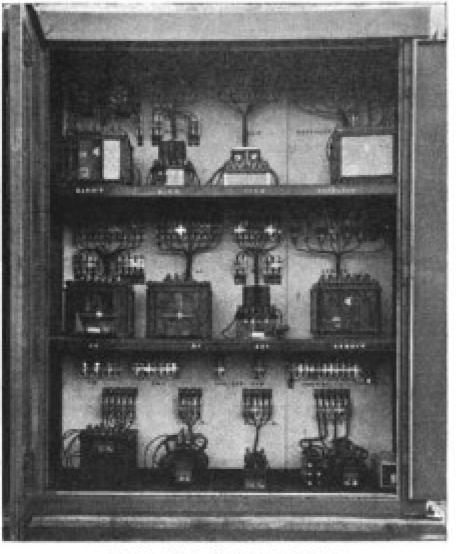


Operator's table at Valley Stream, showing concentration unit on table and the telephone and telegraph test panel in the background

No. 14 A. W. G. copper wire is used. The impedance bonds have a capacity of 1,500 amp. per rail, except at substations, where larger bonds having a capacity of 2,500 amp. per rail were used. When several connections were to be made to the neutral of the impedance bond, the neutral connection of the bond was made up of flat tinned copper strips 3½ in. wide and ranging in thickness from 1/32 in. to 2½ in. It was found much easier to make and maintain a good connection to this rectangular cross-section than to the round cross-section formerly used.

The signal control and telephone cables are taken through the elevation in vitrified clay duct line, except for a short stretch where they are suspended on messenger under the station platform. Two duct lines extend east through the elevation from "VA" tower to the westward distant-signal bridge, and one extends west from the tower. The local cable running east is located in the parapet wall over which the distribution cases are located. The other duct line running east is a 12-way line that extends to a point approximately 1,500 ft. east of the tower where the West Hempstead branch turns off the main line. Here a 4-way duct branches off to the West Hempstead branch home signal. From the manhole on the main line an 8-way duct continues to the westward home signal. From the home signal to the distant signal, a 6-way duct was constructed, and at the distant signal the cables return to the pole line. West from the tower, one 12-way duct runs to the edge of the underpass, and is then carried on a messenger, for about 1,000 ft., under the passenger platform, where it goes into an 8-way duct as far as the eastward home signal, and then it returns to the pole line. A 48-pair lead-covered telephone and telegraph cable, along the main line, is carried through the interlocking in the main duct line. From the tower there is also a 24-pair cable for each the two branches. A 10-pair cable taps off the West Hempstead branch cable to furnish telephone facilities to the new freight station on the elevation, and from this point a 16-pair cable continues to the home signal. The telephone and telegraph cables terminate in a standard steel case on the first floor of the tower, and from there they are carried in conduit to the test panel on the second floor. From the test panel the wires are carried in conduit to a 20-line concentration unit located on the operators' table, the 20 lines being made up of 6 selector and 14 magneto lines. Approximately 9,125 man-hours of labor were required for the telephone and telegraph part of the grade separation.

For signal and switch control, four 61-conductor lead-encased cables run east from the tower. One goes directly to the West Hempstead Branch home signal; one straight through to the main westward home signal; one goes to the first distribution case east of the tower; and the other is the local cable that breaks in each of the distribution cases, except the first. Between the home and distant signals a 27-conductor cable is used. Four 61-conductor cables are run west of the tower; one of these terminates in the first distribution case,



Interior of outside instrument case

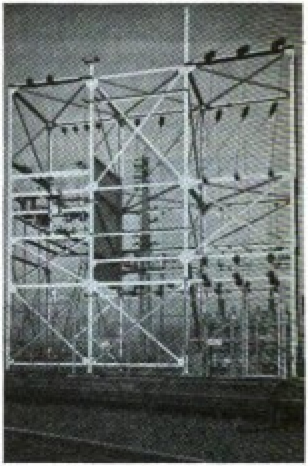
one breaks in each of the cases after the first, and the other two go directly to the home signal. Between the eastward home and distant signals, two 12- and one 5-conductor cables are used. From the tower to the Far Rockaway branch, one 33-conductor cable goes to the westward home signal, with a 12-conductor cable between the home and distant signals. All the 61-conductor cables are especially made of 59 No. 14 and two No. 6 B. & S. gage copper wires. The two No. 6 wires are used to distribute the 110-volt 25-cycle power through the interlocking. This power line is arranged so that it may be fed from either of the 2-kv.a. transformers at the tower.

Shelf-type relays are used for the interlocking circuits, and are placed back to back approximately 3 ft. apart and are extended from the floor to the ceiling. They are made of 1½ in. by 1½ in. by ¼ in. angle-iron, with ¾-in. Transite backs and ⅜ in. Transite shelves, and are 18 ft. long and 10 ft. 6 in. high. The shelves are 18 in. high and 15 in. deep, there being four such shelves in each rack. Below the bottom shelf, a 5-ft. space is used for terminating the control cables, for various buses, and for lighting transformers used in the tower. The shelves have a capacity of 125 average-size relays and are covered with rubber matting to dampen vibration. Each relay has an indicating light, which is illuminated when the relay is deenergized. This adds very little to the cost of construction and greatly facilitates checking the relays when trouble is experienced. On account of the great number of terminals needed for most of the indicating and repeating relays, it was thought advisable to use a double row of terminals for the circuits through the relays. In order to facilitate the checking of circuits, as well as to separate each side of the same circuit, the front, or normal, contacts were placed in the upper row of terminals, and the lower row was used for the back, or reserve, contacts, for the controls of the relay. The terminals were mounted on the Transite board, with $\frac{5}{16}$ in. flat-head stove bolts, the heads being countersunk flush with the rear of the board, to avoid any possible rubbing or wearing of the cross jumpers in the case. The cross jumpers are laid out in symmetric runs, and are carried through 3½ in. insulated bridle rings to their proper location on the terminal board. The wire to the machine, which is No. 16 solid, was run through the floor in fiber duct, then formed and laced with lacing twine, in compact runs. The space between the racks is enclosed at the ends with ⅜-in. Transite board, thus closing in the cross-jumpers and cable and preventing unnecessary walking through and consequent mechanical damage, as well as preventing the accumulation of dirt. Each rack is adequately lighted by a drop light that may be carried anywhere along the rack. The battery for the plant, which is of the nickel-alloy type with a capacity of 150 a. h., is floated across a copper-oxide rectifier capable of charging it at the rate 5 amp. The normal discharge of the plant is 2½ amp.

The electro-pneumatic switches are operated by A-1 movements with CP valves. A pressure of from 40 to 60 lb. of air is provided from two 50-cu. ft. air compressors which are belt-driven individually by 10-hp. 650-volt d-c. motors. The power for the motors comes from the third rail and this rail may be fed from nine different points. Since it is highly improbable that any of these sources will be deenergized for an appreciable length of time, it was felt that the third-rail feed would be sufficient.

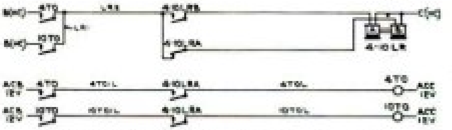
Steel lattice junction pole opposite high-tension rack at tower

Interior of third-rail breaker house showing remote controlled circuit breaker



High-tension rack and remote control high-voltage three-phase oil circuit breakers

The signals are of the position-light type, and each home signal is equipped with a flashing-light train-order signal placed 3 ft. 6 in. below the center line of the top arm. The circuit for the train-order signal is shown, and is self-explanatory except for the flasher relay. The Style "NF" flasher relay was used, with a slight alteration; the contacts on one side were removed, and a counterweight was added to the armature. The train-order signal is illuminated when the relay is energized. When the relay is deenergized, the lighting circuit is broken by the counterbalanced armature, which pulls the contacts apart and returns the armature to its normal or deenergized position. The signal itself is a position-light unit equipped with a yellow cover glass.



Control circuits for flashing-light train-order signals