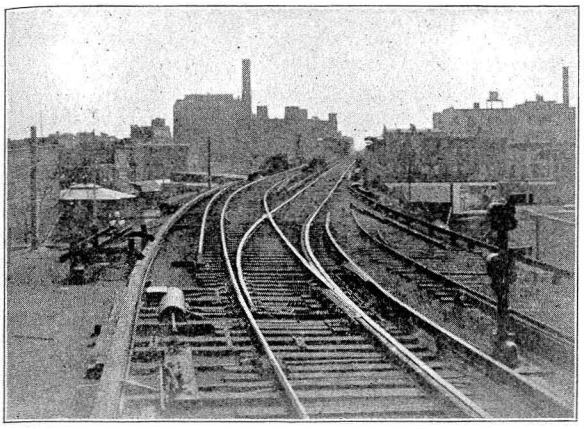


Automatic Portion of Interlocking, Switch 3 and Signal 2R in Foreground.

B. R. T. Automatic Interlocking

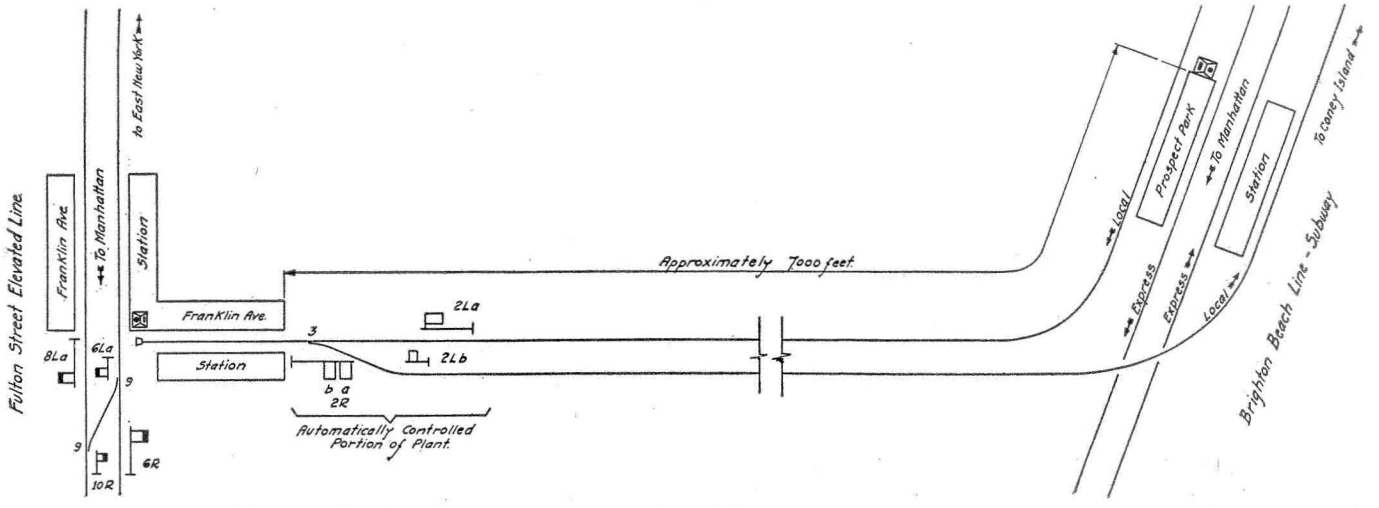
Switch, Signals and Train Stop Controlled Automatically by Train Movement, Introducing a Saving of $390 a Month

By A. A. Roberts

Assistant Signal Engineer, South Brooklyn Railway, Brooklyn, N. Y.

ON March 20, 1923, the Brooklyn Rapid Transit Company furnished an interlocking contribution to the advancement of modern industrial progress by placing in service a complete automatic control system for one switch and three signals that comprise the active portion of an electro-pneumatic interlocking plant located at Fulton street and Franklin avenue, Brooklyn, N. Y.

This point was formerly an important junction of the elevated system for trains on the Brighton and the Fulton street lines. However, since the opening of new sections of the B. R. T. subway system in Brooklyn, the Brighton line express trains operate through the subway to Manhattan and the local trains on this line are switched back at Franklin avenue. Track connections between the two lines at this point were then removed. The interlocking, although much reduced in importance by the changes, still required the presence of a towerman 24 hours daily with practically no duties other than to operate one switch and two signals for the Brighton line local trains. This can be understood by reference to the track diagram, Fig. 1.



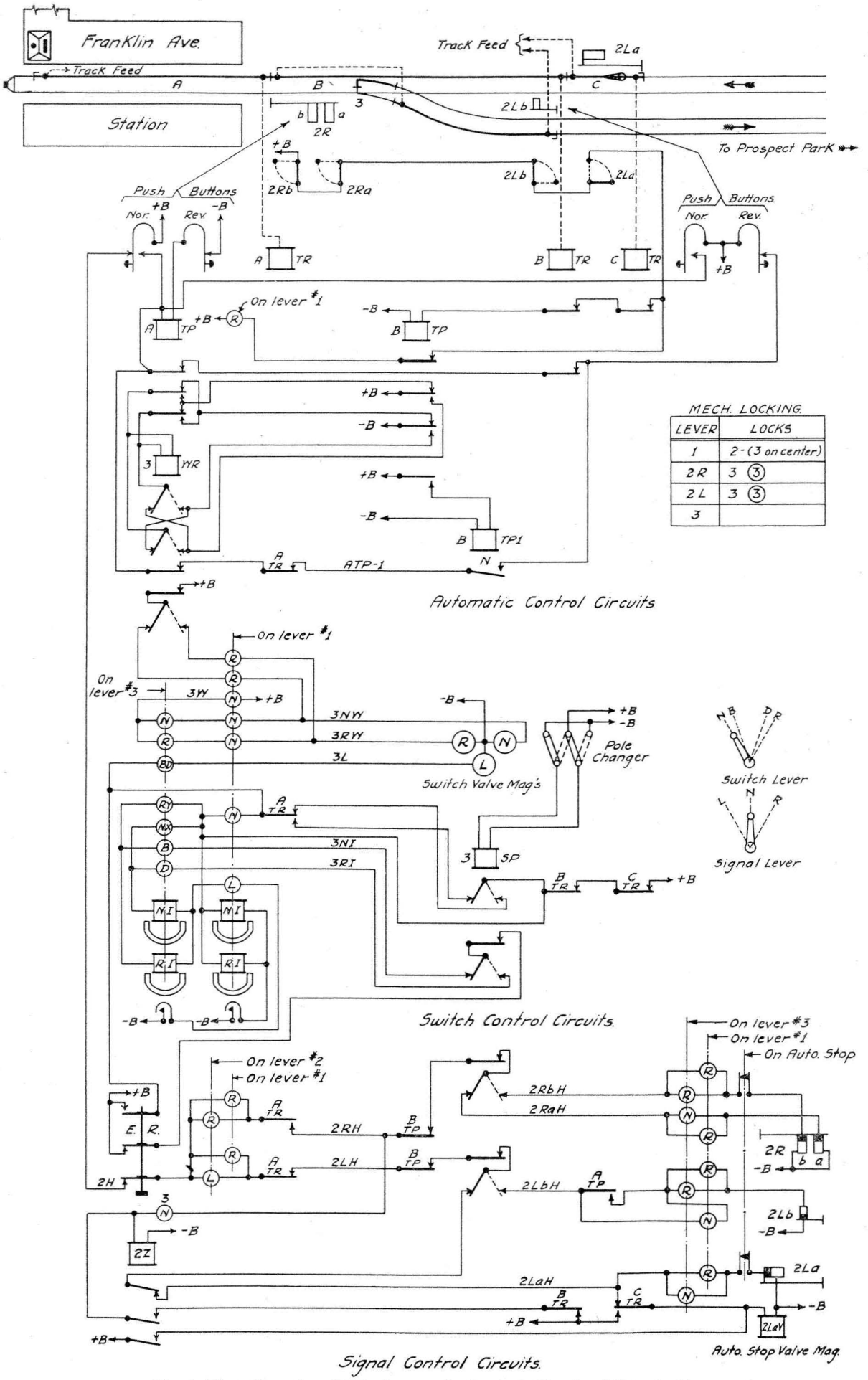
Layout of Lines Showing Corresponding Position of Automatic Interlocking

Economy Demanded Elimination of This Towerman

Early last year the question was presented to the operating and engineering departments as to whether or not the simple train movements necessary to switch back the Brighton trains at Franklin avenue, could not be guided by switch and signal operations controlled automatically and by so doing eliminate the towerman. The answer to this question was required of the signal engineer, who, after a thorough study of the engineering and economic features of the proposition, advised that the scheme would not only be possible, but also that the cost of the improvement would be returned in less than one year out of the saving in salaries formerly paid to towermen at this point.

Very naturally there arose in advance many speculations and a few doubts as to the degree of safety and reliability that could be expected from a system departing so radically from standard interlocking practice. However, the failure record, given further on, covering 11 months' continuous service, is convincing proof of the success of this venture.

The general engineering features and the mode of attack adopted in designing the automatic control system will be understood from the following description and from the circuit diagram, Fig. 2. The interlocking machine is of the electro-pneumatic type with semaphore signals, track circuit detector locking for switch levers and track circuit control for signals. Signal 2La is also provided with an automatic trip stop. Signals 2R, 2L and switch 3 comprise the automatic portion of this plant, for which either manual or automatic operation can be obtained as desired by simply placing lever No. 1, which is known as the change-over lever, in the normal or reversed position. This lever is arranged to be sealed when in reversed position to guard against accidental movement in the absence of the towerman and is also electrically locked in the normal and reversed positions by track circuits. This portion of the plant not only can be operated automatically or manually at will, but also



Track Plan, Together With Automatic Control Circuit of Interlocking

can function automatically while the remainder of the interlocking is being operated by a towerman.

The automatic control system is also provided with push-button type circuit controllers housed in locked wooden boxes at each extremity of the plant, and when operated will cause switch 3 to assume the normal or reversed position and the proper signal to clear as desired. Movement against traffic can thus be made without the presence of a towerman. This feature provides considerable flexibility from an operating standpoint.

Special Circuits Designed for Automatic Control

Standard signal relays of the direct current, neutral and polarized types are employed for the automatic control. These relays operate to establish practically the same sequence of events and protective features in moving the switch and clearing the signals as is obtained by the usual lever control in an electro-pneumatic interlocking machine.

The successive steps by which a complete in and out train movement is accomplished will be described briefly by reference to the circuit diagram, Fig. 2, which shows the circuits both for manual and for the automatic control. The change-over lever is assumed to be in the reversed position and the switch and signals in the normal position indicated on the diagram. As an inbound train enters upon track sections C and B, relay BTP opens, thus removing energy from the pole changing contacts on relay ATP that govern the reverse or normal movements of switch control relay 3 WR. At the same time a retaining circuit is closed holding relay 3 WR energized in its normal position and thus maintaining energy on the normal switch control magnet as an insurance against the possible effects of piston leakage.

When the train passes entirely upon track section A, relay BTP again picks up, providing that all signals are in the stop position. Relay ATP being open, energy is then applied to reverse the switch control relay 3 WR and simultaneously to the D-valve lock magnet 3L. The D-valve magnet is thus energized in advance of the control magnet for a short interval measured by the time required for relay 3 WR to move to the reverse position. This interval, though short, is entirely sufficient to provide the necessary time sequence in the operation of the D-valve and the control valve magnets.

After 3 WR reverses, the switch moves to the corresponding position and upon completing its movement causes the switch repeating relay 3 SP also to assume its reverse position thus checking the position of the switch. The movement of the 3 SP relay de-energizes the D-valve magnet and establishes the circuit for clearing signal 2 Rb, which permits the train to leave in the regular manner.

While the train is moving outbound over section B, relay ATP picks up through the front contacts on relays ATR, BTP1 and a neutral front contact on relay 3WR. The special function of the restoring circuit for relay ATP, is to furnish a check on the proper functioning of the retaining circuit for 3WR relay.

After the outbound train has cleared section B, relays BTP and ATP both pick up, thus energizing successfully, the D-valve and the normal switch control valve magnets, thus restoring the switch to the normal position by the same process, as described for the reverse movement. Relay 3SP moving to the corresponding normal position, again de-energizing the D-valve magnet and at the same time permitting signal 2La to clear for the next inbound train. These operations are repeated in exactly the same way for each complete train movement. Relay 2z, the control of which is obvious, serves to clear the train stop 2LaV whenever movements are made against traffic over switch 3 in the normal position.

When the system was first placed in service the restoring circuit ATP1 of relay ATP was broken through a back contact on relay BTP instead of through the equivalent front contact on relay BTP1 as shown. This relay was introduced to produce a short time lag in the opening of contact N and thus allow relay ATP to pick up properly after a power interruption to the third rail which supplies the track circuits at this plant. Without relay BTP1 the simultaneous pick up of all track relays, when power was restored after such an interruption, did not give the proper serial action to allow relay ATP to restore and this resulted in switch 3 taking up the reverse instead of the normal position.

The push keys indicated near the top of the diagram serve their purpose for changing the route by merely dropping or picking up relay ATP; the switch and signals immediately assume the proper position, depending upon the position of the train and of switch 3. Other details of the various circuits may be understood easily in the light of the preceding explanation and a brief inspection of the diagram, Fig. 2, will suffice to make clear that the desired results were obtained without special apparatus or excessive complication of circuits.

Only Five Failures in a Year

In order that delays due to possible failures may be minimized, telephones accessible to trainmen are located on the platform and near the position of signal 2La, and whenever the signals fail to clear the motormen are instructed to notify the maintainer stationed at Prospect Park Tower, about 7,000 ft. from Franklin avenue station. Certain failures might be of such a character as to affect the signals only, leaving the switch functioning properly. To prevent long traffic delays due to this condition a motorman is permitted to proceed at slow speed by a red signal after previously inspecting the switch and assuring himself that it is in the proper position.

The failure record for the 11 months of continuous automatic service at this plant is of interest in that it clearly refutes the first argument that naturally suggests itself in advance against a project of this character; namely, that prohibitive delays would occur due to frequency of failures and to the length of time that would elapse before repairs could be made. The actual number of failures of the automatic system is as follows:

Date	Delays to Trains	Cause
6/12/22	0 Min.	High resistance contact in circuit controller of Signal 2R1.
9/13/22	3 Min.	Screw out of operating rod in track relay "C."
10/16/22	5 Min.	Leaking cylinder caused failure of automatic stop 2La.
1/19/23	5 Min.	Burned contact caused failure of compressor governor resulting in low air pressure.
1/28/23	3 Min.	Blown track circuit fuse.

The work here described was carried out by the B. R. T. Co.'s signal construction forces. The total cost, amounting to approximately $2,300, covers not only the installation of special features necessary to provide automatic control but also other improvements benefiting the plant as a whole. During 11 months of continuous automatic operation dating from March 20, 1922, to February 20, 1923, the saving effected in towermen's salaries total to about $4,300.

The satisfaction of the company's operating and engineering departments, with the results given by this installation, is evidenced by the fact that two other similar applications of automatic interlocking have since been placed in service on the B. R. T. system.