Automatic Interlocking of a Double Track Junction on B. M. T. Lines

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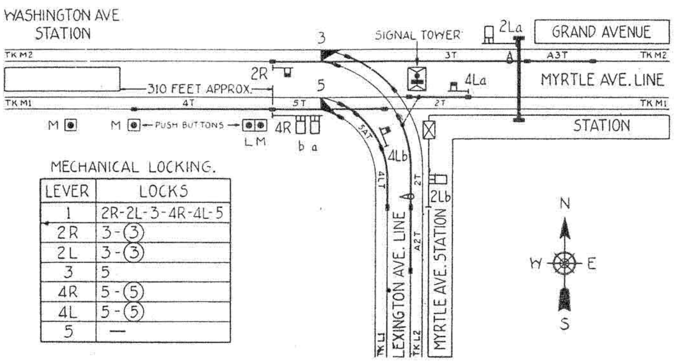
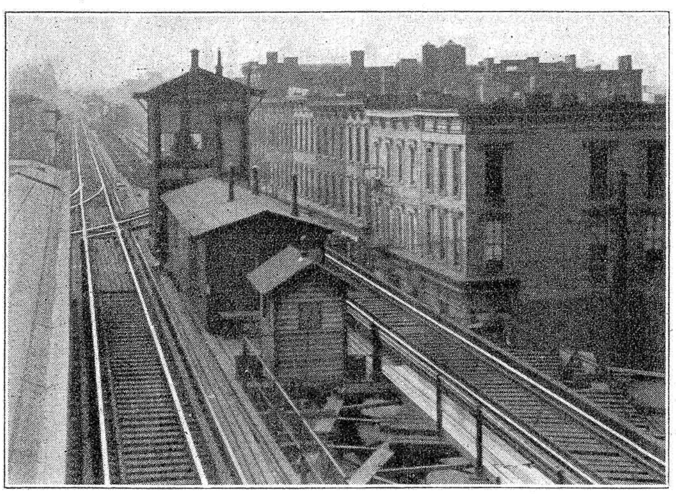
THE fifth of a series of partial and complete automatic interlockings, that have been installed on the B. M. T. system since May, 1923, was placed in service May 24, 1924, at a junction of the Lexington avenue and Myrtle avenue elevated lines known as Grand and Myrtle Junction. This plant consists of a five-lever electro-pneumatic interlocking machine with



Track Layout of Automatic Interlocking

two-position semaphore signals. Power is supplied to the machine from a 14-volt storage battery, charging current for which is obtained from the third rail.

The track arrangement and train movement involved is considerably more complicated than the company had heretofore attempted to provide for automatically. However, an analysis of the estimated installation cost, compared with the operating cost for manual operation, together with the success experienced with previous automatic interlocking installations, led to a de-



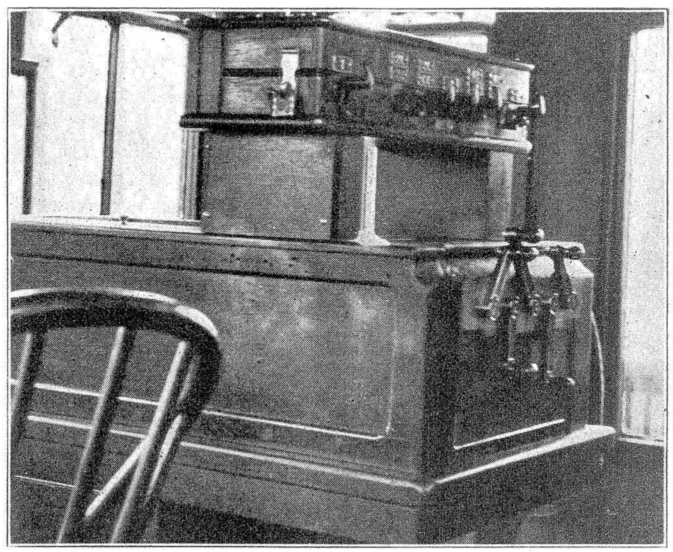
Main Line Looking Past Tower to Junction of Lines

cision to convert Grand and Myrtle Junction over to an automatic plant. Regularity of train movements and proximity of station stops to the crossing made this point a particularly favorable one at which to solve the route selecting problem.

This installation, like the four other automatic plants the company now has in service, is a combination permitting either manual or automatic operation as desired. The manual feature is used only in emergencies or while repairs or changes are being made. Transition between manual and automatic control is governed by No. 1 lever in the interlocking machine serving as a master lever and interlocked mechanically with all other levers in the machine. When normal, No. 1 lever permits manual operation of the plant in the standard way. When reversed, it permits full automatic control and in this position the lever is sealed.

Important Features of Interest

Precedence for westbound train movements on the Myrtle avenue and Lexington avenue lines is determined by priority of time for trains entering on track circuits *A3T* and *A2T* when making stops in Grand avenue and Lexington avenue stations. The westbound route is nor-



Interlocking Machine With Levers Set For Automatic Operation

mally set for Myrtle avenue trains and this route is cleared and held for a train occupying track section *A3T* before track circuit *A2T* is shunted by a westbound Lexington train. On the other hand, Switch No. *3* will move to the reverse position and signal *2Lb* will clear if the Lexington avenue train is the first to arrive in the station.

Eastbound train movements are selected as follows: Push buttons *M M* are located at the three-car and six-car stopping points in the Washington avenue station, as indicated on the plan. Motormen of eastbound Myrtle avenue trains, when stopping in the station, operate either one of the two push buttons from the cab window. If no conflicting movement is under way, switch No. *5*, normally set for the Lexington avenue route, will then automatically move to the reversed position and signal *4La* will clear as the train enters upon track circuit *4T*. After completion of an eastbound Myrtle avenue train movement switch No. *5* returns automatically to its normal position, hence motormen of eastbound Lexington avenue trains need only to proceed onto track circuit *4T* whence the proper signal, *No. 4Lb,* will clear for this route.

Westbound Lexington avenue train movements are, of course, affected by eastbound Myrtle avenue train movements. Precedence of route between these two trains is determined by priority of time in the operation of push button *M* and shunting of track circuit *A2T* in practically the same manner as precedence is established between the two conflicting westbound movements previously described. This arrangement is satisfactory since the running time through the interlocking is nearly the same from either Washington avenue or Lexington avenue station.

Auxiliary Buttons and Releases for Unusual Moves

Auxiliary push buttons *L, M* are placed at home signal *4R* to permit a train, stopped at the signal, to select either route; in fact, all possible train movements, except those against traffic, take place in logical order. All parallel moves can be made simultaneously and conflicting trains awaiting their turn are locked out until the track is clear and the proper route set up. Approach locking becomes effective as soon as a signal is cleared for any route. Route locking release is obtained when trains enter the final track circuit in the route, or in case of trouble, by means of a manual release accessible only to the maintainer. The position of switches *3* and *5* is checked by means of d. c. polarized switch repeating relays through the contacts of which are controlled all signal and route selecting circuits. Air compressors, switchboards and all except five of the relays are located in the lower floor of the tower. Concentration of all relays at one point simplifies the wiring and tends to minimize delays by facilitating quick determination of the cause of a failure.

For several months after the automatic feature was placed in service at Grand and Myrtle Junction, there were occasional delays due to failures, for which the cause could not at first be determined. The trouble was finally traced to insufficient time element in the operation of certain relays. However, during the four months following December, 1924, there was but one failure causing delays to trains or interruptions in the automatic operation of the plant. Practically no increase in maintenance force or maintenance costs is necessary because of the change in method of operation at this plant and the economic saving to the company is very high, since the cost of installing the automatic feature was but little greater than $5,200, the approximate yearly saving in towermen's salaries.

A Study of the Causes of Lightning*

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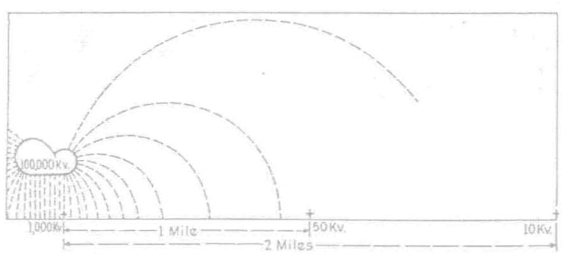
A LIGHTNING stroke is generally thought of as a local but severe high voltage discharge from some cloud. As a matter of fact, the electric energy that manifests itself in the flash is, the moment previous to the flash, stored in the surrounding air for a considerable distance. A certain small part of this energy is stored in the air immediately around the observer, and a small induced current may flow in the body of even a distant observer when a flash occurs. The thundercloud acts as one plate of a huge condenser, the earth as the other, while the intervening air is the insulation. When the voltage between earth and cloud becomes high enough, this insulation breaks down and the energy is dissipated in the short circuit or lightning flash.



Showing How an Induced Current May Pass Through the Body of an Observer Even at Some Distance

The electrical energy is changed into heat, light, sound and chemical energy. The light is seen in the flash, while the sound is heard as thunder. Thunder is caused by air waves set up by the explosive nature of the discharge.

The chemical effects of the lightning stroke are often detected by our senses in the odor of ozone that is frequently noticeable after a storm. The chemical changes occur in the path of the discharge. The two main gases in the air are nitrogen and oxygen. Each molecule of oxygen is normally made up of two atoms. The electric field tears these apart. Some of these single atoms recombine in groups of three. Oxygen with a molecule made up in this way is called ozone. It is very active chemically because the extra atom is easily detached. The nitrogen of the air is also made to combine with the oxygen, producing nitrous oxide and, in the presence of vapor, nitric acid.

Along the discharge path are untold numbers of electrons and ions—chunks of electricity moving at enormous velocities. It is possible that the ionic bombardment of the nitrogen and oxygen atoms along this path transmutes some of these atoms to helium or hydrogen. However, this is quite uncertain and speculative.

The voltage between cloud and ground previous to the discharge causes voltage between different parts of the atmosphere. Right under the cloud the voltage difference per foot of air measured in a vertical direction may be very high. In fact, a certain percentage of the lightning voltage exists between earth and any point above.

Lightning is an unorderly, predatory form of electricity, dangerous not because of its enormous energy, but because of its enormous power and "flighty" habits. The distinction between energy and power is that energy is measured in kilowatt seconds or kilowatt hours, while power is measured in kilowatts. A concrete example is always of interest. If all of the energy of a severe lightning stroke could be put into a storage battery, it would carry an electric automobile about five miles or operate an electric iron for a day. However, since this energy is dissipated in a few millionths of a second in a limited space, the effect is a terrific explosion, and the power is millions of kilowatts though the kilowatt seconds or hours are small.

A study of lightning is of considerable practical im-

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