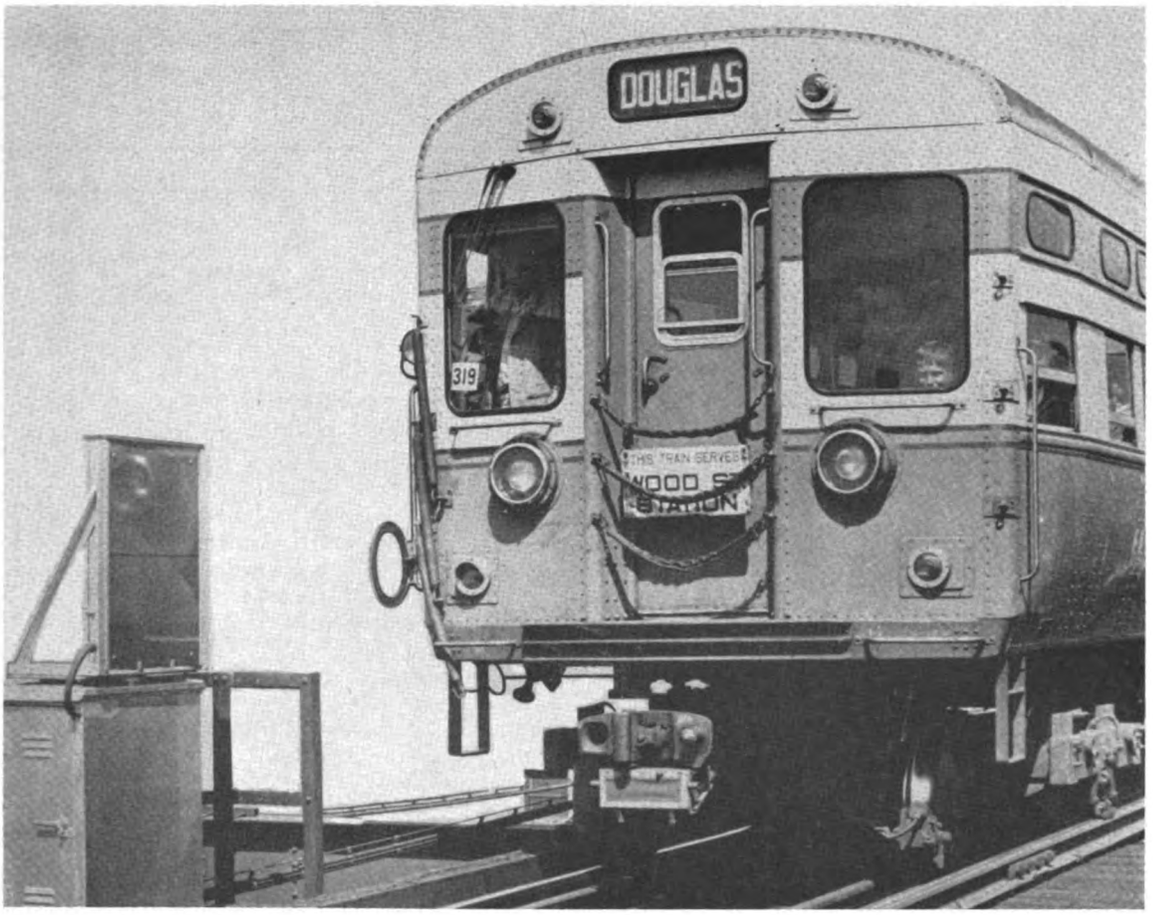


Coil at right front of leading car passes the two coils on wayside case

Junction Controlled Automatically

Sub-radio frequency tuned coils are included in system which identifies trains and automatically controls the power switches and the home signals

APPROACHING trains automatically control power switches and home signals in a junction interlocking recently completed by the Chicago Transit Authority. This new interlocking includes two electro-pneumatic power switches and home signals at a junction of the double-track Douglas Park elevated line with the double-track Lake Street elevated, as shown in the track and signal plan herewith. This interlocking is at Paulina Street which is 1.5 miles west on Lake Street from the northwest corner of the Chicago elevated loop. Between the loop and the new interlocking, the double track line on Lake Street is used by trains of both the Lake Street and the Douglas Park line. This traffic daily includes 484 Lake Street and 374 Douglas Park trains, that pass through the interlocking. During peak traffic in the morning and evening hours the headway between following trains is sometimes less than 1½ minutes.

In this new interlocking the signals are the colorlight type, and the switches are operated by A-10 electro-pneumatic machines. The project includes complete all-relay controls, with a miniature-lever panel type control machine as shown in one of the pictures. The automatic controls are superimposed on the manual controls. The changeover can be made by throwing the master lever on the panel of the machine. Normally the automatic controls are in effect, but the manual controls can be used when desired.

As shown on the track plan, the junction switches are normally lined for the straight-track, east-and-west route on the Lake Street line, and the home signals are at Stop.

A transmitter-receiver pair of coils is mounted on top of a wayside case at the right of the westward track, 1,200 ft. in approach to the westward home signal L14. The wayside coils are spiral wound in a flat form about 1½ ft. in diameter. The flat sides of the coils are in a vertical plane parallel with the track. One coil is above the other, all enclosed in a formica weatherproof case. A corresponding inert tuned coil is mounted at the front right corner of the leading car of each Douglas Park train.

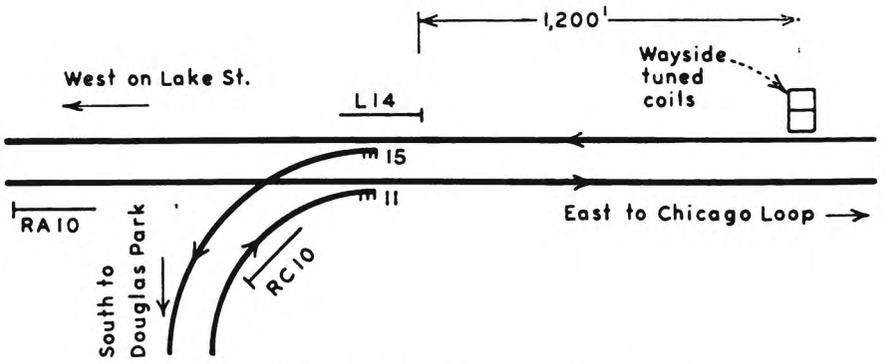
When any westbound train occupies the track circuit in approach to the wayside coils, the transmitter

coil is energized to put out a frequency of 80 kilocycles. When the coil on a Douglas Park train enters the field of the wayside transmitter coil, a reaction is set up to energize the wayside receiver coil. This received energy passes through electronic devices where it is amplified and used to energize a conventional signaling relay which can be referred to as "the Douglas Park Westbound Indentification" relay. When such a relay is energized, it initiates the selection of a route. Before the route selection circuit can be completed, a check is made that all tracks in the route are unoccupied, that no opposing or conflicting moves have been established, and that all timing relays associated with the route have assumed their de-energized positions. When the "Douglas westbound" route selection circuit is completed, the interlocking is automatically controlled to reverse switch 15 and to display the proper aspect on signal L14 for the diverging move to route this train to the Douglas Park line south. After the train departs, the switches automatically return to the normal position.

When a westbound Lake Street train approaches, the wayside transmitter coil is energized the same as previously discussed. However, the Lake Street trains carry no inert tuned coils. Therefore when such a train passes the wayside coil location, no reaction occurs. The control is solely by track circuits. A signaling relay is energized, which can be known as the "Lake Westbound Identification." If no train is occupying home signal limits or approaches, the identification of the westbound Lake Street train automatically controls the interlocking to position switch No. 15 normal (if not already so) and to clear home signal L14 for a straight-track route west on the Lake Street line.

Chronological Order

The Ashland Avenue station is located in the 1200-ft. section between the wayside coils and the home signal L14, and special wayside automatic signals are located so that trains can close up in this 1200 ft. section. When a westbound train is approaching the wayside coils, one or perhaps two preceding westbound trains could be occupying the 1200-ft. of westbound track between the wayside coils and the home signal L14. In order that the automatic control for the interlocking can be effective for the next train that is to arrive at the home signal, a system of relays was installed which store the train identification information, and, in effect, count the trains in and out of the 1200-ft. section between the wayside coils and the interlocking.



Track and signal plan of junction interlocking

Following and conflicting moves are made on a first-in, first-out basis. Say, for example, that a westbound Douglas train passes the wayside control coil location and lines up its route. Then an eastbound Lake train enters its approach control section, and then a second westbound Douglas passes the wayside control coils. The routes will be lined up in chronological order (1) for the first westbound Douglas, (2) for the eastbound Lake and (3) for the second westbound Douglas.

Other Routes Also

When an eastbound Lake Street train enters a section 2400 ft. long in approach to eastward home signal RA10, the interlocking is automatically controlled to place the switches normal (if not already so positioned) and to clear home signal RA10. When a northbound Douglas Park train enters a section 1000 ft. long in approach to home signal RC10, the switch 11 is reversed, and signal RC10 clears. Thus these two routes are controlled on the basis of track circuit occupancy of the approaches, no train identification being required.

Under normal circumstances all trains are operated right-hand running, therefore the routes for "back-up" dwarfs are not automatically controlled. In order that parallel routes may be set up, any route over switch 11 normal, forces switch 15 normal, and any route over switch 15 reversed, forces switch 11 reversed.

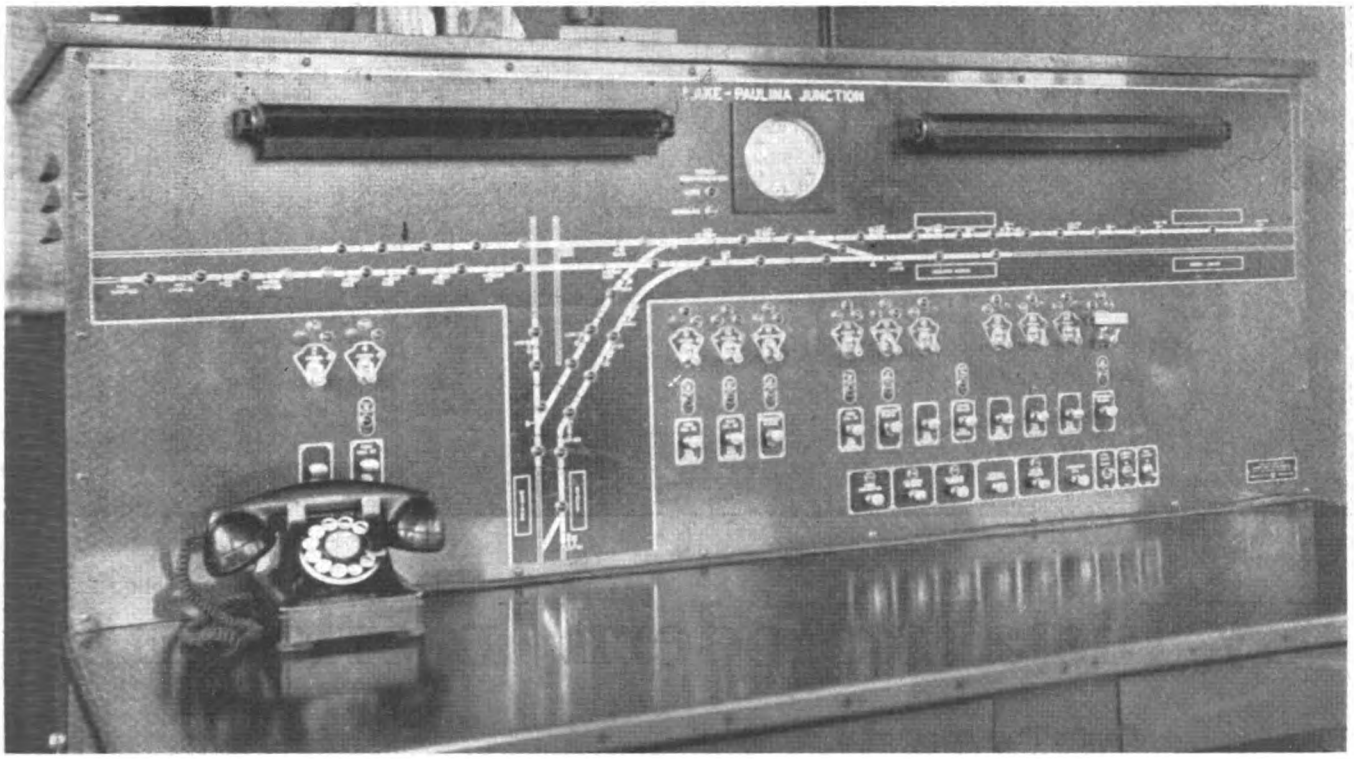
If the westbound automatic controls do not line up the switches and clear the home signal for a train, the motorman stops his train just short of the signal. At the signal there is a wayside box at the proper location so that the motorman can reach out of his window to operate a push button in the wayside box. If any home signals are clear they are controlled to Stop, and after proper checking and time expiration, the switches are lined and the signal is cleared for the waiting train.

Master Lever for Change-Over

If trains are to be run against the normal direction of traffic in an emergency, a leverman is called to take charge of the control machine. To transfer from automatic to manual controls, the switch detector track circuits must be unoccupied, the track switches and switch levers must be in normal position, and all signal levers must be in agreement with signal position. The red indication lamp above the master level will, at this time, be lighted, and the lever may be thrown to the left position, which is for manual control, and the amber lamp above this position of the lever will be lighted. To change from manual to automatic control, all switches must be normal, and the signals at Stop. At that time the red lamp above the master lever will be lighted, indicating that the master lever can be thrown to the automatic position.

When the interlocking is under manual control, all switches and signals are controlled by their respective levers in the conventional manner. An amber indication lamp above either the normal or reverse position of each switch lever, indicates the position of the switch. A red lamp above each switch lever indicates that electric locking is in effect to prevent operation of the switch. After a route has been determined by positioning of switches, the signal lever can be thrown. An amber lamp above the lever position will be lighted, indicating that the signal can clear, and a red lamp above the lever will be extinguished when the signal has cleared.

Normally, when a train accepts and passes a signal, that signal goes



Control panel includes master lever to change from automatic to manual controls

to Stop and the lever must be placed normal before again using it to clear that signal. However for westbound routes, "fleeting" control can be set up so that the home signal will automatically clear for following trains. This fleet control is established by first setting up the switches and throwing the signal lever, and then pulling the "fleet" button applying thereto. An amber lamp above the fleet button is lighted while fleeting is in effect. Fleeting is cancelled by pushing the button back to its normal position.

Track Circuit Controls

The multiple-unit car trains on this elevated railroad are operated by electric traction using 600 volts d.c. propulsion. The track circuits are the single-rail straight a.c. type, using vane type relays. To improve shunting, the track circuits are fed at about 12 volts a.c., with a 20-ohm resistor in series with the relay to cut the voltage down to about 0.7 volts on the relay terminals. To prevent erroneous operations that might be caused by momentary loss of shunt, each track relay is repeated by a repeater which has 2-seconds slow pick-up.

In the route release locking, a release is initiated when the rear of a train clears the switch detector section. Under automatic operation, the pre-conditioning of switches is inherent and therefore loss of shunt protection is provided under this type operation. A time delay of approximately 5 sec. is introduced in the switch locking circuit. This time must expire after the detector sections of the two switches are unoccupied before the switch locking is released. Since pre-conditioning of switches is prevented under manual operation, this time delay is not introduced when the plant is operated manually and switch locking is released when the detector sections are unoccupied.

Except for the track circuits, all controls, circuits etc. are operated by 16 volts d.c., supplied from rectifiers. The feed to each circuit goes through a separate current-limiting resistance unit. If a circuit becomes shorted, the current will increase to the rated capacity of the limiting unit, but no higher. This prevents damage to the rectifier, and does not interfere with normal operation of other circuits fed from the same rectifier. Thus a short cannot knock out the entire plant.

Two independent sources of commercial a.c. supply are extended into this interlocking. When the normal source fails, an automatic device switches the interlocking load over to the emergency source. If the normal source comes back, the load will be switched back to this source automatically; however, this cut back is delayed for 15 seconds. This prevents rapid switching back and forth which might cause trouble. The automatic cut over from one source to the other is made so quickly that none of the a.c. relays, or other circuits are affected.

The a.c. power on the interlocking is not normally grounded. Therefore the automatic ground detector system will detect grounds on the a.c., as well as on all d.c. circuits. The relays on this new interlocking are the plug-in type, in racks which are mounted in shock absorbers made of springs and rubber cushions. As a part of the project a pen type automatic recorder was installed. This recorder has 20 pens. When fed constant d.c. energy the operation of a pen forms an open rectangle with one side missing. Under different circumstances, the same pen coil can be fed interrupted current (75 pulses per minute) so that the pen moves back and forth; thus when operated it forms an inked-in rectangle. Thus this 20-pen recorder is used to record 40 different operations, such as occupancy of track circuit, clearing of a signal, etc.

This interlocking was planned and installed by CTA signal forces under the direction of C. A. Butts, signal engineer, under the jurisdiction of C. W. Wolf, electrical engineer, and Stanley D. Forsythe, general superintendent of engineering. The major items of interlocking equipment, including the train identification system, were furnished by the Union Switch & Signal Division of Westinghouse Air Brake Co.