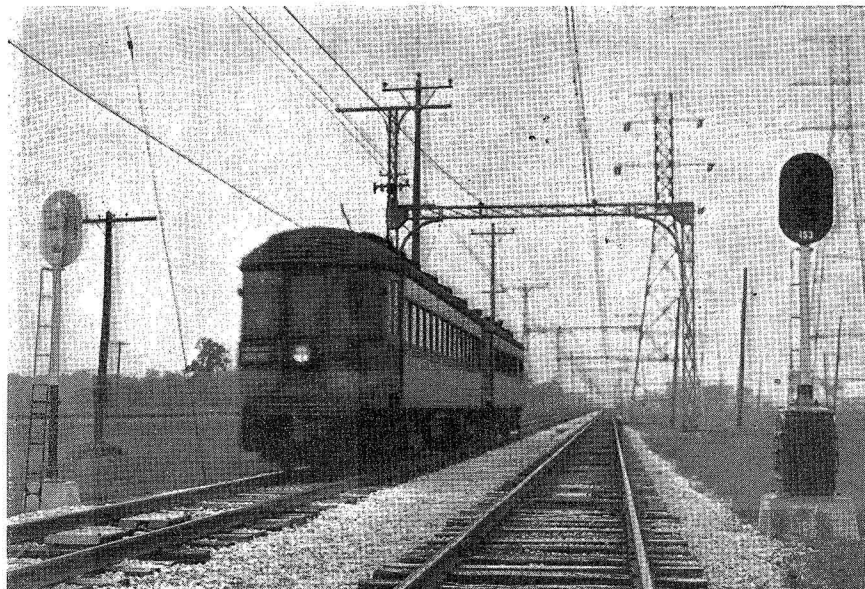


Southbound electric train at signal No. 152, just south of Glenayre station



North Shore Installs Automatics

Line circuits in underground cable, pre-wired instrument cases, and extensive provision of switch indicators are outstanding features of recent installation on 25 miles of double-track electrified line

ON MAY 19, the Chicago, North Shore & Milwaukee, the North Shore Line, placed in service the last section of a 25-mile automatic block signal system on the double-track Skokie Valley division between Howard Street Junction in Chicago, and North Chicago, Ill.

Signaling to Increase Safety

Prior to the provision of signal protection in this territory, regular trains were operated on time-table authority and train orders were issued for non-scheduled or extra movements. Traffic includes 30 southbound and 32 northbound regularly scheduled passenger trains daily, and approximately 9 freight trains not

scheduled and extra trains. On the south end, between Howard street and Dempster street, Niles Center, Ill., a distance of 5 mi., traffic is considerably heavier due to the added operation of Chicago Rapid Transit Company trains over this section of the North Shore tracks. During the rush hours, 7 to 9 a.m. and 4 to 6 p.m., trains are operated in either direction on 8 min. headway; during the remainder of the day, until 12 midnight, service is provided on 24-min. intervals; while from 12 midnight to 6 a.m. trains are scheduled every hour. The automatic block signaling system, involving 55 color-light signals, was installed to provide increased safety of operation.

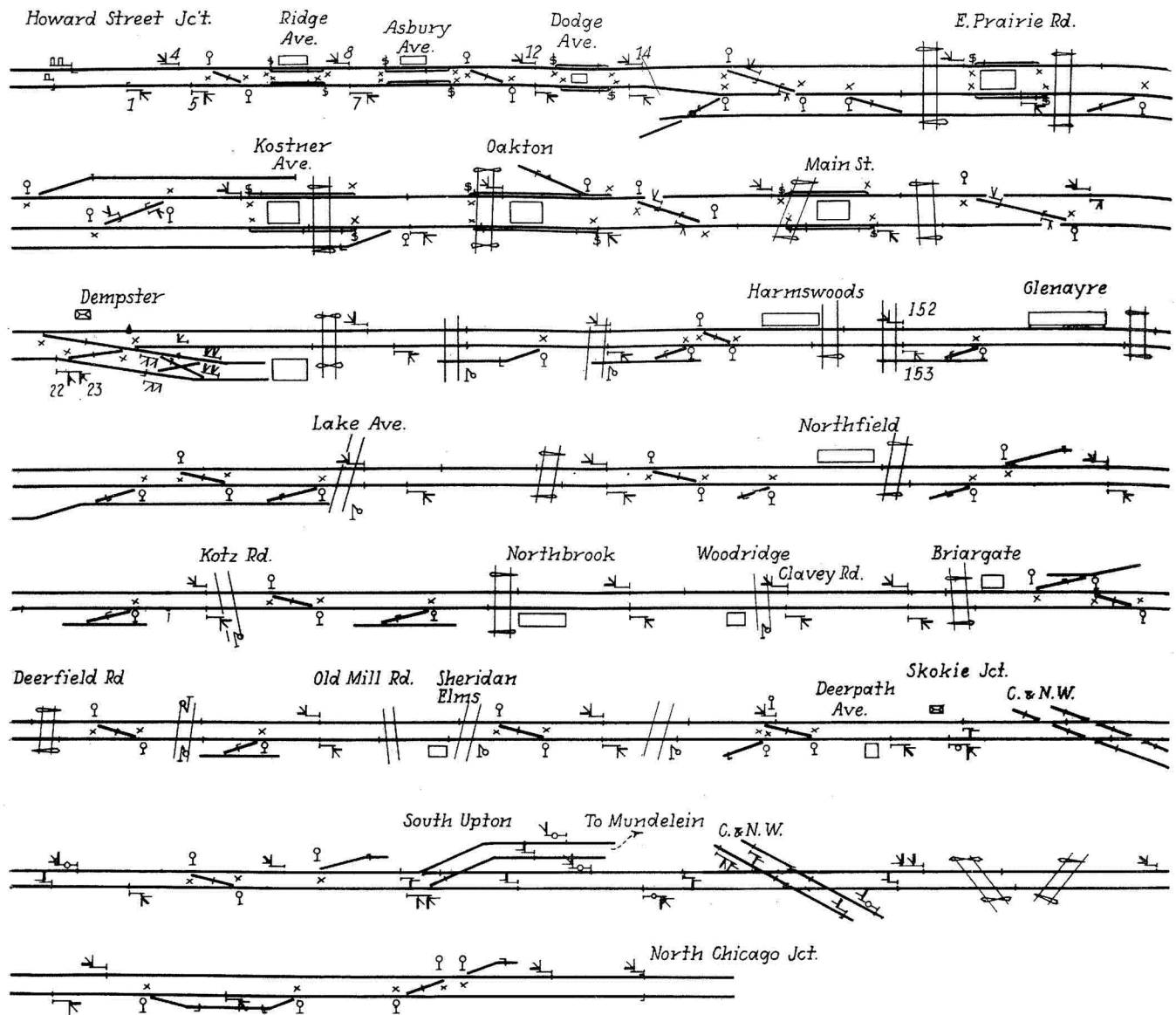
The electrified North Shore Line, extending between Chicago and Milwaukee, operates over the lines of the Chicago Rapid Transit Company out of Chicago as far as Howard street. From Howard street the North Shore operates over two routes to North Chicago: i.e., the Shore Line Route, which follows the shore line of Lake Michigan, and the Skokie Valley route, which was constructed further inland in 1925 and 1926 as a high-speed line, primarily to by-pass the shore line cities for through Chicago-Milwaukee traffic. At North

Chicago the two routes join and extend on to Milwaukee.

The recent installation consisted of the provision of three-indication color-light signaling on the double-track Skokie Valley division between Howard Street Junction, where the North Shore joins the lines of the Chicago Rapid Transit Company, and North Chicago.

Three Interlockings in Territory

Three interlockings are located in this territory: Dempster Street interlocking, a 24-lever mechanical plant located 5 mi. north and west of Howard street, at the terminal point for rapid transit trains operated over the North Shore tracks from Howard street; Skokie Junction interlocking, a 31-lever all-electric plant located at a crossing of the North Shore and the Chicago & North Western Lake Bluff cut-off; and South Upton interlocking, a 55-lever all-electric plant at a wye and crossing layout involving the Skokie Valley division and the Libertyville branch of the North Shore, and the Chicago & North Western freight route, tracks 3 and 4, between Chicago and Milwaukee. Also involved in the installation were 25 highway grade crossings, including:



Track layout between Howard Street and North Chicago

17 crossings protected by automatic gates and 8 crossings protected with wig-wag signals.

Signals

The three-indication color-light signals, displaying red, yellow, or green aspects, are of the Union Style N-2 type, using 18-watt, 10-volt, single-filament lamps at automatic locations and double-filament lamps on interlocking signals.

Referring to the diagram of the track layout, signals 1, 2, 4, 5, 7, 8, 12 and 14, at Howard street were previously in service; signal No. 7 acted as the northbound end-of-block signal and displayed two indications, stop and caution. In the recent installation, a clear aspect was added to signal No. 7, 55 new signals were installed north of this point, the interlocking home signals were changed

from mechanical semaphore to color-light at Dempster street, three indications were provided instead of two on the Skokie Junction and South Upton interlocking home and distant signals, electric locking was provided at Dempster street, replacing detector bars, 55 light-type switch indicators were installed on crossovers and turnouts in the territory, and the highway crossing control circuits were revised to fit into the new signaling.

Signal Spacing

Signal spacing varies from $\frac{1}{2}$ to approximately 2 miles, the longest block being 11,873 ft. Trains at present are operated up to 70 m.p.h. Except for a portion on the extreme south end, 2 miles in length, which is equipped with third-rail, the tracks involved are electrified with a 600-volt overhead catenary system mounted on

suspension trusses. The catenary columns supporting the suspension trusses are located 10 ft. 9 in. from the center of the adjacent track and were originally designed and installed at this distance to allow signals (which, it was contemplated, would be installed at a later date) to be located adjacent to the track in such a manner that unrestricted view of the signals would be provided motormen; thus the signals, individually mounted on separate signal supports, are located 9 ft. from the track center. The instrument cases are painted black, the poles and the rear of the signal backgrounds are painted with aluminum paint, while the background faces are painted black. The signals are line controlled, the line circuits breaking through Union U-3 and U-4 switch circuit controllers.

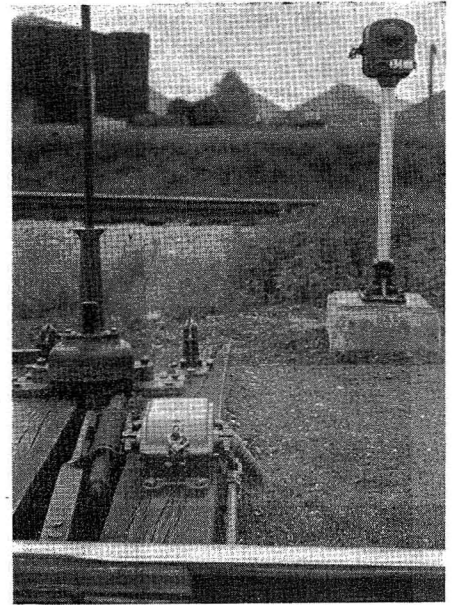
Each main-line hand-throw switch in the territory is equipped with a

Union push button light-type indicator. When a trainman desires to operate one of these switches, he pushes the button and if the track in approach to the switch is unoccupied, the indicator lens will be illuminated. Indicators of this type were provided on 53 switches, while indicators with a slow-release feature were installed at two switches on the extreme north end to set signals in advance and give the same measure of full protection afforded by the others, since these circuits do not extend far enough to allow the normal approach indication. Although three-position color-light signals were previously in service between North Chicago and the Illinois-Wisconsin state line on the Milwaukee route, a non-sigaled gap, approximately $\frac{1}{2}$ mi. in length, has been left at North Chicago due to the fact that a realignment is contemplated in the future and trains at present must operate at restricted speeds due to pronounced curvature and grades.

Underground Line Circuits Provided for 18 Miles

The provision of the line circuits, which are all 110-volts, 60-cycle, in the territory in which the signals were installed, presented some interesting features. The right-of-way is jointly owned with the Public Service Company of Northern Illinois for a considerable distance and three 132,000-volt, three-phase transmission lines parallel the North Shore tracks, in addition to the 600-volt catenary propulsion system and a 2,300-volt, 60-cycle distribution system supported on risers on the catenary structures. From a safety as well as a maintenance viewpoint, therefore, it was decided to place the signal line circuits underground wherever feasible and to use aerial cable supported on messenger in other sections.

The line wires between Howard street and Dempster interlocking, 5 mi., are in No. 14 aerial cable, the sizes varying up to 15-conductor, wire-tied to a messenger supported on the catenary structure, or on steel poles in the third-rail area. From Dempster street to Deerpath avenue, a distance of 15.5 mi., the line controls are in mummy-finish underground cable placed east of the tracks 20 to 30 ft. from the nearest rail depending upon obstructions and the contour of the ground. Between Deerpath avenue and the north limits of South Upton Junction interlocking, the line circuits are carried in previously existing aerial cables mounted on the catenary structures and in open line wires on wood poles, additional aerial cable and line wire having been supplied where necessary. In the section from South Upton to North Chicago Junction, the line wires are again in mummy-finish underground cable, for a distance of 2.5 miles, on the



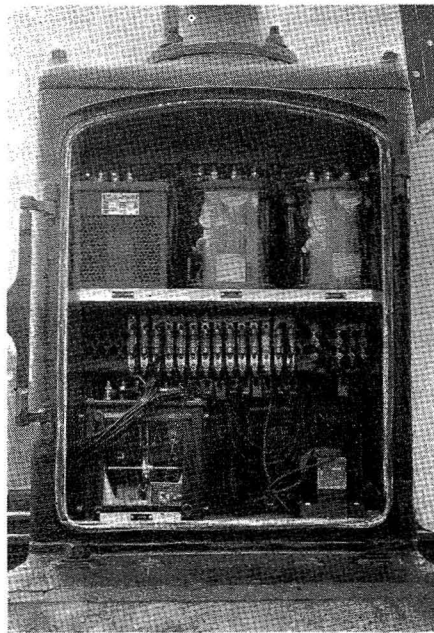
Fifty-five switch indicators were installed west side of the tracks between the west rail and catenary uprights.

Trench Machine Used

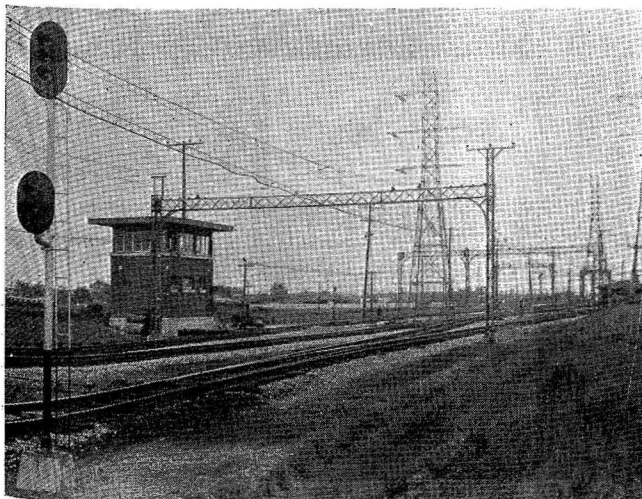
The trench for the main underground cable was dug by a contractor using a high-speed trench machine. The trench provided was 6 in. wide with 2-ft. minimum depth. The contractor also jacked 3-in. galvanized iron pipes under all road crossings and under the tracks where instrument cases were located on the opposite side of the tracks from the cable run.

All of the cable was laid by the North Shore forces. The cable was ordered in exact lengths and shipped on reels; the reels were mounted on a six-wheel truck and the truck was driven alongside the trench, the cable being reeled off into the trench and threaded through the pipes under streets and tracks. The cable was threaded through a piece of flexible conduit at the pipe ends, or was wrapped with sheet lead to prevent chafing. When the cable was placed, the contractor's men refilled the trench by hand. At underpasses, the underground cable was placed in wood trunking laid in the bridge ballast.

The trench digger, manned by an operator and a helper, dug up to 4,500 ft. a day. The cable was laid by a gang including the truck driver, a foreman, and six men, as much as three miles of cable being placed in a day. Fifteen men in the contractor's re-filling gang back-filled up to two miles of trench in a day. In the sections where aerial cable was run, the cable from either direction was dropped directly to a junction box, or to a goose-neck on each signal case, the drop being supported on a mes-



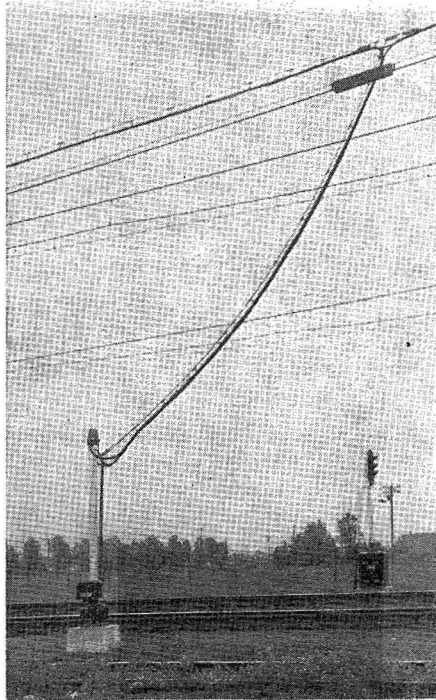
Above—Typical instrument case. Left—General view of Dempster interlocking. Home signals 22-23 in foreground



senger. Union pin-point type lightning arresters were installed on all aerial signal control circuits.

Materials and Handling

Combination sheet-steel and cast-iron instrument cases, with wood back boards, were provided in either single or double sizes, depending upon the amount of equipment to be housed. Standard A.A.R. porcelain terminal blocks, SLV-13 line relays, and No.



Aerial cable drop to junction box

14 flexible stranded jumpers with wedge-on terminals were used. The cases were shipped from the factory of the Union Switch & Signal Company wired complete with instruments as far as possible.

Concrete foundations were installed by a contractor and were cast at each location, plywood forms being used over and over. The instrument case foundations were provided with a recess in the top 27 in. long, 10 in. wide, and 10 in. deep. A 5-in. piece of stove-pipe was placed in the form, leading in a downward slant from the bottom of the recess to the side of the form. After the concrete had set the stove-pipe was collapsed, leaving a duct which was used as a cable entrance to the case. The cable was stripped down at the end and adequate slack in the individual wires was provided by coils placed in the recess.

The instrument cases and impedance bonds were shipped in end-door boxcars and the crane of a rail-mounted ditcher was used to pick up the cases through the end-door of

the boxcar and place them directly on the foundations. The impedance bonds were unloaded at location beside the tracks and later placed in position between the track rails. All cases and impedance bonds were distributed in 2½ days, in spite of the heavy traffic conditions existing. The poles and signals were assembled in a yard at Highwood, on the Shore Line, and distributed by truck.

2300-Volt Power

Power is obtained from the Public Service Company of Northern Illinois; no standby is provided since the commercial source is interconnected with a reliable power distribution network. The center section is fed from a distance of 19 mi. between South Upton Junction and Oakton street, Niles Center, Ill., from a 2,300-volt, 60-cycle distribution line, previously erected in 1926 with sufficient capacity for the then contemplated signal system service. The 2,300-volt line is fed at traction substations at Kotz road and Old Mill road. The line is sectionalized at Dempster street, Lake avenue, Kotz road, Deerfield road, and Old Mill road, and consists of two No. 4 bare copper wires carried on risers on the catenary supports for the entire distance. The 2,300-volt supply is transformed down to 220-110 volts at each cut-section and signal location, using G.E. 1½-k.v.a. transformers, cut-outs, fuses, and pellet-type lightning arresters. The drops from the transformer consist of two or three rubber-covered No. 10 wires, depending on the connected load, run in conduit to a junction box at the base of the catenary leg or upright; from this point the power feed is run in under-

ground cable to the signal or cut-section locations.

Two three-mile sections on either end of the territory fed by the 2,300-volt line are supplied by a 220-110-volt, 60-cycle line fed directly from the Public Service Company of Northern Illinois. The line on the north end consists of three No. 6 underground cable conductors, while the line on the south end is in aerial cable.

The track circuits are a-c. using W-20 transformers, Model 15 track relays, Ohio Brass Company Type CL Webber 400,000 c.m. 10-in. traction bonds, Union 1,000-amp. capacity impedance bonds, No. 9 single-conductor underground cable track leads, Raco No. 710 and Union bootleg outlets, and 42-in. stranded plug-type connectors. The rail is mostly 100-lb., with stone ballast, and continuous insulated joints.

Organization

The circuits for this installation were designed by the Union Switch & Signal Company, this company also supplying the greater proportion of the material. The work was planned and equipment installed by the North Shore under the direction of: J. S. Hyatt, chief engineer; F. J. Kramer, engineer maintenance of way; W. G. Fitzgerald, signal supervisor; and H. G. Mason, assistant engineer. Work was started October 4, 1937. The first section, between Howard and Dempster streets, was placed in service March 17, 1938; a second section, Dempster street to Clavey road, on March 18; a third section, Clavey road to Deerpath avenue, on April 22; and the last section, Deerpath avenue to North Chicago, on May 19.



Milwaukee-bound train at signal No. 153