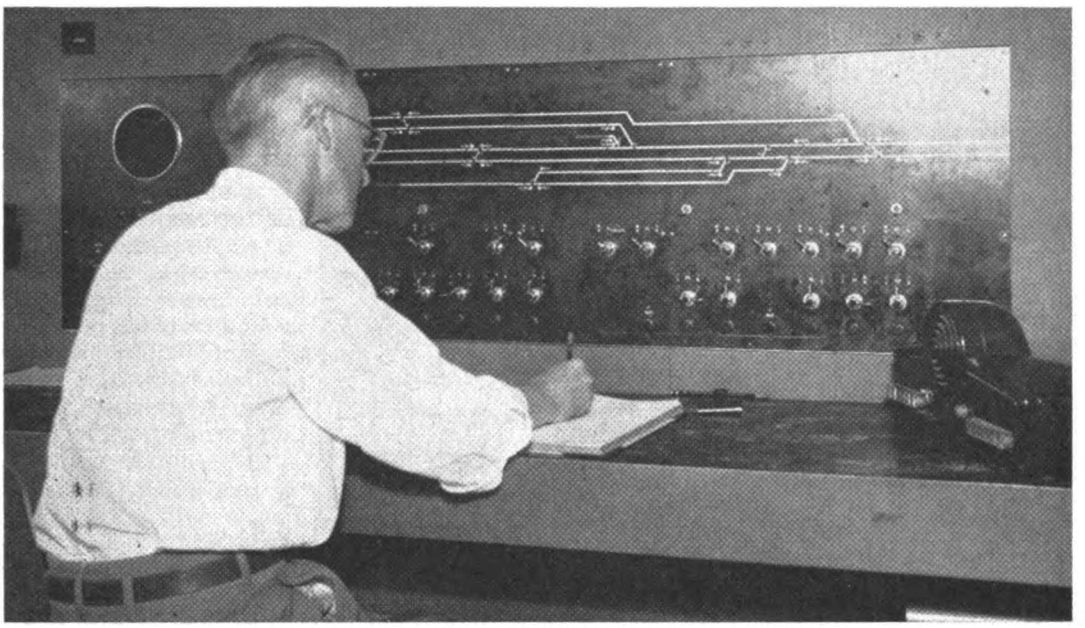


The interlocking control machine is in the office on the docks.

New Interlocking on Leads to Docks Saves Time for Ore Trains

Signal arrangement and controls were well planned to handle incoming hill transfer trains and switching moves required to push cars out into elevated docks—Special call-on signal controls save time and insure safe operations

ON THE TRACKS leading to elevated ore docks at Duluth, Minn., the Duluth, Missabe & Iron Range has installed an extensive electric interlocking that is controlled remotely by line code from the office out on the docks, 82 ft. above lake level. Previously, the switches and crossovers in this area were operated by hand-throw stands, and train movements were directed by hand signals. The new interlocking saves train time; improves safety by authorizing train movements by signal indications; and increases track capacity because trains may now be operated in either direction on all tracks.

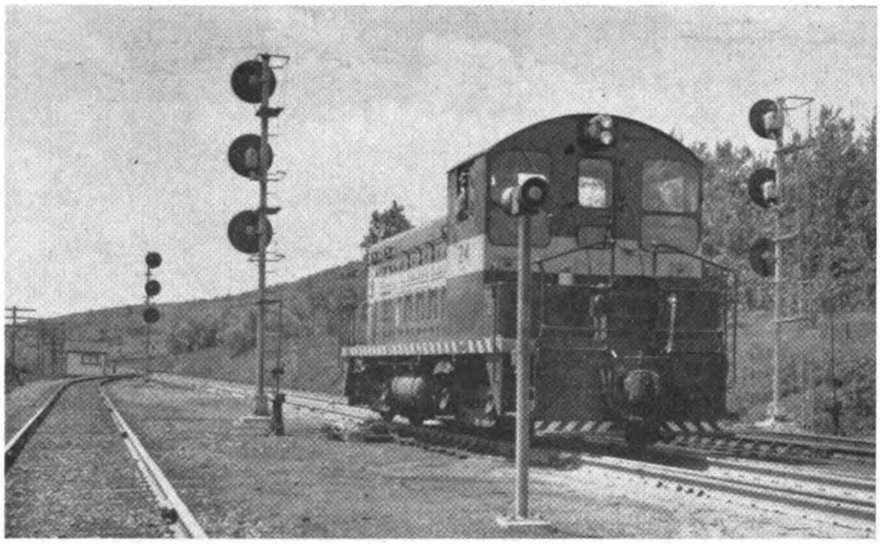
The layout includes two docks, each of which extends 2,304 ft. from shore out into Duluth harbor, so that deep draught lake boats can be brought up along each side of both docks. Four tracks are located on top of each dock, these tracks being 82 ft. above water level. The iron ore is dumped from the cars into pockets under each track. When a boat is in position to receive ore, long chutes are lowered to allow the ore to flow by gravity from the pockets down the chute into the boat.

The Duluth, Missabe & Iron Range hauls this ore in 180-car train loads for about 70 mi. from the Mesabi iron range, southward to Proctor yard, which is 7 mi. from the Duluth docks. At Proctor, the cars are classified, and assembled in blocks, with the cars in sequence as required for dumping into the pockets in the docks.

In the 7 mi. from Proctor down to the dock, the railroad decends approximately 400 ft., the maximum grades being about 2 per cent. Each transfer train operated between Proctor yard and the dock includes about 80 loaded ore cars, and each return train includes about the same number of empty cars.

This line from Proctor down the hill is double track (with normal movement left hand) to signal 34L, as shown on the plan. At signal 34L, the double track branches out to eight tracks. Two of these tracks are the approach tracks leading to Dock No. 5; two are car storage tracks; two are the approach tracks leading to Dock No. 6; and two are passenger and freight mains, connecting to the main line which extends to the Duluth passenger station, freight houses and industries in Duluth.

On the approach tracks, the distance from crossover 15 to the "End of Block" sign at Sig. 8R near the entering end of the dock, is about



View looking toward Proctor, showing signals 26L and 23L

2,920 ft., which is long enough for a train of ore cars, including a locomotive and a caboose.

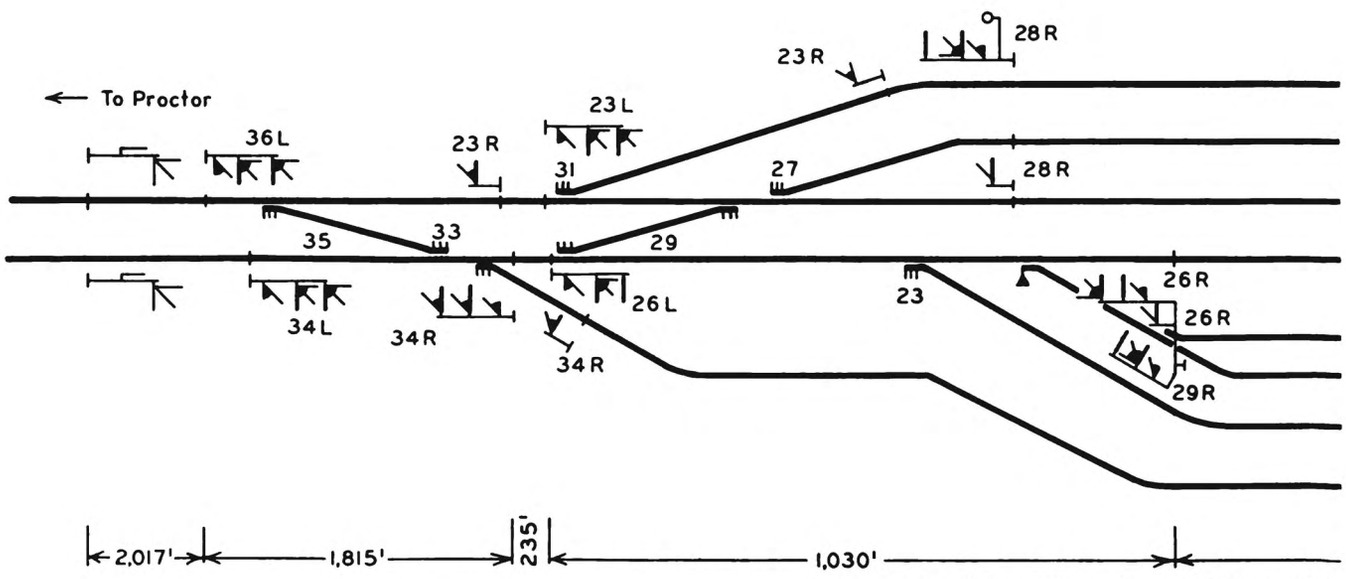
For example, when an incoming ore train is arriving on the right-hand track of the approach to Dock No. 5, Signal 10L is clear for the train. The caboose is cut off and held on the grade north of Signal 10L while the train proceeds out on the approach to stop short of the "End of Block" sign at Signal 2R, which is near the entering end of the dock. A dock locomotive then goes north from the dock (on the other track) to Signal 12L at the approach cross-over, Cross-over No. 11 is reversed, and a restricted-speed aspect is displayed on this signal for the locomotive to move in behind the train to push it out onto the dock. With cross-over No. 11 positioned normal, a restricted-speed (Call-On) aspect is displayed on Signal 10L for the caboose to drift down behind the train and switcher locomotive. In the meantime the hill transfer locomotive has cut off from the head end of the train, and has moved out on one of the four dock tracks where it picks up a train of empties, and proceeds northward over the approach to stop with the rear of the train at Signal 12L. Cross-over No. 11 is reversed and the Call-On aspect is again displayed on Signal 12L for the train to back across onto its caboose, after which the train departs up the grade on the return trip to Proctor. Similar operations apply for train movements when arriving on the approach tracks leading to Dock No. 6.

During the first trick each day, there are four hill transfer crews that each make four round trips between Proctor and the dock. Three crews on the second trick, and three crews on the third trick, each making three round trips. A few of these trains handle cars of local freight and merchandise which are taken to the freight house and industries in Duluth. A total of about 34 trains daily, bring about 85 loaded cars of ore each from Proctor to the docks.

Control Machine on Dock

The interlocking control machine, which is the panel type, is in the operator's office located adjacent to a cross walk between the two docks at track level, which is 82 ft. above water level. The panel of this machine is 64 in. long and 20 in. high. Nine switch levers control power switch machines on four crossovers and five single switches. One lever controls electric locks on a hand-throw single switch. The switch levers are in the upper row, the signal levers in the next row below and the code starting buttons in the bottom row.

The signals are the searchlight type. The high signals each have three "arms," the bottom one of which is normally dark, being lighted only when required in the call-on aspect red-over-red-over-yellow. In addition to conventional proceed aspects, the

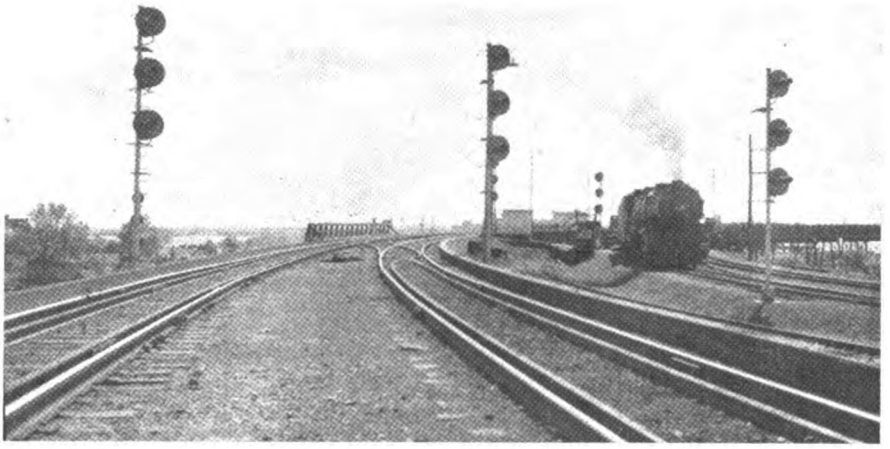


Track and signal plan of the entire interlocking which

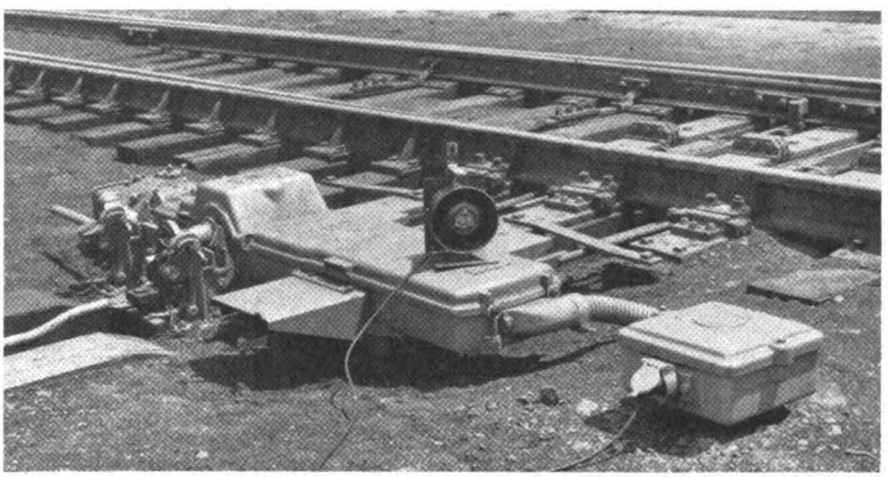
call-on aspect can be displayed to direct locomotives to enter an occupied section. Such moves are necessary to couple onto standing cars when making switching moves as explained above. The call-on aspect is red-over-red-over-yellow. When this aspect is to be displayed the leverman sets the signal lever; operates the regular code sending button below that signal lever; and finally, he pushes the special call-on control button which is in the face of the barrel of that signal lever. As a protection against opposing movements, a time-delay of 60 seconds must elapse, after pushing the second button, before the call-on aspect will be displayed. During this 60 seconds, all signals involved are held at the Stop aspect, and energy is cut off the feed to the lamp in the bottom (third) "arm." The 60-second delay is omitted if the directional stick relay insures that the proposed move is in the same direction as the original occupancy move, such as a dock engine going around at a middle crossover.

On all but four of the high signals the two upper "arms" are searchlight signal heads, and the third (bottom) arm is a single lamp unit. On four signals; 10L, 12L, 14L and 16L, all three "arms" are searchlight units with 25-watt lamps and 40-degree deflection lenses, to provide the required range on 4-degree curves. On all signals with three "arms" the bottom unit is normally dark, being lighted only in the call-on aspect, red-over-red-over-yellow.

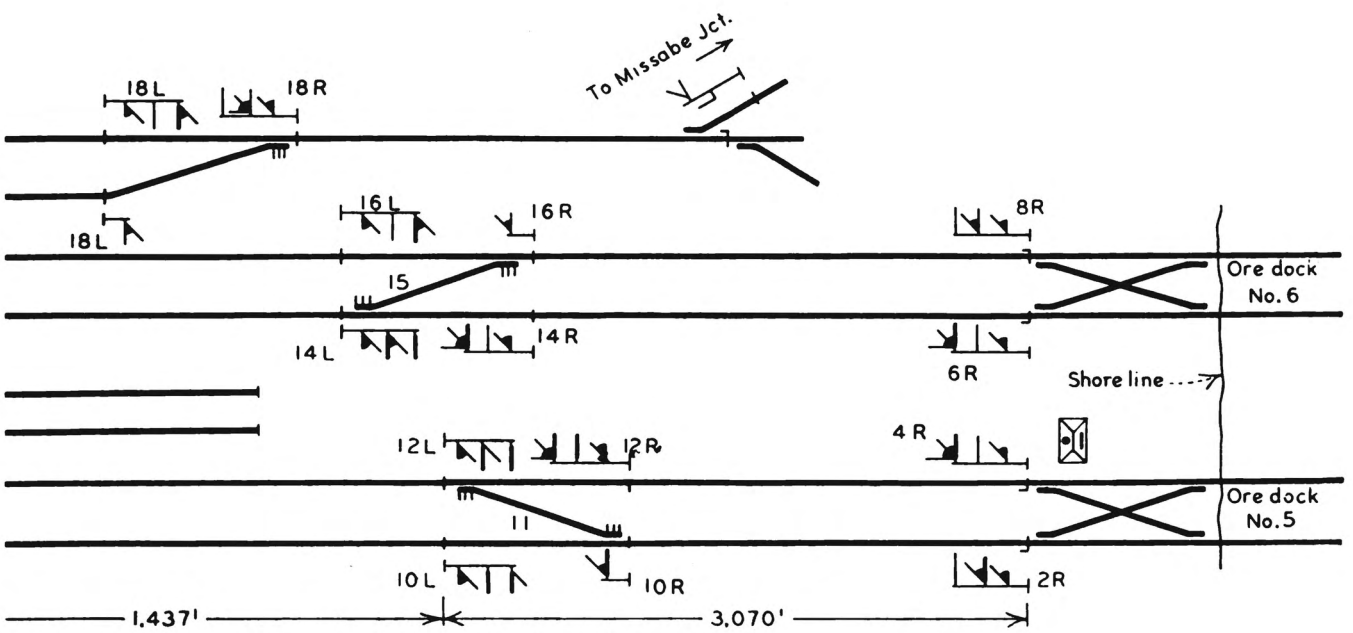
The 13 electric switch machines in this interlocking are the dual control



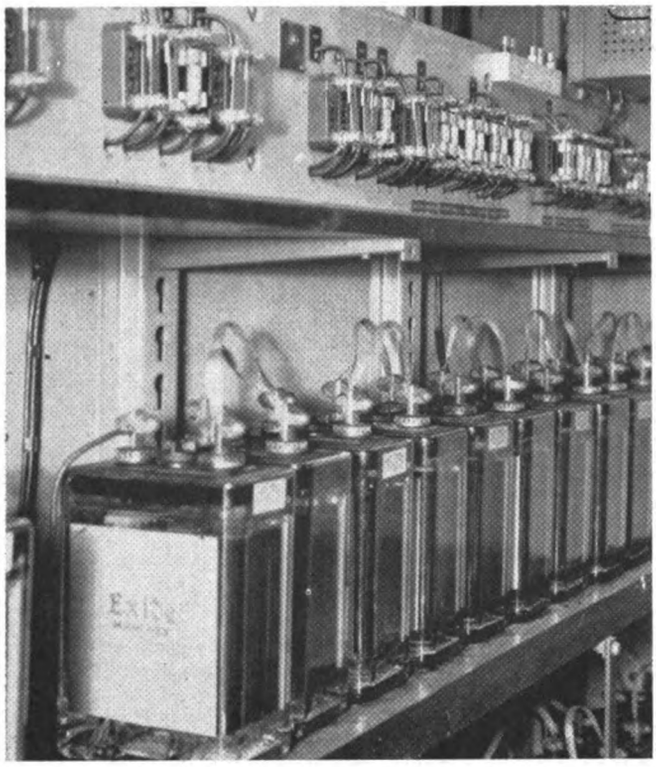
Signals 16L, 14L and 12L control trains going toward dock



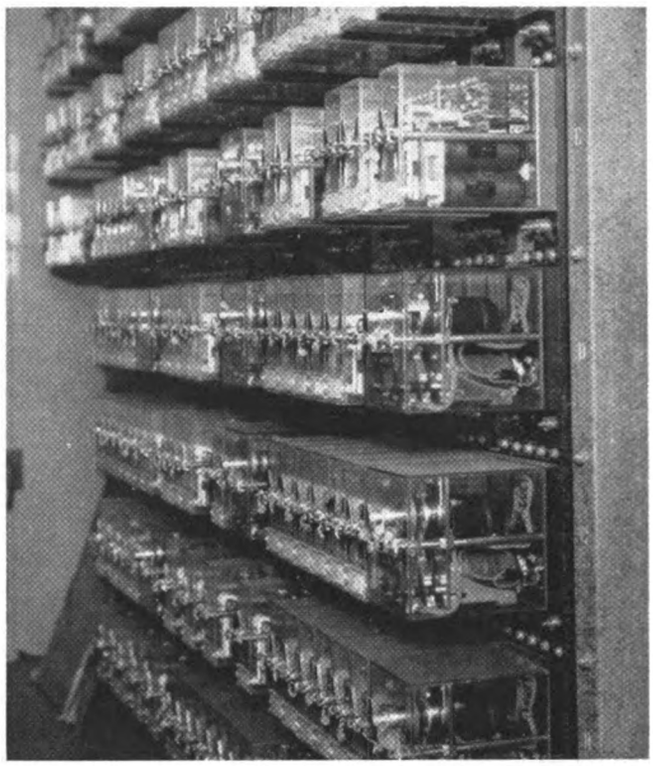
Portable talk-back loudspeaker plugged into receptacle at switch



Includes the switches and crossovers in the area leading to the ore docks



Batteries are in sheet-metal houses



The relays are the plug-in type

type. In each switch layout three 1-in. by 8-in. insulated gauge plates are used in each switch, one on the No. 0 tie and one each on the first two ties under the points. Two of the plates extend and are bolted to the switch machine, thus maintaining the relative location of the machine and rails. Raco adjustable rail braces are used on the three ties with the gage plates.

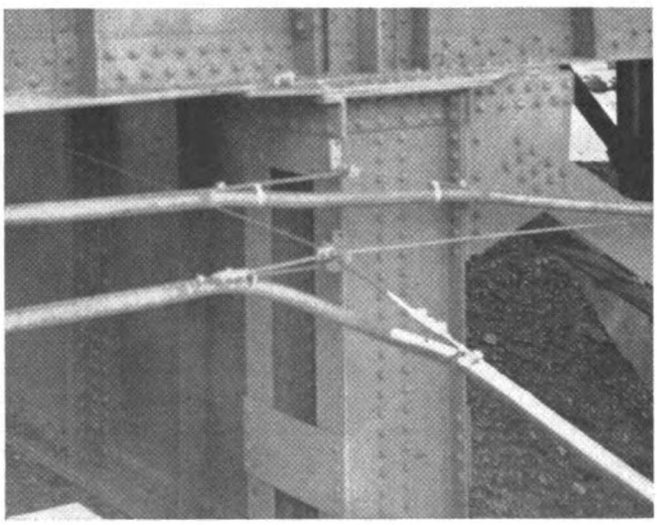
Single switches 23 and 27, as well as crossover 29, are equipped with 110-volt switch machines which are fed from 55 cells of 80-a.h. Exide lead storage battery. (Switch 33 and Cross-over 35 are 28 volt) The cross-overs 11, 15 and 35, as well as switches 17, 31 and 33 are equipped with 24-volt switch machines, from 14 cells of 80-a.h. Exide battery.

An aerial cable extends along the trestle structure from the control office to the relay house near signal 16L. This cable includes four No. 9 and forty No. 14 wires. One pair of the No. 9 is used for the code line circuit. This cable, made by the American Steel & Wire Company, has a neoprene jacket, and is lashed to a seven-strand Copperweld messenger by a continuous strip of copper ¼ in. wide and about 1/16 in. thick. Beyond the end of the trestle this cable is run on line poles below the lower crossarm.

The connections from instrument housing to the rails are in No. 6 trench-lay cable, using Raco bootlegs. The rail joints are bonded with A.S.&W. Co. type S-1 bonds. Each track circuit is fed from one DME-9 storage cell. Type B, plug-in relays are used throughout this installation.

This project includes a talk back loudspeaker intercommunication system. The control console on the desk of the CTC control machine can be connected to carry on two-way conversations with seven outlying talk-back loudspeakers, which are located as indicated on the plan. These talk-backs are used by train and engine crews as well as track foreman and signal maintainers, when occasions arise for calls to or from the leverman.

In addition to the fixed loudspeaker locations, the maintainer has portable loudspeakers which he can connect to the circuit in any instrument house as well as into a special receptacle in the side of the junction box at each switch machine as shown in one of the pictures. These portable talk-backs are the RCA, rated at 8 ohms. The larger talk-back speakers which are mounted on pipe masts 7½ ft. high are the Raco RR40 rated at 16 ohms. The console on the CTC control desk is a Rauland amphicall type. This interlocking was planned and constructed by railroad forces under the jurisdiction of F. J. Voss, vice-president and chief engineer, and Harold S. Spindler, signal engineer.



Cable messengers are attached to steel trestle structure