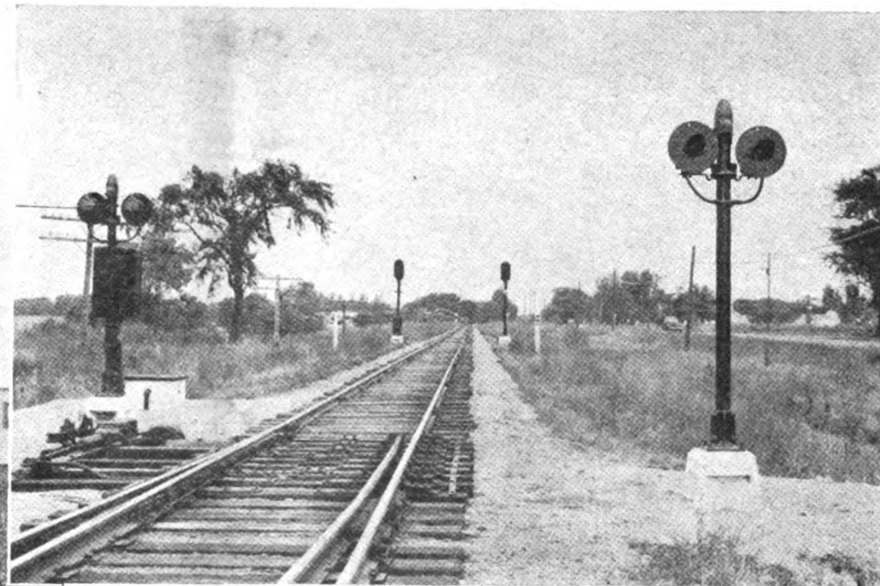
Below — Typical leave-siding indicator. Right—Color-light switch signals at spring switch



Special arrangement of indicators at spring switch layouts to protect and facilitate train movements

Automatic Signaling with spring switches

Installed on the Great Northern

THE Great Northern has recently installed automatic block, including spring switches at five sidings, on 65 mi. of single track between St. Cloud, Minn., and Lyndale Junction which is about one mile from the passenger station in Minneapolis, Minn. This section between Lyndale Junction and St. Cloud is part of the original line of the Great Northern between these points, and includes short rolling grades as well as a considerable number of curves. In later years, alternate lines have been constructed which now handle several of the transcontinental passenger trains such as the Empire Builder. Thus the Lyndale Junction-St. Cloud territory now handles only three passenger trains each way daily, and a considerable number of fast through freight trains, as well as a local freight train each way daily except Sunday. The total number of trains daily ranges from 10 to 14.

Under these circumstances, the primary requirement was for a signaling system which would increase the safety of train operation, and the next consideration was to save as much time as practicable for the fast through freight trains when making meets, and, at the same time, limit the entire project to a cost which could be justified by the present and prospective traffic on this line. The conclusion was to install automatic block signaling, including spring switches at both ends of the five sidings which are used ordinarily by through trains, including Robbinsdale, Osseo, Albertville, Monticello and Clearwater. At other short sidings, used primarily as

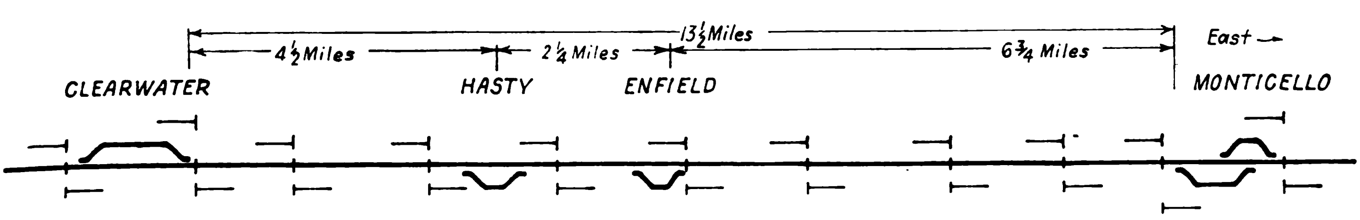
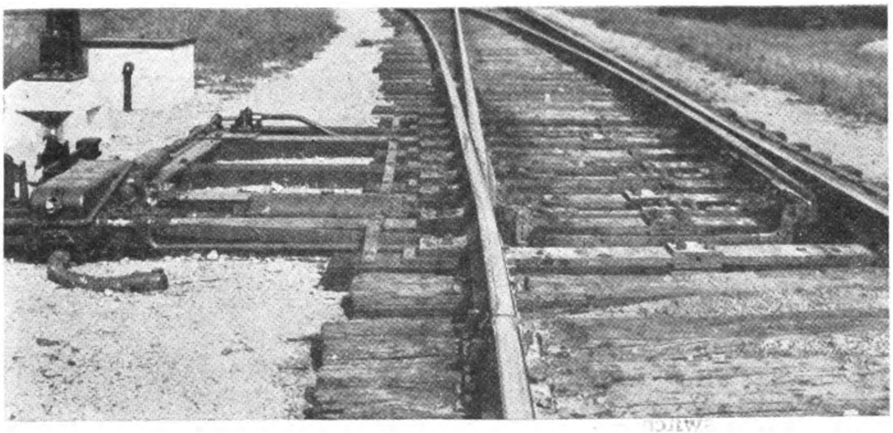


Fig. 1—Track and signal plan of typical arrangements of signals



Each spring switch layout includes a mechanical facing-point lock

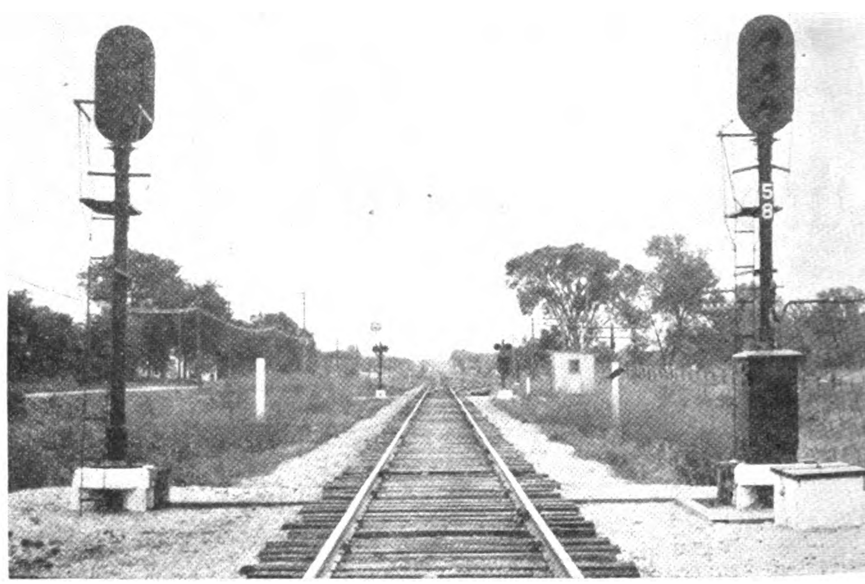
house tracks, the conventional hand-throw switch stands were left in service, and no head-block signals were installed at these short sidings, protection being provided by intermediate automatic signals. For example, the short house tracks at Enfield and at Hasty are located in the over-all station-to-station block between Monticello and Clearwater, as shown in Fig. 1.

Construction of Spring Switches

The spring switch mechanisms are the Pettibone-Mulliken Company, Mechanical Switchman Type including the oil buffer and spring as one unit, which is connected as part of the throw rod. At each of these switches the previous handthrow stand was replaced by a Union Switch & Signal Company S-20, hand-throw switch-and-lock stand including a facing-point lock which locks the switch for main-track movements, the plunger being withdrawn automatically when a train starts to trail through the switch from the siding to the main track.

This mechanism includes a set of contacts which check the position of the switch within ¼ in. of its normal position; that the plunger is through the lock rod, and not through too far so that it would not be withdrawn for a trailing move from the siding. A switch repeater relay is controlled by a circuit through the normally-closed contacts of the point detector and the lock plunger, checking both conditions, unlocked and overlocked.

When installing a spring switch layout, each switch was equipped with insulated gage plates, ¾ in. thick and 7 in. wide, on three ties, the one ahead of the points and the first two under the points. On two ties these plates extend and are attached to the case of the switch mechanism, to prevent lost motion. Also on the tie for the lock crank, there is an insulated gage plate and a plate extending under the crank.



Automatic block signal location at a passing track switch

Spring Switch Protection

In addition to the automatic signals, as shown in Fig. 2, there are also two color-light switch signals, one on each side of the track, at each spring switch, the two signals being provided so that an engineman approaching from either direction will have his signal to the right of the track. As shown in the accompanying picture, these switch signals each consist of two lamp units, one on each side of the mast, the one to the left having a red cover glass, and the one to the right a lunar white. These lamp units include Lebby mirror reflectors, the cover glasses being 6⅜ in. in diameter. The lamps are rated at 10 watts, and are fed at 8 volts d.c. The mast is high enough to bring the center of the cover glasses 7 ft. above the level of the top of the rail.

The lamps in these switch signals are normally extinguished, being lighted by approach control, but otherwise they are not controlled by track circuits. When the switch is normal, and the lock plunger is through the lock rod, the lunar lamp in each of the two switch signals is lighted. If the switch is not in the full normal position, checked within ¼ in., and if the lock plunger is not normal, the lunar white lamp is extinguished, and the red lamp in each signal is lighted. Thus these switch signals are the equivalent of conventional switch lamps and targets, with the added pro-

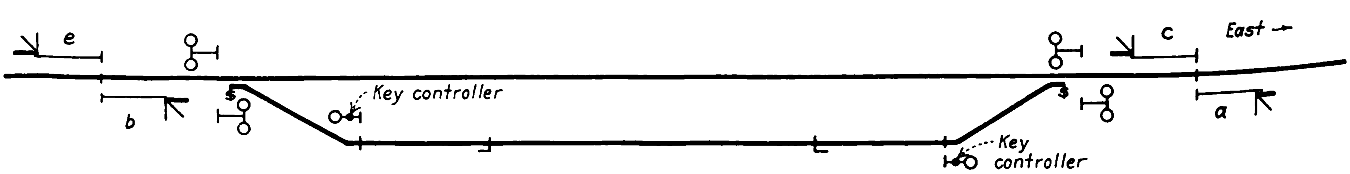


Fig. 2—Plan showing locations of switches, signals, indicators and key controllers

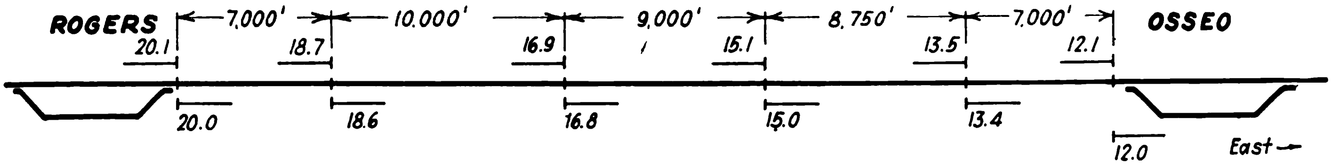


Fig. 3—Plan showing typical arrangements of intermediate signals between sidings

tection of checking the position of the switch point accurately, as well as checking the facing-point lock. While both lunar white lights serve as identification of the spring switch in proper operating condition, trainmen on the rear of a train trailing through a spring switch are required to observe that the lunar white light is displayed behind them so that they will know that the switch returned to the normal position.

Leave-Siding Indicator

For directing train movements when departing from a siding through a spring switch, a train is directed by an indicator located on the turnout at the clearance point, thus definitely fixing that point. As shown in one of the accompanying pictures, such an indicator consists of a single lamp unit on a mast high enough to place the center of the lens 7 ft. above the level of the top of the rail. The 5⅜ in. lens is yellow, and the lamp is normally extinguished.

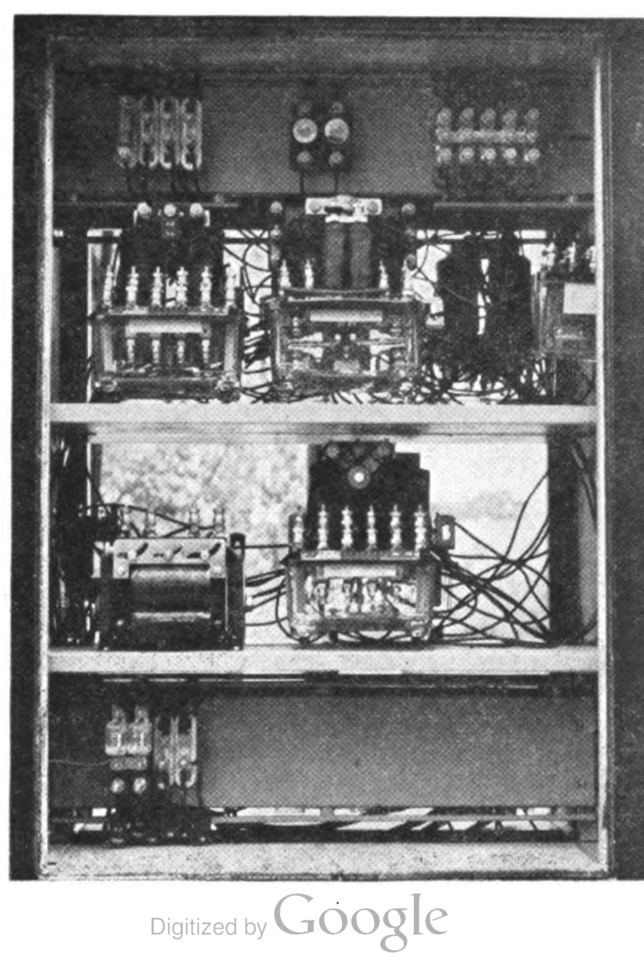
When a train on the siding is ready to depart, the conductor or head brakeman goes to the leave-siding indicator, inserts his switch key in a controller on the mast, and turns the key 60 deg. clockwise. Providing the switch is normal and the lock plunger is normal, and also providing no opposing train has passed the next station in advance, or no following train has entered the track circuit approaching the entering signal, at the opposite end of the siding, then the operation of the key controller completes a circuit to energize an indicator stick relay, which, when picked up, sticks up through its own front contact, so that the brakeman can remove his key and return to his train. Once the stick relay is up, the lamp in the leave-siding indicator is lighted to display a yellow aspect, and at the same time the main-track automatic signals governing opposing and following trains are controlled to the red aspect. The yellow aspect in the leave-siding indicator authorizes the engineman to pull his train through the spring switch and depart on the main track, without stopping.

As the train trails through the switch, the switch-repeater relay is released, which releases the leave-siding indicator stick relay. Therefore, the circuits revert automatically to the normal condition. If, after having established a yellow aspect on a leave-siding indicator, a train is then delayed, the indication must be taken away, in order that the main-track signals can clear for other trains to move. This "take-away" is accomplished by inserting the switch key in the key controller, and turning it 60 deg. counter clockwise. This releases the stick relay, and places the circuits back to normal condition again. The only purpose for the short track circuit, 500 ft., on the siding in approach to the leave-siding indicator is to approach control the lamps in the two switch signals at the switch which were discussed previously.

In some instances, an eastbound freight train, for example, would complete its movement into the siding about the time or soon after a westbound train on the main track had entered the station layout. Under such circumstances if the freight train is authorized by timetable or train orders to proceed, there is no occasion for that train to stop for the head brakeman to operate the key controller to clear the leave-siding indicator. Therefore, the rules provide that when making a meet with an opposing train, when that train passes, the train on the siding can pull on out through the spring switch promptly without stopping to clear the leave-siding indicator, provided the main-line leaving signal indicates proceed.

Automatic Block Signals

The automatic block signals are the color-light type mounted on masts to bring the center of the lower lamp 12 ft. above the level of the top of the rail. The concrete foundations are the pre-cast one piece type. Where no special circumstances are involved, the head-block signals are located about 100 ft. from a passing track switch. Where house tracks are so located that track length is needed to make switching moves beyond the passing track switch, the head-block signals are set out a couple hundred feet or more so that the way freight can make switching moves without passing beyond the head-blocks, which would



At each of the intermediate signals there is a double-door case for the relays and the rectifiers

Robert Rudd, the signal maintainer, on his motor car at an intermediate signal location

knock down the opposing signals to the next station, thus possibly causing delay to another train.

About 3,000 ft. to 5,000 ft. has been adopted for this territory as sufficient in which to stop a train after having passed a signal displaying the Approach aspect at maximum permissible speeds. Accordingly, the first signal in approach to a switch, as for example eastbound intermediate signal 13.4 in Fig. 3 is located about 7,000 ft. from eastbound station-entering signal 12.0 at the west end of Osseo. By thus using 7,000 ft. spacing rather than dividing a station-to-station block into equal automatic blocks much longer than 7,000 ft., a westbound freight train, for example, has all the possible time available to get into a siding and at the same time allow an eastbound opposing train to get a green aspect on signal 13.4. Another advantage of making the first intermediate block as short as practicable is that if a westbound freight train is waiting on the siding for a westbound passenger train to pass, the passenger train will pass beyond the first signal, 13.5, sooner than if the block were longer. Thus the freight can pull out to follow, on a proceed signal, sooner. The distance between signals 13.4 and 18.7 is divided into three blocks, averaging 9,750 ft. thus making a total of five intermediate blocks, 7,000 ft., 8,750 ft., 9,000 ft., 10,000 ft. and 7,000 ft., respectively.

As shown in Fig. 4, the station entering signals are overlapped. Each automatic block is divided into two track circuits with the relays at the signals, and this permits the use of overlaps without requiring extra line wires. As shown in Fig. 4, the red control for following movements of each and every signal is overlapped one track circuit beyond the next signal ahead with the exception of the distant to entering signals. As for example, signal 16.9 is overlapped beyond signal 18.7. This practice improves protection in case a westbound train, for example, stopped with its rear just west of signal 18.7.

The track circuits are the d.c. neutral type using 4-ohm Style-K relays. Each automatic block is cut into two or three track sections so that the track circuits range up to 4,000 ft. in length. The rail joints are bonded with rail-head plug type bonds. The control circuits are arranged on the absolute permissive block system, using polar line circuits with three line wires, one for each direction and one common. The line control relays are the retained-neutral polar type which prevent flashing of the signal lamps when the polarity is changed. The main operating coils of these relays are rated at 480 ohms.

The signal line wires were installed on a crossarm which was added to the existing telegraph pole line. The three signal line control wires are No. 10 Copperweld and the two wires for the 220-volt a.c. power distribution circuit are No. 10 copper. These wires furnished by the Anaconda Company are equipped with Duraline covering which consists of a layer of impregnated paper on the wire with impregnated double braid on the outside. This type of covering is claimed to provide not only protection against weather but also a high degree of electrical insulation over a long period of years.

At each signal location the 220-volt a.c. power feeds through a Type-BT Size 132 rectifier, with a d.c. output rated at 13.5 volts, 0.6 amp. This rectifier charges a set of four cells of Exide KXHS7, 75-a.h. storage battery which feeds the line circuit and the signal lamps, which are rated at 8 volts, 10 watts. These lamps are normally extinguished, being lighted on approach control. Where curve conditions are such that a signal cannot be seen farther than the length of a track circuit, the approach lighting is through a back contact of a track relay. Where the lighting controls must be longer than a track circuit, a Type-W relay, rated at 88 ohms, is used in the line circuit to the rear. Each track circuit is fed by a set of three cells of 500 a.h. Waterbury primary battery connected in parallel.

This automatic signaling was planned and installed by the Great Northern forces, the major items of signal equipment being furnished by the General Railway Signal Company.

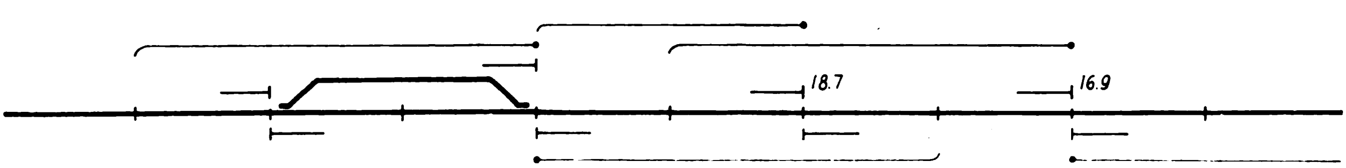


Fig. 4—Diagram showing the extent of the overlaps of the signal controls