

four red signals being lighted until the gate returns to within a few inches of the normal locking post, at which time the red signals on the Alton are extinguished and the yellow signals are illuminated. The control of these circuits is accomplished by means of a G. R. S. Model 7 switch circuit controller mounted on the lower part of the gate mast and actuated by a connection from the gate. The signal feed is taken from the low-voltage side of a 110—10-volt transformer which is connected to a commercial source of power. As supplementary protection, caution signs are located on the Alton 2,500 ft. from the crossing, and on the Pennsylvania a stop sign is located 200 ft. from the crossing in each direction.

In operation, the trains on the Alton are required to slow down to 15 m.p.h. when approaching the crossing.

Trains on the Pennsylvania are, of course, required to stop and, if no trains are seen approaching on the Alton, the brakeman unlocks the gate and moves it to the opposite position. After the train pulls by, he returns the gate to the normal position and locks it. The installation of the gate cost about \$460 for materials and labor. It is estimated that the operating expenses with the gate will not exceed \$200 annually, as compared with \$6,000 when the interlocking was in service.

At Higbee, Mo., where this same line of the Alton is crossed by a branch line of the Missouri-Kansas-Texas, a gate similar to the one just described was installed where no protection was formerly in service. In this case the benefits consisted of the elimination of train stops on the Alton.

# Ends of Double Track Equipped With Automatic Interlocking

Interlockings at both ends of a 20-mile section of double track are made automatic—Changeover pays for itself in six months

**L**AST JULY the Great Northern converted to automatic operation two interlocking plants—formerly manually controlled—one at each end of the 20-mile section of double track extending from Atwater, Minn., westward to Pennock, Minn., on the “lower” main line between St. Paul and Seattle. The cost of changing both of these interlockings was approximately \$1,540, and the net annual saving amounts to \$3,058.

In 1923, when this line was equipped with automatic color-light signals, mechanical interlockings were installed at these two ends of double-track. In each case the interlocking machine was of the Saxby & Farmer type and was handled by the telegraph operators, who were then on duty three tricks daily. Under these circumstances, manually-controlled interlocking was logical and gave somewhat more flexibility than could be obtained under automatic operation.

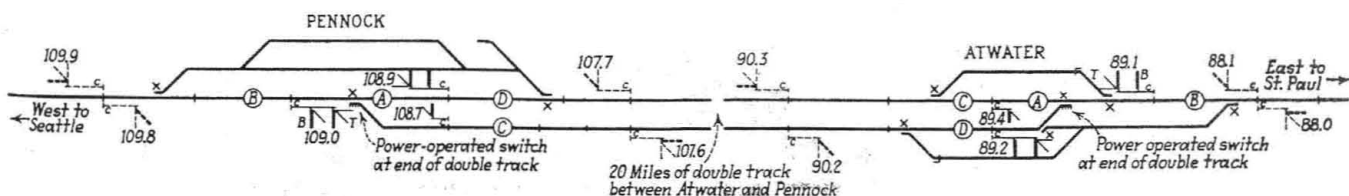
However, operating conditions became such that it was no longer practicable to maintain three-trick telegraph operation at the two end-of-double-track stations, and therefore it was decided to make the change herein described. This decision was especially warranted in view of the Great Northern’s extensive and successful

experience in the application of automatic interlocking to complicated crossings, gauntlets, junctions and ends of double track.\* The new, automatic, interlockings, as well as the manually-controlled plants which they supersede, were designed and installed by the forces of the railroad company.

Atwater is 13 miles east, and Pennock is 7 miles west, of Willmar, an important point on a division that is mostly single track except for the section between Atwater and Pennock. The traffic at the present time consists normally of four passenger trains and three freight trains each way daily.

## Existing Signals Unchanged

In converting the electric interlockings to automatic operation, the (color-light) signals were left in the positions they formerly occupied. The interlocking machine, at each station, was removed from the depot, and in its place were substituted two-push-buttons which the agent can use when, for example, it is desired to run a train from the single track to the double track against the current of traffic. Except for special movements of this kind, however, the operation of the new layout is entirely automatic. The electric switch machines were equipped with dual selectors, so that trainmen may make special



Both ends of the double track between Pennock and Atwater are protected by automatic interlocking with power-operated switches

\*See *Railway Signaling*, December, 1932, for description of the Great Northern’s pioneering experience in automatic interlocking, and for description of automatic end-of-double-track interlocking at Lohman, Mont.

train movements during the hours when the agent is not on duty to operate the push-button referred to above, but such moves are very infrequent. With these and a few other changes in equipment, and with the necessary accompanying changes in the circuits, the cut-over to automatic operation was easily and quickly effected.

The operation of the automatic plants is similar, in most respects, to that of other automatic end-of-double-track interlockings on the Great Northern which have been described from time to time in these columns. That is, the approach of a train on any one of the three approach track circuits causes the end-of-double-track switch to assume the desired position and the corresponding signal to clear, providing, of course, that all conditions are favorable to such a train movement. Adequate time, approach and detector lockings are provided.

In the event of a train moving from the single track to the double track against the current of traffic, the operation of the system is not automatic. If such a move is contemplated during the daytime, when the agent is on duty, the agent can reverse the end-of-double-track switch, by operating the "R" push-button, and thus clear the corresponding (lower-arm) signal for this move. If the lineup is thus established and is not used, the agent operates push-button "N" to restore the plant to automatic operation. If such a train movement is made at night, when the depot is closed, the train must come to a stop and a trainman must throw the dual-controlled switch to the reverse position, before the train can proceed through the plant on a hand signal. In this connection, it is important to note that the Great Northern's system precludes the possibility of a train receiving a proceed signal indication in any automatic interlocking when the dual-control selector lever on any one of the switch machines has been thrown to the manual-operation position. The reason for this is that the instant an interlocking switch becomes a hand-throw switch, then this particular layout ceases to be an interlocking plant and signals other than hand signals should not be used unless they are distinctive and especially installed for hand operation.

### Depot Indicators

In addition to these two switch-operating push-buttons in the agent's office at each station, there is a panel-type "control indicator" which indicates to the agent that the push-button operation has or has not been effective. When a train enters the detector track section in which

the power-operated switch is located, this control indicator displays "Stop." In addition to this indicator, two light-type indicators and one panel-type indicator are used to indicate the approach of a train on any of the three approach sections. In each case the approach-indication section on the single track extends to the head-block signal at the adjacent passing-siding, and that on the normal main of the double track extends  $2\frac{1}{2}$  to  $2\frac{3}{4}$  miles in advance of the corresponding home signal.

Directional preference is provided for a train running on the single track to the double track and "meeting" a train on the double track: If the train on the double track enters the home-signal clearing section before the train on the single track enters its approach section, the home signal for the train on the double track will, of course, clear. But, if the train on the single track enters the approach or clearing section for the signal governing its movement from the single track to the double track, before the other train has passed its home signal, the route will be taken away from the latter train and the route for the former train will be cleared to permit this train to pass from the single track to the normal main on the double track. After this train has entered the double track, the route for the single-track-bound train will again clear to permit this train to proceed.

### Equipment Details

With the differences noted herein, the interlockings were not changed. The signals are the General Railway Signal Company's Lebbly-mirror color-light type, using 8-volt 10-watt lamps. The G. R. S. Co. also supplied the Model 5 switch machines, as well as the dual-selectors which were applied at the time of the changeover. All of the control apparatus was supplied by the G. R. S. Co. Primary battery, supplied by the Waterbury Company, is used on the track circuits. The control circuits are fed by Exide KXHS7 storage battery on a-c. floating charge, using Union Switch & Signal Company rectifiers, and are carried in trunking and on an open line, Copperweld wire being used for this purpose.

An important feature of the power switch machine is that it is equipped with a magnetic brake, in accordance with a requirement, on the Great Northern, that all low-voltage switch machines be so equipped. This requirement is a result of experience on this road, which has shown that an unlocked switch machine might "drift" when the electric power is cut off, and that the switch might open under, and thus derail, a train.



Electro-pneumatic car retarders in a busy classification yard