Automatic Interlocking Protects End of Double Track

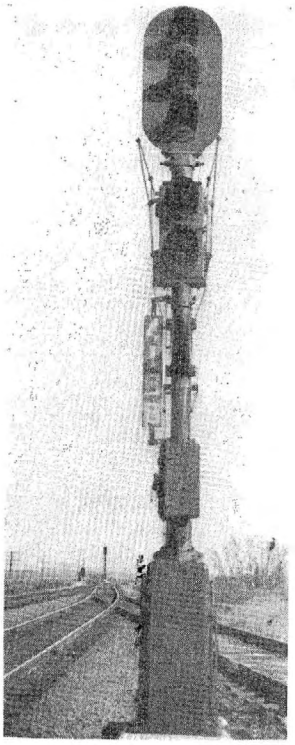
Switch and related signals at Lohman, Mont., are controlled and operated automatically for regular movements .... Great Northern's experience with automatic interlocking reviewed

AUTOMATIC interlocking has been more extensively developed and applied on the Great Northern than is commonly appreciated. Not only was this road an active pioneer in the application of automatic control to simple railroad crossings, but it has demonstrated the feasibility and economy of extending automatic control to complicated crossings, and to gauntlets, junctions and ends of double track.

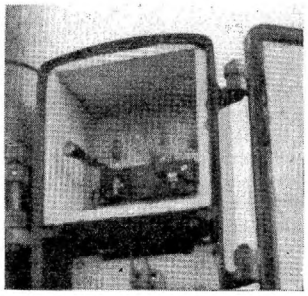
The Great Northern's first automatic plant was installed in 1914 at Hanover, Mont., to protect two single tracks forming a gauntlet over a bridge. Signals only, with directional control, were used. The next automatic plant, installed in 1922, protected a gauntlet track over a bridge, smashboards and torpedo machines being included. Both of these plants are still in service.

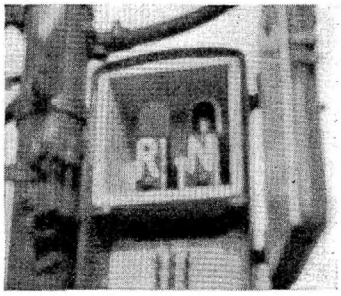
The purpose of this article is to describe some of the technical problems involved in, and the operating results of, the Great Northern's automatic interlocking at the end of double track at Lohman, Mont. But first, by way of introduction to this particular installation, it is well to review briefly the experience of this road with automatic plants other than simple grade crossings or gauntlets. This automatic end-of-double-track interlocking is not the first of its kind on the Great Northern. In 1924 this road installed, at Breckenridge, Minn., an automatic interlocking for the protection of an end of double track and yard lead combined, with optional push-button control. In 1926 the end of double track at Minot, N. D., was made automatic, as described in the January, 1927, issue of *Railway Signaling*.

In the latter part of 1927 the Great Northern replaced a mechanical interlocking plant with an automatic plant at Hutchinson Line Junction, Wayzata, Minn. (*Railway Signaling*, September, 1928) where a single-track branch line joins the double-track main line. Here it was possible to use automatic control for all regular train movements, with the exception of those from the double-track line to the branch line, the latter train movements being provided for by a push-button at the Wayzata station. This plant involved an expenditure of $11,000 in new equipment, and effects a yearly saving of $5,000. Thus it liquidated its capital investment in little more than two years.



Eastward home signal No. 416.8, governing normal movements to the single track. Below—Knife-switch and push-buttons used for irregular moves





In 1929, a junction of a single-track branch line with a single-track main line, at Barnesville, Minn., (*Railway Signaling*, November, 1929) was equipped with interlocking similar to the above, with manual control, by means of a pushbutton located at the Barnesville station, provided for train movements to the branch line.

In 1928, a low-voltage table-lever interlocking at Pacific Junction, Mont., where two single-track lines converge to double track, was converted to a part-automatic interlocking in which four of the five regularly-used routes are controlled automatically. (*Railway Signaling*, April, 1932). The remaining regularly-used route, as well as three infrequently-used routes, is controlled manually by the dispatcher at Havre, four miles distant, through the agency of a table-lever interlocking machine and two push-buttons. The cost of these changes was $3,700, bringing the investment in the plant, as it now stands, to approximately $14,000. The saving effected by reason of the release of the three operators formerly employed at Pacific Junction is $5,400 a year—a return of 146 per cent on the investment in the new facilities.

These random examples are cited here merely to show that the Great Northern had fully established the feasibility of such systems when it was called upon to solve the operating problem which presented itself at Lohman. The advantages and limitations of automatic control were known quantities.

The Lohman Plant

Lohman marks the eastern end of a 17-mile section of double track extending to Pacific Junction, 4 miles west of Havre, Mont. In 1924, when the double track

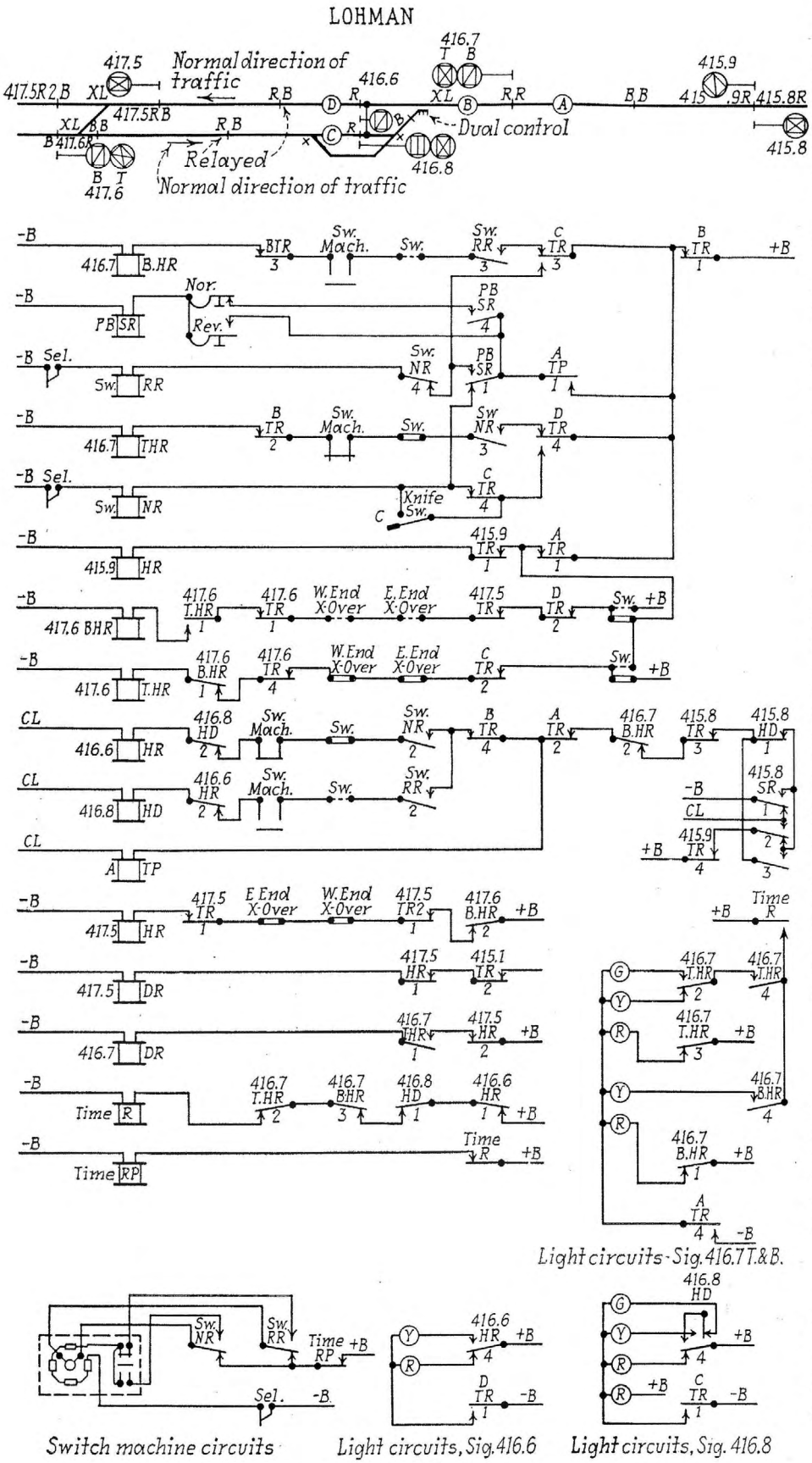
was extended to Lohman, a low-voltage interlocking was installed for the end-of-double-track switch and related signals, the table lever control machine being installed in the telegraph office in the nearby station. Manual control was provided at that time, primarily because 24-hour telegraph service was maintained at this point and the operators were available for handling the interlocking machine. However, in 1928 it became desirable to close this telegraph office, and, as a consequence, the end-of-double-track interlocking was made automatic, the work being completed in December of that year.

As the circuit plan shows, the only movement which is not automatically controlled is the infrequent westward movement from the single track to the eastward main on the double track, that is, the movement against the normal direction of traffic. This movement is controlled by push buttons located in an iron box attached to signal case No. 416.7 and locked with a standard switch lock. Two push-buttons are provided, one marked "Reverse" and the other "Normal." With track section *A* occupied, if the Reverse button is pushed, stick relay *PBSR* will be energized, closing the operating circuits for the switch machine, and causing the switch to reverse for a movement from *A* to *C*. This *PBSR* circuit is opened by the passage of a train over track section *B* or may be opened by pushing the Normal push-button if the train movement is not made after the Reverse button has been operated.

In addition to these push-buttons, a knife switch is provided in an iron box on signal No. 416.8 for use under circumstances which make section *C* a passing track and which require an eastward following train to cross over to the westward track at signal No. 417.6 and approach the interlocking on section *D*, to be governed by signal No. 416.6. Trains on section *C* automatically take preference over trains on section *D*, but the closing of the knife switch by trainmen of a train on section *C* will permit the train on section *D* to line up the interlocking for a movement from *D* to *A*.

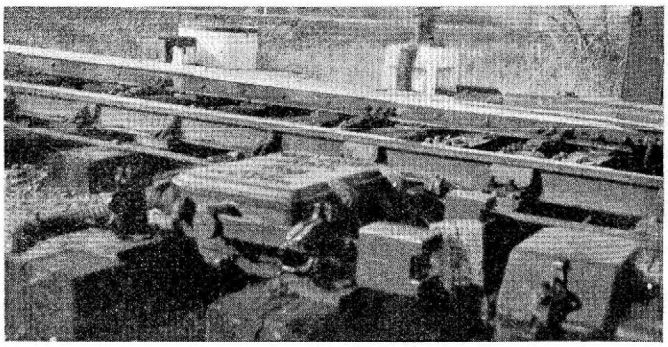
Magnetic Brake

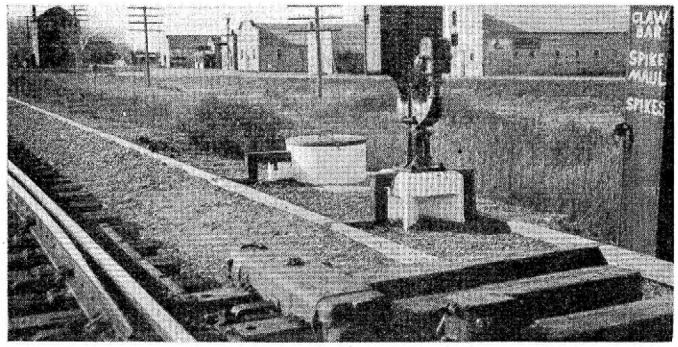
The power switch-machine at the end of the double track is equipped with a magnetic brake which is an important feature of this installation. It was in connection with the automatic plant of this type installed at Breck-



Complete schematic circuit plan showing how the regular routes are automatically controlled, and how the irregular movements are manually controlled through the use of the two push-buttons and knife-switch shown on the preceding page

enridge, Minn., in 1924, that the necessity arose for providing, at a point where no attendant was on duty, some means of holding an unlocked switch securely in the position it occupied when the current was cut off the operating motor. It was found that an unlocked switch machine might "drift" when power was cut off, thus opening the switch under, and causing the derailment of a train which was proceeding over the plant on a hand signal. The application of a magnetic brake was suggested to the manufacturers and insisted upon by the Great Northern, and is now in use on all low-voltage switch machines installed on that road.





Two views of the power switch layout. Dual-control selector above

Comparatively little work was necessary in changing the Lohman plant over to automatic operation. The table-lever machine was removed, the two push-buttons and knife-switch were installed, and the circuits were, of course, considerably revised. In all other respects, however, the plant is unchanged. The signals are the General Railway Signal Company's Lebby-mirror color-light type. This company also supplied the Model-5 switch machine, dual-control selector and all control apparatus. Primary battery, supplied by the Waterbury Battery Company, is used on the track circuits. The control circuits are fed by Exide storage battery on a-c. floating charge, and are carried in trunking and on an open line, Copperweld wire being used. The investment required in the change to automatic operation was $1,280 and the annual saving is $2,888. The plant was designed and installed by the forces of the railroad company.

Speed Signaling in England

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miniature color disk, fill the lens and emerge in a colored beam. Under this arrangement approximately 80 per cent of the light emitted from the lamp is collected and produces a beam of exceptionally uniform intensity.

It is found that this development, in combination with the optical construction employed, has made this type of color-light signal economical for use with primary batteries, since a 3-watt 4-volt lamp produces an indication of 11,000-beam-candle-power. Further, by using a lamp which consumes only 12 watts of energy, an indication of 37,500-beam candle power may be produced, and thus a very brilliant and powerful unit in color-light signaling becomes economically possible.

Signal and Point Repeaters

All switches and color-light signals fitted with electrical detectors are repeated in the cabin from which they are controlled. The indications are given by small 12-14-volt 3-watt lamps fixed behind colored lenses. These repeaters are fitted behind the levers to which they apply. The point indicator is a red light which appears only when the switch points are out of the normal or reverse positions, are not properly bolted, or are in opposition to the lever, due to a broken switch rod.

Marker lights, and those lamps which are normally out and only display one aspect, such as the second yellow light in a four-aspect signal, are not repeated, but are fitted with double-filament lamps. The yellow and green aspects of low-speed signals are indicated in the cabin.

There are 74 track circuits, varying in length from 30 to 900 yards. These are all of the alternating current (phase-controlled constant-current) type, and the feed apparatus and the relays are in the majority of cases housed in buildings adjacent to, or forming part of, the signal boxes.

There are two pairs of power-operated points controlled from Mirfield No. 1 signal cabin. The machines are of the British Power Railway Signal Company's 110-volt alternating-current type. Provision is made for operating these machines by hand in the event of a failure. The locking is so arranged that when any signal leading over these points is cleared, the crank handle cannot be obtained, and also the removal of this handle locks all such signal levers in the normal position.

No detector bars are provided at facing points, protection being given by track circuits extending wherever possible about 50 ft. in the rear of the points. The switch levers are locked in the normal and reverse positions by these track circuits.

Power Supply

Power for operating this installation is obtained from two separate substations, at a pressure of 400 volts a-c. A hand-operated switch is fixed in Mirfield No. 2 cabin for changing over from one supply to the other, if necessary. From the signal box, current is carried by twin-armored cable, at 400 volts, to each cabin between Heaton Lodge Junction and Thornhill and N. W. Junction.

The current is transformed to 110 volts at each cabin, the transformers and switchgear for each box being supplied by the British Power Railway Signal Company. From each cabin, current at a pressure of 110 volts is carried over rubber-insulated twin cables to cast-iron distribution boxes. This current is used for switch-indication relays and for feeding the local coils of the search-light signals.

Each signal box is equipped with an indicator, which shows a green light when the plant insulation is normal, but if there is any leakage through faulty insulation the green disappears and is replaced by an upper or a lower red light, corresponding respectively to a positive or negative ground.