Automatic Interlocker for a Crossing

Satisfactory for Thin Traffic; Home and Distant Signals Arranged on the "Normal Danger" Plan

ONE cold day in December, 1921, at the crossing of the New York Central and the Lackawanna railroads, near Utica, N. Y.—Signal Station "W U"—the instruments on the signalman's desk in the interlocking cabin burst into flames, from a 4,000 volt current which entered the building on a telegraph wire that had become crossed with a power wire in the city of Utica, about half a mile away. So quickly did the fire spread that the signalman was unable to get his shoes from under the desk, and was forced to rush in his stocking feet through the snow to a telephone to notify the fire department.

As the rebuilding of the interlocking and the construction of a fireproof brick building would be costly, and as all of the nearby switches might satisfactorily be operated by hand, it was decided to do away with the interlocking and to put in automatic railroad grade crossing signals; and thereby save the $3,500 annual wages paid to signalmen to operate the machine.

Hall "Searchlight" Signal

The details of the arrangement to be used for the protection of the crossing by automatic signals were decided upon in conference between Chief Engineer C. R. Vanneman of the Public Service Commission of the State of New York, and the signal engineers of the Lackawanna and the New York Central roads. On the plan being agreed upon and application made to the Commission by the two roads, formal approval for the installation of the crossing signals was given and the reconstructed signal arrangement was completed and placed in service on January 30, 1923, since which time it has worked with very satisfactory results. Slight constructive defects developed with the alternating-current, motor-operated semaphore signal mechanisms which were used, and some trouble was experienced with the bonding of the rails for propulsion current. With these exceptions the arrangement has worked with reliability and with greater efficiency than a manually operated interlocking.

It has been shown that at railroad grade crossings where there are no switches, or where switches may satisfactorily be operated by hand, as in manual block signal territory, the arrangement gives all the protection necessary at a crossing to permit trains of either road to proceed across the other without stopping.

Plant to Be Installed at Helena, N. Y.

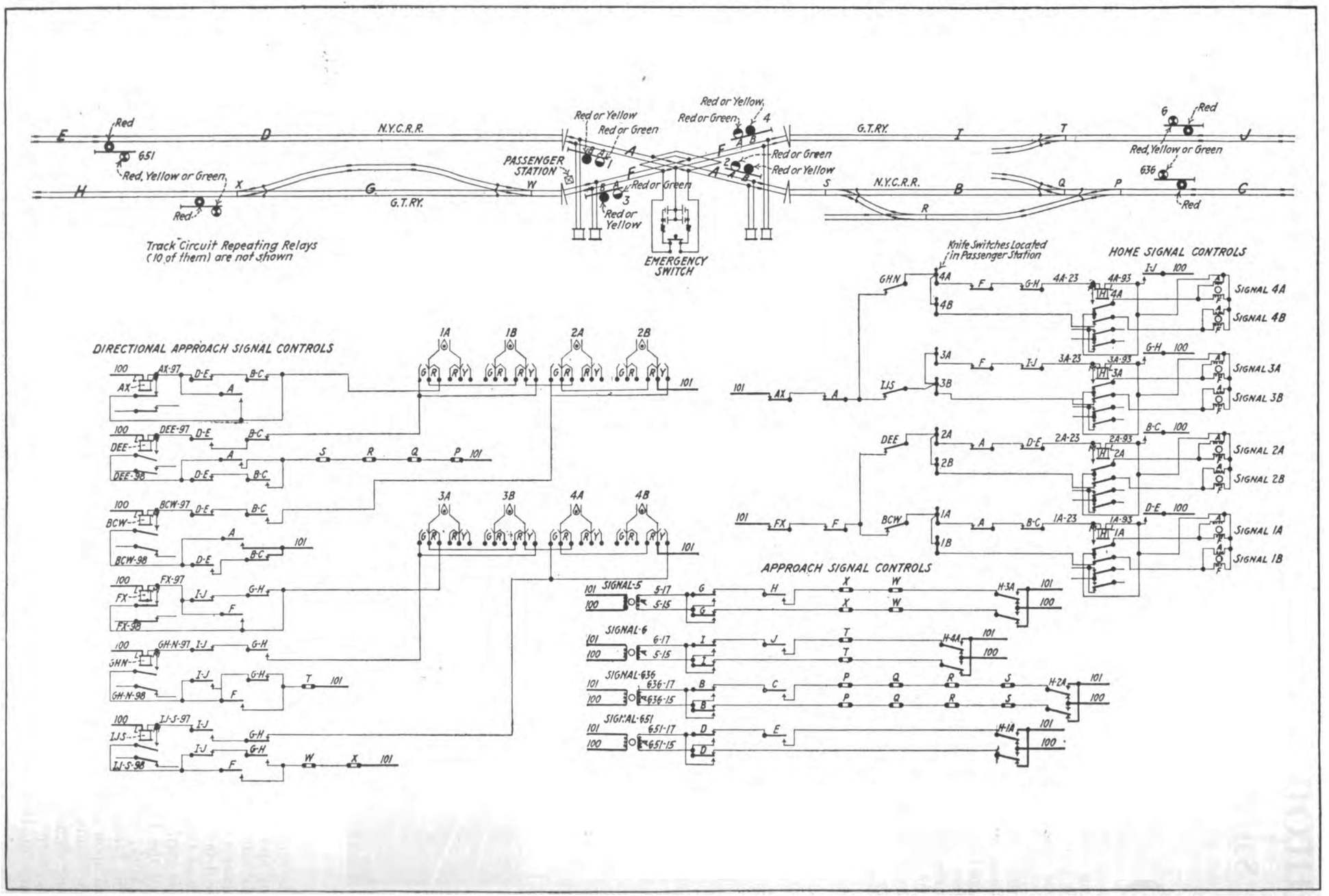
In consequence of this satisfactory experience, the New York Central, with the approval of the Canadian National Railways and with the approval of the New York State Public Service Commission, has arranged for the installation of automatic railroad grade crossing signals at Helena, St. Lawrence County, N. Y., where the New York Central's line to Ottawa, Ont., crosses the Canadian National (the Massena branch of the Grand Trunk). This plant is here described.

The Pennsylvania has agreed with the New York Central for the substitution, as soon as plans have been prepared, of similar crossing signals for the mechanical interlocking now in use at the crossing of the two roads at Madera, Pa. Madera is in the wilds of the coal regions, 20 miles north of Altoona.

In view of the greater reliability of colored light signals as compared with motor-operated semaphores, and the elimination of moving parts which may cause false clear indications, the New York Central has decided that for future installations of automatic railroad grade crossing signals colored light signals shall be used. This type of signal is, therefore, to be put in at Helena. It is the Hall single-light signal, with movable roundels, described in *The Railway Signal Engineer*, March, 1921, page 119. The appearance of a single signal is illustrated herewith. (At Helena, double signals are used, as indicated in the drawing.)

As light signals lack the convenient circuit controllers of the semaphore apparatus, the circuits for Helena are materially different from those at the crossing in Utica, where semaphores are used. The control is as flexible and as reliable as that obtained with the semaphore and there will be more efficient working. With light signals, the only moving parts will be those of the relays and the electro magnets of the signal mechanisms; and with current supplied from 1,000-ampere-hour primary batteries, the arrangement should be safe, reliable, efficient and economical; and easy to maintain.

A typical plan of the arrangement of signals to be installed at Helena is shown in our full-page drawing, for which we are indebted to W. H. Elliott, signal engineer of the New York Central. As a complete circuit plan is somewhat difficult to follow, this is a partial plan, designed to show the typical and principal controls to be provided. It is to be noted that signals of two lights (home signals) are provided to govern movements over the crossing (signals 1, 2, 3, 4) and each home signal has



Typical Circuits for Automatic Signals for a Grade Crossing at Helena, N. Y.

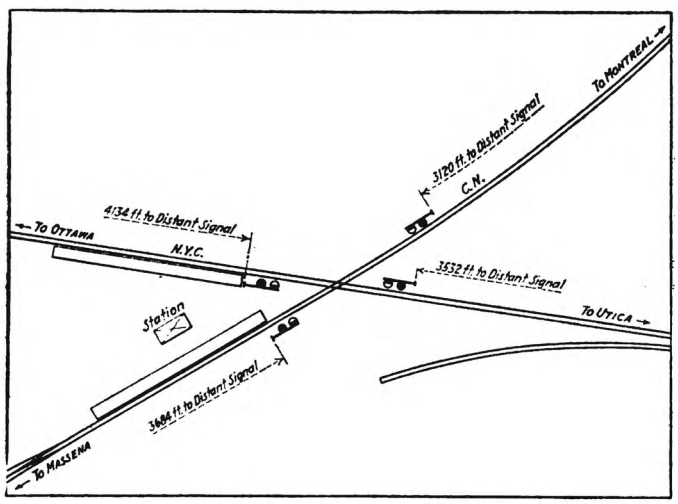
an approach signal. The approach signals (651, 636, 5, 6) are three indication. The home signal has but two indications, displaying green or red above and yellow or red below. Marker lights (red) for the approach signals, although shown on the plan, will not be used on the Canadian National signals.

As noted, this is not a complete plan; and the tracks are not drawn to scale. The actual location of the tracks of each road, as related to those of the other road, is indicated in the small sketch.

Circuit Conditions

The circuits are arranged to permit the first train coming on to an approach lighting or preliminary clearing circuit, to proceed over the crossing under clear signals; and by its presence to arrange the circuits for the other road so that the signals on that road will indicate (provided a train approaching on that road has entered the approach lighting circuit, making it possible to energize the signal lamps): at the distant signal, *caution*—approach next signal prepared to stop—and at the home signal, *stop*.

When no train is *approaching* the crossing, all lights are de-energized—dead. Even with a locomotive or a car



Crossing at Helena, N. Y.

standing on the crossing, and by its presence there making the electrical contacts at the signals of the other road necessary to protect itself from trains on that road, the signals of the other road do not light up until an approaching train needs them.

Should two trains on the same road approach the crossing running from opposite directions, the first train to run on an approach lighting circuit will cause clear signals to be displayed for itself—green by the upper light on the approach signal and green by the upper light on the home signal. Then, when the train moving in the opposite direction runs on the approach lighting circuit on its side of the crossing, it will cause signals to be displayed for itself as follows: in the approach signal a yellow over a red light, and in the home signal a red over a yellow light; and the signals for the other train—the one which approached first—will also be made to display these same indications. Thus, each train, as soon as two are approaching together, from opposite directions, sets a caution (slow-speed) signal against the other one. These indications having been displayed, switching movements may be made in either direction, on that one line, over the crossing, without flagging.

If any of the track circuits of one road are occupied by a train, the signals of the transverse road will be made to display proper indications to cause a train on that road to stop at the crossing; and the train cannot get a signal to proceed until the train on the road first occupied has gone over the crossing and its rear end has cleared the crossing track circuit. On the rear end so clearing, the home signal of the other road will at once indicate "Proceed," to permit the other train to proceed over the crossing. As long as the crossing track circuit (which is only about 150 ft. long), or the track circuit for an approach to the crossing, is occupied by a train, the route is held for that train. The train gives up the route only when its rear end has passed over the crossing and is clear of the crossing track circuit.

The circuits have been arranged to provide direct control by relay for each signal indication, except where it is necessary that control be had through the contacts of the signal relay mechanism. The mechanism contacts are operated by a cam on the armature shaft, according to the direction in which the armature is turned, to cause a yellow or a green light to be displayed. These contacts on the signal mechanism are the means by which signals of the transverse road are held at stop, when either of the home signals of the road first occupied indicates proceed.

The Principal Circuit Combinations

Track circuits are of the end fed type, except "A" and "F," which are center fed, having a relay at each end. The track battery is controlled through a knife switch located conveniently at the crossing. In accordance with a card of instructions this knife switch can be used, in case of signal failure, by the conductor of any train which cannot get a proceed signal, to set signals on the other road at stop, so as to permit his own train to proceed over the crossing.

Relay AX is of the stick type, the pick-up of which is controlled through the front contact of track relays "D," "E," "B" and "C" and through contacts on signals 1A, 1B, 2A and 2B, made only when the signal displays a red indication. The control through track circuits "D," "E," "B" and "C" is shunted out through a back contact on track circuit "A." The purpose of this relay is to hold the crossing signals on the Canadian National in the stop position, when a train is approaching the crossing in either direction on the New York Central, and the N. Y. C. signal displays an indication to proceed over crossing.

DEE relay is of the stick type, normally de-energized. The pick-up is controlled through the back contact of the D-E relay, through front contact of B-C relay, through circuit controller on signals 1A and 1B in multiple, made only when signals display green or yellow. The circuit holding the relay energized is controlled through front contact of D-E relay, back contact of B-C relay and through switch circuit controllers on switches "S," "R," "Q" and "P." The control through relays D-E and B-C is shunted out through a back contact on the track relay for Section A. The control provided by these relays is designed to release the route for a train to pass on the transverse road when the rear of a train on the road first occupied passes over and off of the short crossing track circuit, it being necessary, in order to accomplish this, to keep the signal on the first road from clearing for a movement in the opposite direction.

Signals No. 5 and No. 6, and signals 636 and 651 are the approach signals for trains coming from, respectively, Masena, Montreal, Utica and Ottawa. Energy is applied to the field side of the mechanism at all times. For the control on the armature side, energy is taken through pole-changing contacts on the H relays for the home signals of the tracks governed. The control is then through all switch circuit controllers and track relays between the approach and the home signals and through the approach lighting relays. When a home relay is de-

energized, current flows in the direction causing the approach signal to display yellow. When a home relay is energized, current flows in the opposite direction causing the approach signal to display green.

Signals 1A, 2A, 3A and 4A are home signals. The operating coils of these signals are controlled through H relay, and through all track circuits and switches in advance of the signal, including the approach clearing circuits in the opposite direction; through track circuits between the home signals on the transverse road, through a knife switch in the passenger station at the crossing and through back contacts of stick relays, "BCW," "DEE," "IJS" or "GHN" respectively. Signals 1B, 2B, 3B and 4B are controlled through back contact of H relays, through knife switches at passenger station, through back contact of "BCW," "DEE," "IJS" and "GHN" respectively; through the track circuit of the transverse road between home signals, and through AX or FX relays. The armature and field coils for each home signal are in multiple. When H relay is de-energized, a shunt is provided on "A" signal through back contact. A shunt is provided for "B" signal through front contact of H relay. The H relays are normally de-energized, being energized through back contact of track-circuit repeating relays, when a train enters an approach clearing section.

Space-Interval Operation

The home signals, in addition to the automatic controls, are controlled by knife switches, operated by the station agent for manual block operation. A knife switch is provided for each home signal, so that when the block extending to the next station is unoccupied a train may be allowed to pass into the block on a green indication of the top signal. When the block is occupied a train may be permitted to enter the block on a yellow indication of the lower signal. Thus by the use of the knife switches the station agent has a complete block signaling outfit. A train for Ottawa, for example, having departed from the station, signal A2, by means of the knife switch, is held at stop (red) until the train reaches the next station.

Track relays are to be of the Hall gauze contact type with batteries of 1,000 ampere hour caustic soda type. Signals are to be of the three-position Hall color-light type, having armature resistance of 250 ohms and 500-ohm field coils.

If a signal governing a movement over the crossing does not clear when it should, it is necessary for a trainman to go to the crossing and, after ascertaining that no trains are approaching, unlock a box and open the two-way single-throw knife switch which cuts the current off from the two track circuits that cover the crossing, thus setting at stop the controlling signals on both roads; after which the train may be moved over the crossing under protection of a flag. The bulletin prescribing the practice to be followed in such a case, is worded as follows:

A signal indicating stop may be passed only on hand signal from trainman standing on crossing. Trainman must, before giving hand signal, observe that no train is approaching on any track, and then only after he has unlocked box at crossing and opened crossing switch. After train passes, crossing switch must be closed and box locked.

The same process may be followed in case a train on the other road, having the right to the crossing, is standing at the home signal, and is willing to relinquish its right.

As it is desirable that the track circuits of the crossing be as reliable in their working as it is practicable to make them, the home signals are placed as close to the fouling point at the crossing as the local conditions as to rail joints, switches, platforms, etc., will permit, 50 ft. being prescribed as the minimum distance. With the signals so located and derails not being used, the crossing track circuits are of a minimum length; and with relays at each end of each circuit there is small chance that the relays will fail to operate to cause the home signals to indicate stop whenever the crossing is occupied.

As the approach signals are located braking distance from the home signals for the maximum speeds authorized on these divisions, trains receiving proper signal indications will not be required to reduce speed below that prescribed for a crossing protected by interlocking signals. From an operating standpoint the arrangement is as efficient for through movements as any other system of signals; and where switching movements are to be made, within the track circuit limits, it provides block signal protection with a promptness in the display of signal indications that may be had only from apparatus that is automatic in operation.

For the benefit of the reader who is not familiar with automatic signals it may be explained that when a train or any part of it is moving or standing on a section of track, in the rails of which the electric current of the signal system is flowing, the signals which notify all other trains to keep off that section of track are automatically set at "stop." The presence of the wheels of the cars de-energizes one or more electro-magnets; and the electro-magnets act to move all signals—one or many—on all conflicting tracks or routes to indicate "stop" to approaching trains.

The light signals are electric lights, properly hooded, so that they are seen by the engineman in daylight as well as at night; and in this case the circuits controlling them are extended to a point about a mile back of the approach signal and there controlled by a track relay so that the lamps are *never lighted* except when a train comes on to the rails of the lighting section. Thus each approaching train lights its own signals a proper distance ahead; though, of course, these signals are potentially energized by the absence of any train of the transverse railroad on or approaching the crossing.

In the drawings the track circuit limits are indicated by thick spots in the lines which show the rails.

The color-light indications are: red for stop, yellow for caution and green for proceed.

The Hall light signals differ from other light signals in that there is only one lamp for all three colors, an armature of very light weight serving to change the colors by moving small, thin roundels to position in front of the lamp. The roundels are 1 in. in diameter and 1/16 in. thick.

The North Carolina Stop Law

In the State of North Caroline at highway crossings of the Southern Railway, the number of persons killed by trains in the last six months of 1923 was four, and of injured, 11; as compared with 6 killed and 24 injured in the first half of the year. and larger numbers in half years before that. These figures are reported by the railway company in connection with a note on the law of North Carolina requiring drivers of automobiles to stop before crossing railroad tracks; and the law is given credit for the diminution in the number of disasters at crossings. The number of motor vehicles registered in North Carolina last year was 247,612 as compared with 182,060 in 1922.

The law requiring automobiles to be stopped before passing over a railroad crossing "has reduced crossing accidents at least 75 per cent." This is quoted from a statement made by Robert Scott, director of safety of the Atlantic Coast Line and refers presumably to conditions in the state of North Carolina. Mr. Scott, speaking in Georgia, recommended the passage of a stop law in that state.