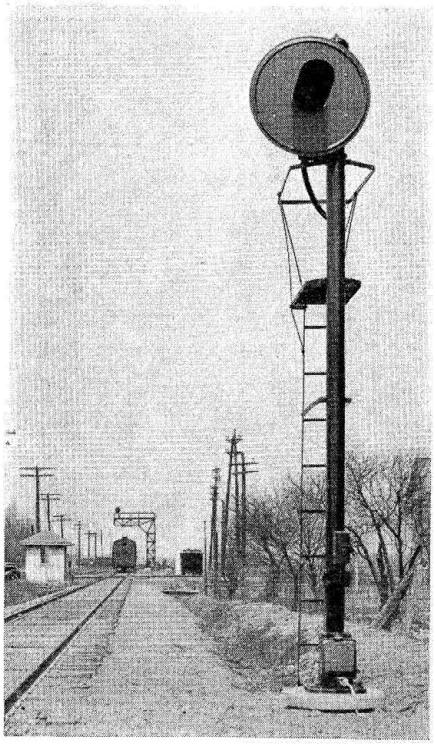
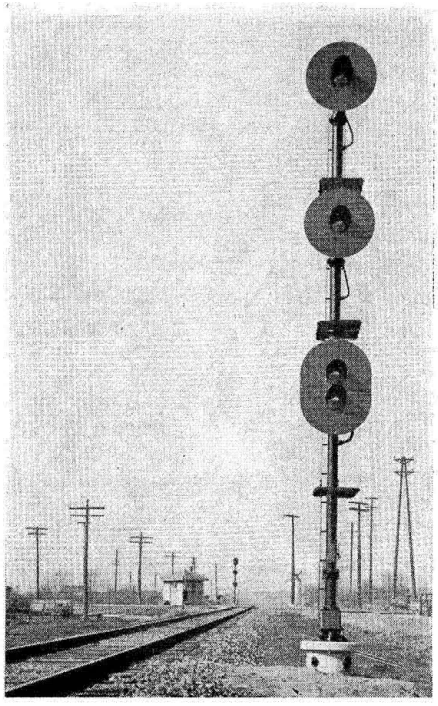
D. T. & I. Installs

Installation at crossing of the D. T. & I. and the Nickel Plate includes automatic releases of routes, special key controller releases at signals, and plug-type relays in welded sheet-steel cabin





Above—Home signal on D. T. & I. Below—Home signal on N. Y. C. & St. L.

At Morris, Ohio, 1.7 miles north of Lima, Ohio, the Detroit, Toledo & Ironton has installed an automatic interlocking plant at a crossing with the New York, Chicago & St. Louis, the main lines of both roads being single track at this crossing. Train movements in this territory on both roads are governed by timetable and train orders. Prior to the installation of this plant, trains of both roads were required to stop before passing over the crossing. A watchman at the crossing operated a tilting crossbar signal and a gate, which was normally set to obstruct the D. T. & I. The main purpose in providing the new plant was to eliminate unnecessary stopping of trains. On account of ascending grades northward on both roads, delays were involved during the starting and accelerating of northbound trains after stopping at the crossing.

As the traffic increased to a total of 26 through trains and approximately 17 shifting moves over the crossing daily, the need for elimination of train stops, as well as for greater flexibility of operation, led to the decision to install an interlocking. The D. T. & I. operates no passenger service, but handles 12 freight trains daily, while the Nickel Plate operates 4 passenger trains and 16 freights daily. About 17 switching moves are made over the plant each day. An average of 43 moves are made daily, in addition to extra trains as required. Trains are bunched, the busiest period being between 6 a.m. and 11 p.m.

Signals and Aspects

The home and distant signals on the D. T. & I. are the H-2 searchlight type, equipped with 8-volt, d-c., 250-ohm operating coils and 11-volt, 11-watt single-filament lamps. Each operative searchlight unit is fitted with 8-3/8 in. compound and hot-spot close-up indication lenses. Both the home and distant signals on the D. T. & I. are side-of-mast mounted on 5-in. masts. This is the case throughout this installation on the D. T. & I. signals, except in the case of the southward home signal No. 1, which is located on a cantilever bridge, due to the impossibility to erect a regular mast, because of the presence of an adjacent siding on the west side of the main line. The D. T. & I. home signals, No. 1 and No. 2, consist of one operative unit, minus any marker light or number plate. The northward home signal No. 2 displays red for Stop and green for Clear, whereas the southward home signal No. 1 displays either red, yellow or green for Stop, Approach and Clear, respectively. This signal acts not only as a home signal for this automatic plant, but also as a distant signal for an adjacent Pennsylvania crossing interlocking, Sugar Street (DC), 1 mile south of this automatic plant, for which reason the additional yellow aspect is provided. When signal No. 1 is cleared, a green aspect will be displayed, providing the southward home signal at Sugar Street has been cleared. Otherwise, a yellow aspect will be displayed. The distant signals on the D. T. & I. are equipped with an HC-41 yellow marker light and background, mounted vertically below the operative searchlight unit. These signals display a green-over-yellow for Clear or a yellow-over-yellow for Caution, if the home signal is Clear and the block between the distant signal and home signal is occupied, respectively. No Stop-and-Proceed aspect is displayed by the distant signals, the Caution aspect being used in lieu thereof, thus obviating the unnecessary stopping of trains when displaying their most restrictive aspect, which calls for a train to approach the home signal prepared to stop, but at the same time, prepared to stop short of any train, broken rail, open switch or other obstruction.

The home and distant signals on the Nickel Plate are the Style-R, vertical color-light type, equipped with standard optical type, doublet combination lenses provided with hot-spots, single-filament, 11-volt, 11-watt lamps are used. The Nickel Plate home signals are three-"arm" signals, conforming with the standard practice on that road for interlocking home signals. The eastward home signal No. 4 displays either green-over-red-red, or red-over-red-red for Clear and Stop, respectively, the two lower "arms" being Style-R fixed single units. The westward home signal No. 3 displays either red-red-over-yellow

Automatic Interlocking

or red-red-over-red for Restricting or Stop, respectively, the two top "arms" being fixed single units. This signal also acts as a distant signal to the Baltimore & Ohio junction interlocking, west of the crossing, but displays no aspect more permissive than Restricting in any case when cleared. The B. & O. home signal is located on a curve and on a descending grade, and is not capable of displaying any aspect more favorable or permissive than Clear-Medium with a speed restriction of 30 m.p.h. In view of these facts, the Restricting aspect was provided for the government of trains on the Nickel Plate up to the B. & O. home signal. If the westward Nickel Plate home signal was capable of displaying an Approach aspect, it might be assumed that the B. & O. home signal was either at Stop, Restricting, Medium-Approach or Clear-Medium. At the same time, if the westward Nickel Plate home signal was capable of displaying an Approach aspect, a Clear distant signal would be displayed instead of the present Approach, thus authorizing a greater speed up to the Nickel Plate home signal. If this was the case, a tonnage freight train on the downward grade might be unable to stop between the automatic plant home-distant signal and the B. & O. home signal, should the latter be at Stop, because of the obstructed view of this latter signal due to the curve. Under the present setup, a Nickel Plate train gets an Approach aspect on the automatic plant distant signal and is prepared to stop at the westward Nickel Plate home signal, which when cleared, displays the Restricting aspect. Another reduction in train speed is then made so as to be prepared fully to stop at the B. & O. signal, regardless of the aspect being displayed by that signal. As mentioned before, this setup requires the engineman of a westbound Nickel Plate train to have his train under full control on the down-grade curve while approaching the B. & O. home signal.

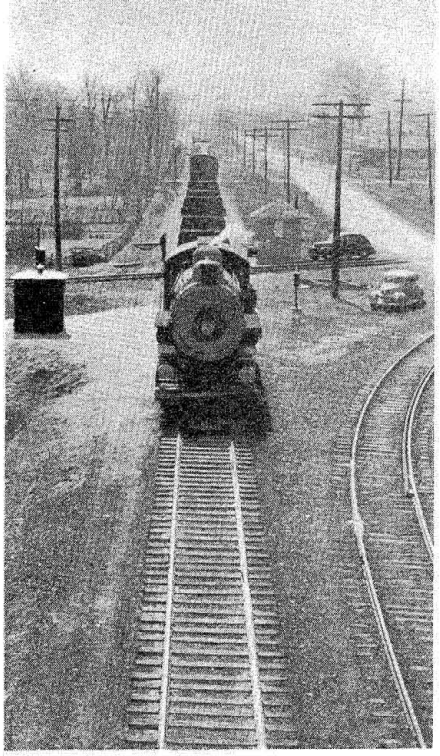
The Nickel plate distant signals are equipped with black enameled and white lettered number plates, identifying them as such. The westward distant signal No. 859 displays yellow for Approach with the westward home signal No. 3 either red-red-over-yellow or red for Restricting and Stop respectively, and red for Stop-and-Proceed when the respective block is occupied. The eastward distant signal No. 884 displays green for Clear when the eastward home signal No. 4 is green-over-red-red for Clear; yellow when the home signal is red-over-red-red for Stop; and red for Stop-and-Proceed when the respective block is occupied.

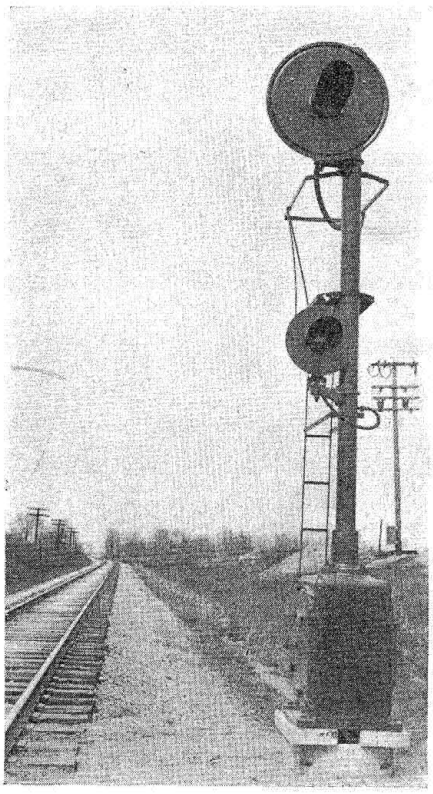
The distant signals on the D. T. & I. and Nickel Plate are approach and normally lighted respectively, and all of the home signals on both roads are normally lighted, except in the case of a power outage, when they are cut over to approach-lighted. Cylindrical precast concrete foundations, manufactured by the Railroad Concrete Products Company, are used for mounting the signal masts. All the home signal masts at the crossing, as well as the Nickel Plate distant signals, are mounted directly on foundations, except those of the D. T. & I. distant signals, which are equipped with a base-of-mast instrument case for relays and other signal apparatus.

Operating Features

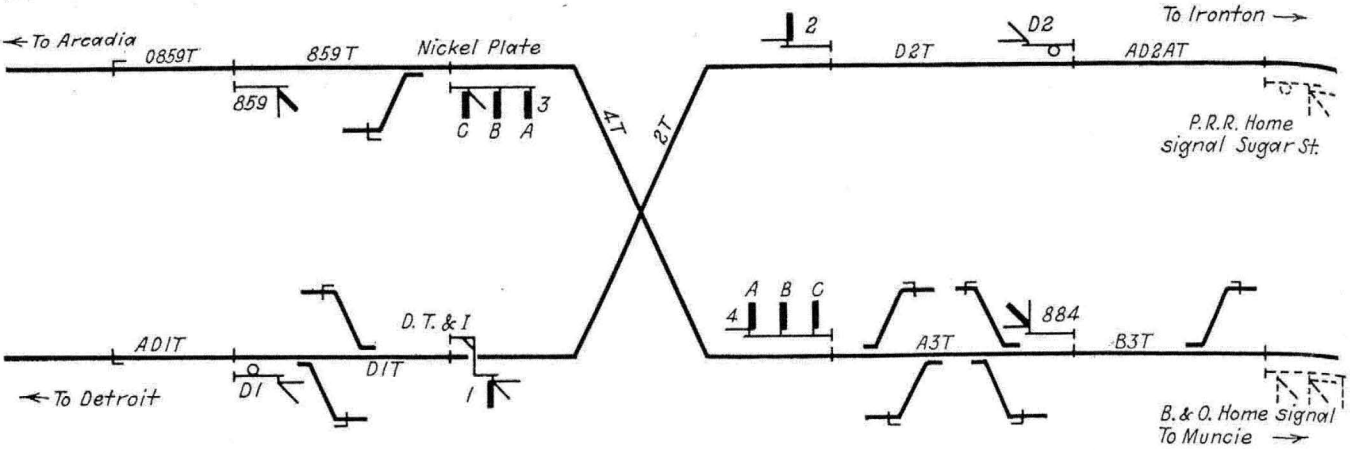
The controls at the interlocking are so designed that a train making a through movement will normally encounter no interference from a subsequent train on either line. However, if a train approaches the home signal, but does not promptly accept the proceed indication and enter home signal limits, within a six-minute interval, it will lose its privilege to use the crossing, providing a train on the other road approaches in the meantime. In making this surrender, the home signals on both roads display the Stop aspect for a minimum of one minute before any other signal can display a proceed aspect. In case a reverse move is contemplated, it can be made on a signal indication, provided the use of the crossing is not required by a later train on the other road.

The interlocking of one road against the other is accomplished by a slow-release, slow-pickup route locking relay RLR, acting in conjunction with a polar route relay RR, the polar contacts of which must select the respective routes. This is a mechanical check on route selection, as the polar contacts must be in either one or the other positions. Referring to the accompanying circuits, let it be assumed that a train approaches signal 3 on the Nickel Plate. This releases the track relay 859TR, thus opening the approach stick relay circuit 3ASR. The polarized route relay RR must position its polar armature to the left before signal 3 can clear, and the slow-release, slow-pickup route locking re-





Above—Train on the D. T. & I. Below—Approach signal on the D. T. & I.



Track and signal plan of interlocking at Morris, Ohio

lay RLR must release. When the approach stick relay 3ASR releases, positive battery for the polarized route relay circuit RR passes over front contacts of the 1ASR and 2ASR relays, back contacts of the 1SR, 2SR, 1ZR and 2ZR relays, and front contacts of the 1RGPR and 2RGPR, RR relay to the left. In turn, the circuit for the slow-release, slow-pickup route locking relay RLR is opened, which would open instantly except for the fact that the RLR relay has a slow-release feature, made necessary by the fact that a contact is in the polarized route relay circuit RLR relay, over front contacts of the 2TR and 4TR relays, over the left polar contact of the RR relay, over front contacts of the 2RGPR and 1RGPR relays, back contacts of the 4SR, 3SR, 3ASR, 3TESR and 4ZR relays, a front contact of the 4RGPR relay, through the coils of the C3HR

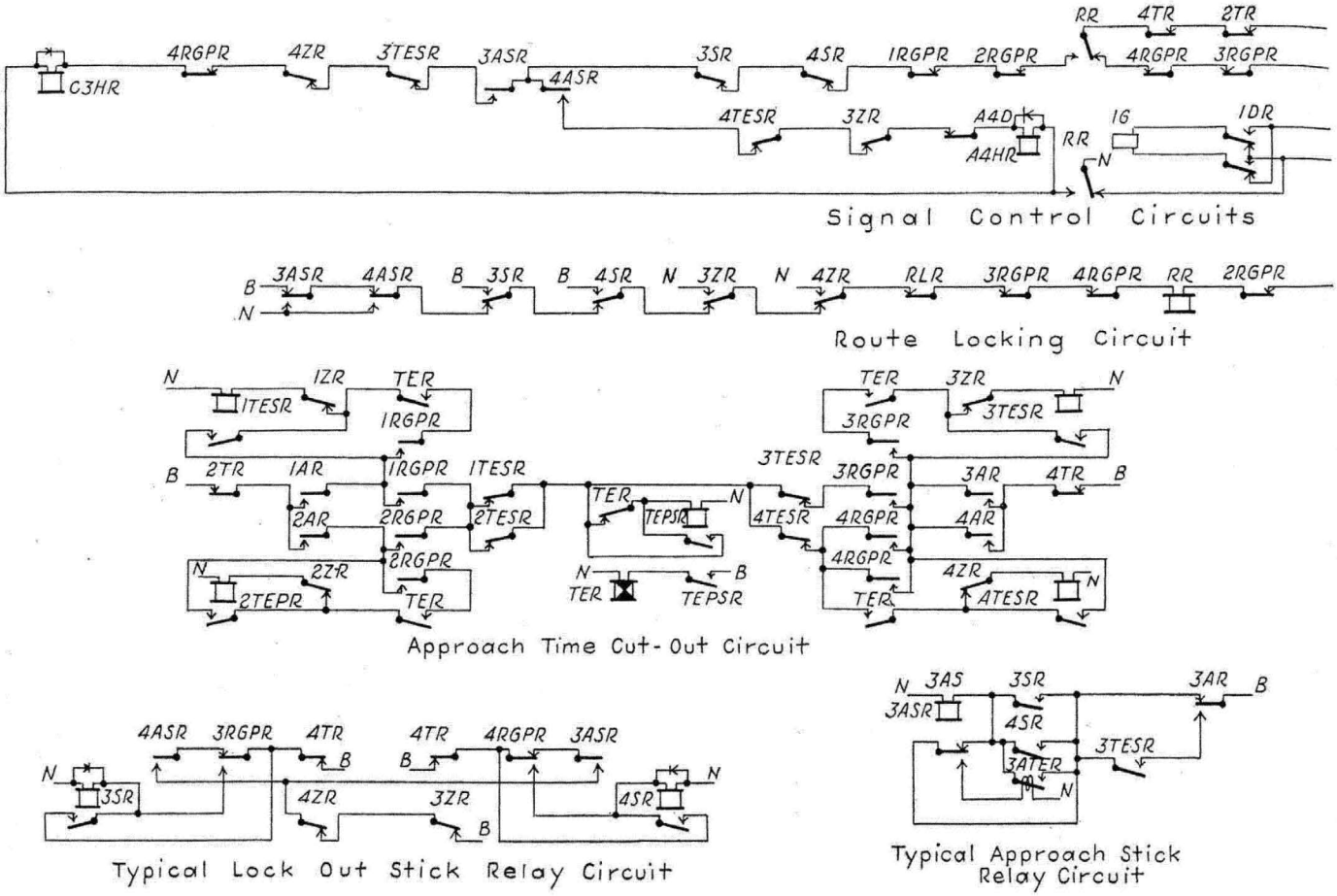


Diagram of typical special circuit

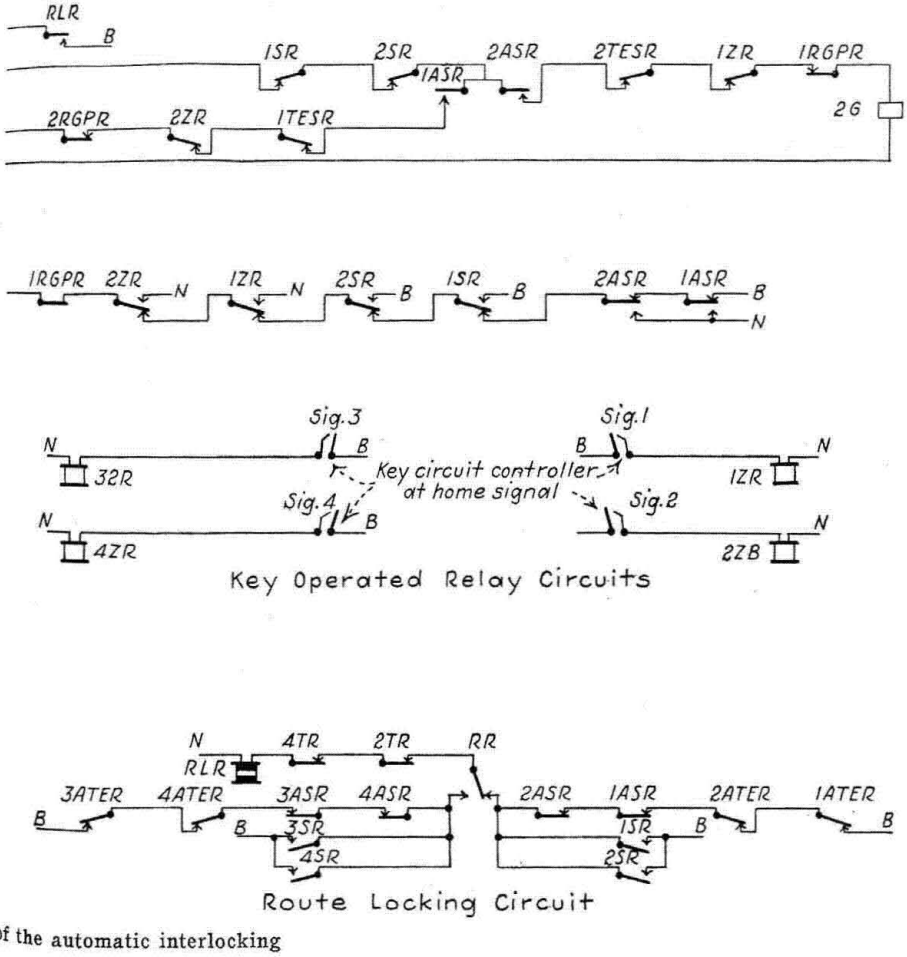
through the coils of the RR relay, over front contacts of the 4RGPR, 3RGPR and RLR relays, back contacts of the 4ZR, 3ZR, 4SR and 3SR relays, front contact of the 4ASR relay, and to negative battery over a back contact of the 3ASR relay, thus positioning the polar contact of the RR. When the slow-release, slow-pickup route locking relay RLR drops, signal 3 will clear, and the control circuit for the polarized route relay RR will be opened.

The control of the home relay for signal 3, C3HR, starts with positive battery, over a back contact of the relay, to negative battery over a left polar contact of the RR relay. The control of the control relay for signal 4, A4HR, is similar to the control of the C3HR, the difference being that the 4ASR relay is released instead of the 3ASR relay, upon the approach of a train to signal 4. No home control

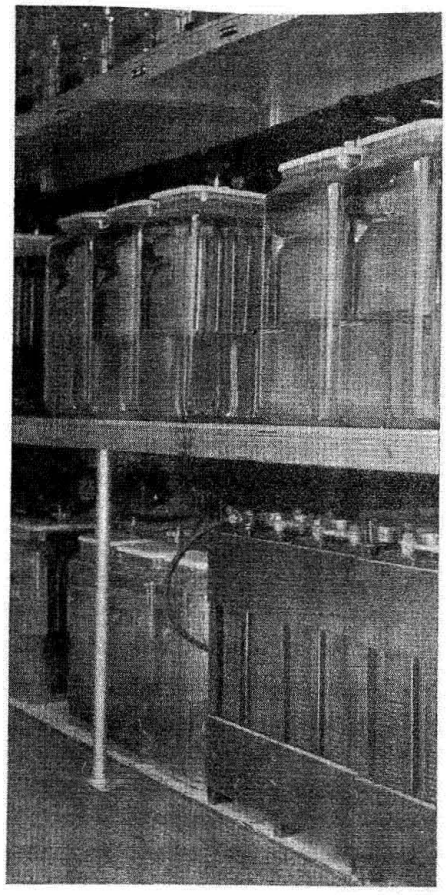
relays are used for the D. T. & I. home signals, these being of the searchlight type, the mechanisms thereof obviating the necessity for home relays. The control of the D. T. & I. home signals originates over contacts of the RR relay, the signal to be cleared depending upon whether either the 1ASR relay or 2ASR relay is released, only one of which can be down at a time.

Whenever a train occupies any part of the interlocking, one of four time-element relays, 1ATER, 2ATER, 3ATER (illustrated in circuits) or 4ATER, depending upon which road is involved, begins to measure the time. After six minutes have elapsed, the picking up of this TER relay energizes the corresponding ASR relay, provided, however, a train on the other road has occupied the plant in the meantime, which in turn, will put the corresponding signal at Stop. At the same time, the corresponding RGPR and RLF relays will be picked up, causing the route relay RR to position its polar contact to the respective position, and again open the RLR relay, because of an opposing ASR relay being open. If no such opposing train approaches, the proceed aspect is retained until it is accepted. If a train leaves the limits of the interlocking, for instance, it may take a siding, before or after the six-minute interval has elapsed, the time relay immediately becomes de-energized and nothing controlled by it influences the operation of the circuits, and the plant immediately becomes normal. If a train on the other road had occupied the plant prior to the first train clearing the center track circuit, the route-stick relay is energized through a back contact of the center track circuit relay, and the home signal governing a reverse movement of the first train is held at Stop behind the train, so the signal will be set for the other road, which then has the privilege of using the crossing.

For the purpose of imposing a time when all home signals are at Stop, when one road is surrendering the privilege to use the crossing to the other road, the RR relay, together with the timing relay, energizes a second timing relay of the thermal type. After a half-minute interval, the thermal relay functions to energize a thermal-stick neutral relay, which remains energized through its own front contact and the route stick and timing-relay contacts in series in addition to cutting off energy to the thermal unit. In cooling to close its normal contact, the thermal relay imposes another half-minute interval on the system, making a total delay of one minute. At this point the second train is given preference and, all home signals having remained at Stop for one minute, the home signal governing the second train clears.



of the automatic interlocking

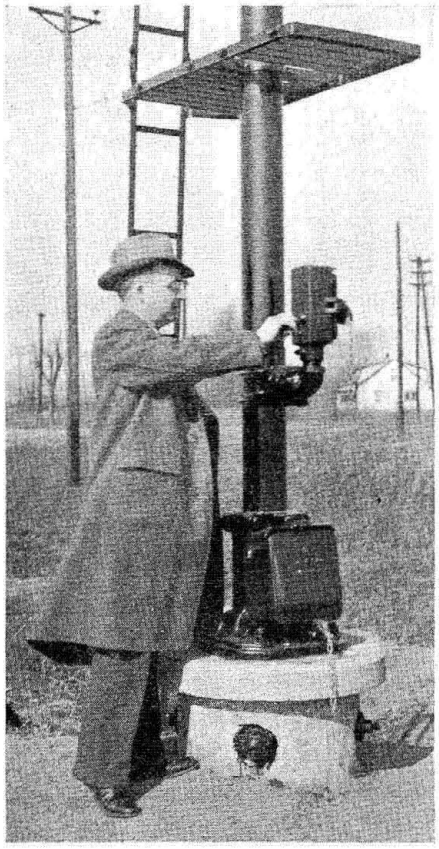


Primary and storage batteries in the sheet-metal housing

A change of route, caused by a momentary loss of shunt on a track circuit within home signal limits, is prevented by the slow-pickup principle in the route locking relay, RLR. A change of route, caused by a momentary opening of a track circuit is prevented by the difference in timing between the slow-release relay SR and the slow-pickup route locking relay RLR. The loss of shunt principle on the approach track circuits is in the ASR approach stick relays. The loss of shunt principles, as applied to the Morris layout, were explained in an article on page 38 of the January issue of *Railway Signaling*.

Switch Key Controllers

Ordinarily, the above procedure will provide for the proper operation of all trains by signal indication without flagging or undue delays, and, furthermore, with perfect safety. However, it is possible that both roads may have trains approaching the crossing, and the second train, after waiting for the signal throughout the two delay periods, totaling a maximum of seven minutes, would not accept



Special controller operated by standard switch key

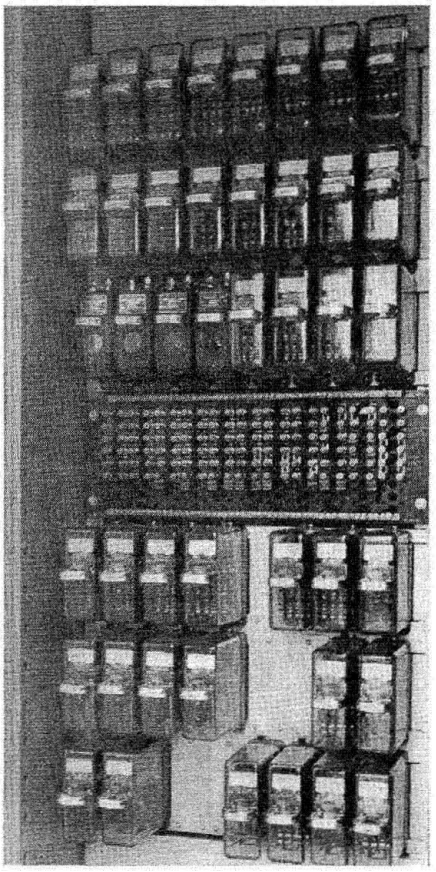
the signal and proceed over the crossing. In this event, the plant would be tied up for both trains, because after the second six-minute period had elapsed the signal would again be restored to normal. However, to avoid flagging and to facilitate movements over the crossing during the extensive freight interchange and shifting periods, a switch key controller, painted red, was attached to the mast of each of the four home signals. When trains are stopped at any one of the home signals by a red indication, and it is apparent that the circuits of the opposing road are not occupied, a member of a train crew can insert a switch key in the respective key controller, turn the key ⅛ turn, then remove it. This clears the respective signal promptly and locks out the other road, thus relieving the situation. Each key controller controls a ZR relay, which in turn, will knock down the respective thermal-stick neutral relay once it has been picked up, to obviate the delay to train movements which would be created if no release of this sort was provided.

Train Recorder

A continuous graphic chronological record of the operation of the principal functions of the plant, including approach clearing sections 3AR, 4AR, 2AR and 1AR; detector sections 4TR and 2TR; and signals 3, 4, 2 and 1, is provided by a 20-pen Esterline-Angus recorder, only 10 pens of which are active. Approach clearing sections 1AR, 2AR, 3AR and 4AR are represented by pens No. 1, 9, 19 and 11 respectively, while detector sections 2TR and 4TR are represented by pens No. 5 and 15 respectively. Signals 1, 2, 3 and 4 are represented by pens No. 3, 7, 17 and 13 respectively. Each pen is operated by a 24-volt, d-c. control magnet, and the chart driving mechanism is operated by 110-volt, 60 cycle, a-c. synchronous motor. Strip charts are 90 ft. long and are driven continuously at 3 in. per hour. One roll is sufficient for 15 days, although they are changed every 14 days as a safety precaution. Easy reading of the chart is facilitated by horizontal brown lines of graded width at 2-, 10- and 60-min. intervals with marginal numbers at hourly intervals. With a knowledge of the actual length of track circuits and the record tape, the average speed of a train over any approach to the plant can be estimated. Also, the operation of various time functions can be observed, the smallest time division on this tape representing two minutes.

Instruments and Housing

The relays, battery rectifiers and other allied signal apparatus are located in a Celotex lined, welded sheet-steel house, 5 ft. by 7 ft. by 7 ft., placed near the crossing on the northeast side. This house is set on four concrete foundations several inches above the ground level, bolted thereto by ¾-in. by 24-in. anchor bolts.

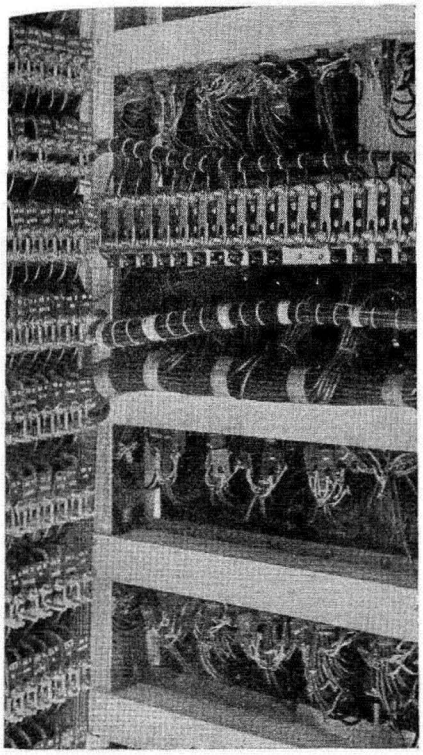


All relays are of the plug-in type

Quick-Detachable Relays

This automatic interlocking is said to be the first and only one of its type to utilize the plug-type relays, the majority of which are the PN-50 type. The space required for the installation of these relays is only about one quarter the space that is necessary for the equivalent number of contacts in a standard wall or shelf type relay mounting. Separate mounting bases, independent of the relays and containing receptacles for plug connections, are mounted permanently on a vertical rack or framework, 2 ft. 7 in. by 6 ft. 8 in., in the center of the cabin, and wire connections are soldered to the receptacle terminals. The plug connectors at the rear of the relays match receptacles in the fixed base, so that the relay is pulled out horizontally. The plug connectors extending from the rear of the relays come in contact with spring sockets in the mounting base receptacles. The coil connections are made in a similar manner, but reversed, so as to function as guides for the proper resister of the other connectors. Each contact spring has an individual plug connector of rugged design. These plugs are located in a recess in the base of the relay, protected on all four sides by a wall of insulating material projecting beyond the tips so as to prevent any damage whenever the relay is being handled. The spring sockets in the mounting base receptacles are designed to give high contact pressure with low friction, enabling easy connection or disconnection of the relays. When the relays are plugged into their mounting bases, a special latch locks the relay in position automatically. These relays are so designed that it is impossible to plug a relay into the incorrect base. The coil connectors are grouped separately from the contact, spring connectors, thus providing easy identification. A convenient arrangement is provided for circuit checking without unsoldering any wire connections whatsoever. A single coil is used, mounted horizontally, and no lead wires extend from it, connections being made directly to molded inserts in the rear coil head. Contact spring and coil changes can be made without disturbing the magnetic air-gap adjustment of relays. The contacts of these relays are of simple-rugged construction, and the contact pressures are high. The relays resist vibration, caused by passing trains, thus elim-

inating "flipping," false closed and open contacts and other trouble, the main reason for which this type of relays were provided in this installation. The track relays are of the 4-ohm, PN-50 type, with four front-four back and eight front-eight back contact combinations. The line relays are 550-ohm, PN-50 type with the same contact combinations as the track relays. The polar relays are of the PP-51 type, 800 ohms, with eight normal and eight reverse contacts. The thermal relays are of the 10-volt, PT-52 type, with one front and common contact. Other relays used on



Wiring at rear of relay panel

this installation, a few of which are also located in the house, include DN-11 track, DP-20 track, DN-18 line, DX-13 line, DT-10 line, ANL-40 power off and DN-22-P power off relays.

All of the underground cables entering the house, which are Kerite parkway with mummy finish and no metallic content, are terminated on a terminal board behind the relay rack. Each cable is pot-headed and the individual conductors extend to standard Raco terminals, from which point other conductors are distributed to the relay sockets where they are soldered in place.

Power Supply

Commercial power at 110 volts, 60-cycles, a-c., is received at the crossing. The main operating battery at the crossing for relays, signals, etc., consists of eight cells of Edison A4H, nickel-iron-alkaline, rated at 12 volts, 160 a.h., on floating charge from a Union RT-42 copper-oxide line rectifier. Track circuits on the Nickel Plate are straight primary battery fed by three cells of Edison Type 1002, 1000-a.h. primary battery in multiple. Track circuits on the D. T. & I. are a-c. primary, fed by three cells of Edison Type 1002, 1000-a.h. primary battery in multiple, across which is wired an RT-5 track rectifier. The rails on both roads are bonded with Thermet-Weld bonds. Connections to the rails are made with Union Type-U bootlegs and single-cable bootleg connections welded to the rails.

Construction by Railroad Forces

This installation was installed and placed in service by the D. T. & I. under the supervision of T. W. Burns, signal foreman, under the direction of P. L. Forbes, superintendent of telegraph and signals and W. G. Clinton, signal engineer. The Nickel Plate distant signals were installed by the forces of that road. The circuits, plans and major items of signaling equipment were furnished by the Union Switch & Signal Company.

Signaling on the Denver & Salt Lake

(Continued from page 361)

the intermediate signal locations, the relays and batteries are housed in large-sized, double-door, sheet-metal cases. The terminals, fused cutouts, bootleg outlets and various other accessories on this installation were furnished by the Railroad Accessories Corporation. The insulated wires and cables are of Kerite manufacture, outer covering of the underground cable is of the mummy type, with no metal. Sections of 4-in. fiber conduit were installed in the concrete foundations when they were poured in place. The cables are brought up through these conduits into the cases or houses. At signals, the cables extend up through the masts, and, near the top, out through fittings to the searchlight units.

The rail through this territory is 100 lb., and Rail Joint Company armoured type insulated joints are used. Each hand-throw switch is equipped with one 1-in. by 8-in. insulated gage plate, with adjustable rail braces, and each spring switch is equipped with three insulated gage plates and adjustable rail braces. The switch circuit controllers are equipped with spring devices which, in case the connecting rod becomes disconnected, will operate the controller to the center position. The cables from a switch circuit controller extend through a section of discarded air hose and down into the ground. A special fitting is provided on the case of each switch circuit controller so that the end of the air hose can be clamped in place.

Switch-Position Protection

At the passing track switches, all of which are hand-operated, the contacts in the switch circuit controller operate a switch-repeater relay. At outlying spur tracks, the contacts in the switch circuit controllers shunt the track circuits. At each of the five switches, which are equipped with spring switch mechanisms, two switch circuit controllers are used, one connected to each of the two switch points. The circuit for the control of the switch relay controlled through contacts of these two switch circuit

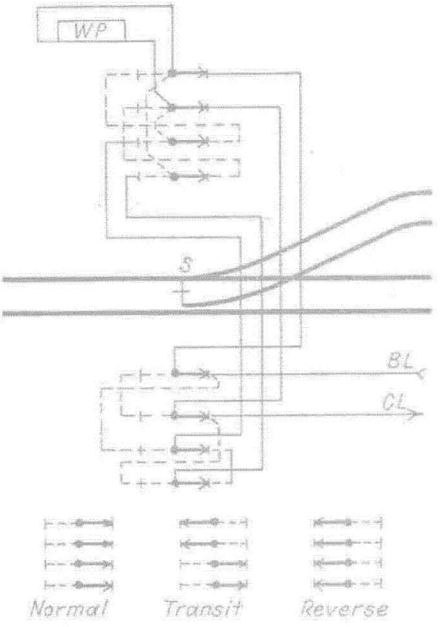


Fig. 11—Controller connections at a spring switch

controllers is shown in Fig. 11. If the normally-closed switch point is open more than ¼ in. or if the normally-open switch point is open less than 3-in., the relay is released. In order for the relay to be energized to repeat the reversed position of the switch when hand-thrown, the normal point must be open at least 3 in., and the reverse point must be closed within ¼ in. of the stock rail.

This installation was installed by the D. & S. L. forces under the jurisdiction of B. W. Molis, signal engineer. The major items of signal equipment were furnished by the General Railway Signal Company.