Automatic Cut-Outs at an Automatic

Time-element features constitute distinguishing characteristics of new Rock Island plant at Ottawa, Ill.

AN automatic interlocking has been applied to a complicated layout on the Rock Island at a crossing with a branch line of the Burlington. Operating problems, particularly the need for flexibility arising because of numerous switching moves, station stops, heavy grades, and frequent main line service, have necessitated the installation of several different types of automatic time element and stick relay cut-out facilities.

The new plant is located at Ottawa, Ill., at a crossing of the double track main line of the Rock Island between Chicago and Davenport, Ia., and the single track Fox River branch of the Burlington. Rock Island traffic consists of 8 eastbound and 5 westbound regularly scheduled freight trains, and 11 regularly scheduled passenger trains each way, daily. Burlington traffic consists of two passenger and two freight trains each way, daily; however, the North Ottawa yard of the Burlington is located ¾ mi. north of the intersection and since the greater proportion of the industries in this vicinity are south of the Rock Island tracks, a great number of switching moves are made over the crossing daily by the Burlington, two engines being regularly assigned to this service. The trains on the Fox River branch of the Burlington are operated under train orders, while on the Rock Island main line in this vicinity, they are operated under train orders and a Union Style S automatic block signaling system as well as an intermittent (ramp type) automatic train control system. The speed limit over the crossing for the Burlington is 20 m.p.h., while on the Rock Island the maximum permissible speed is 40 m.p.h. With the installation of the automatic interlocking, which replaced a mechanical lever interlocking at this point, Union Switch & Signal Co. Style D color-light signals were provided as high home and distant signals on the Rock Island, Union Style H searchlight signals as home signals on the Burlington, and Hall fixed (caution position) signals as distant signals on the Burlington; Union color-light dwarf signals were provided on the Rock Island for back up moves as well as on one Rock Island turnout and one Burlington turnout within the interlocking limits. The automatic block and distant signals on the Rock Island are approach lighted, while all home signals and the Burlington distant signals are continuously lighted.

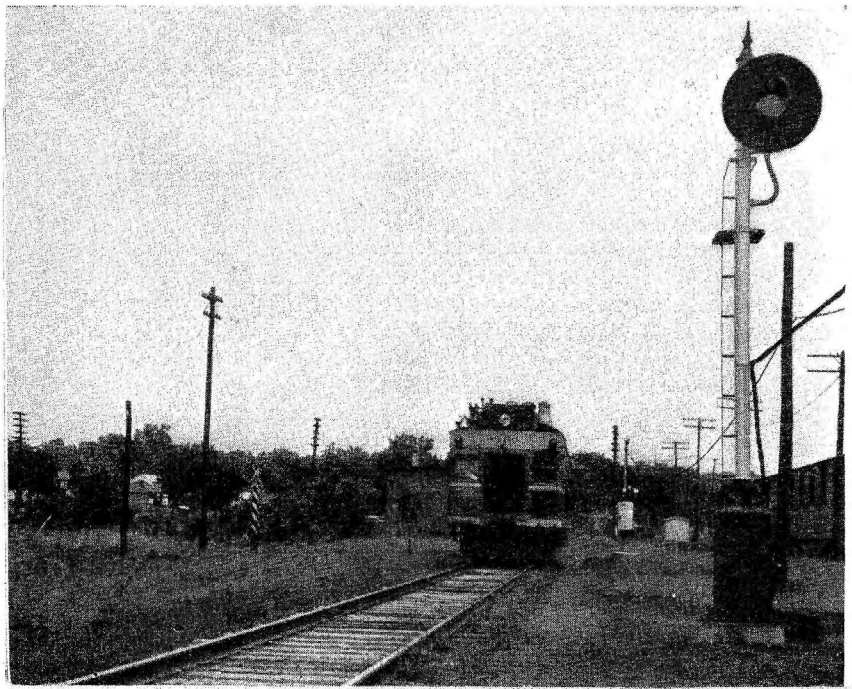
Several features of the layout result in stops or reversal of direction taking place within the automatic interlocking limits: (1) the Rock Island Ottawa passenger station is just east of the crossing; (2) a Burlington enginehouse and water tower are north of the crossing, on the west side, the enginehouse lead, facing for southbound movements, continuing around to form a wye connection with the westward Rock Island track at a point west of the crossing; (3) the Rock Island Ottawa yards are west of the crossing just beyond the eastbound approach control limits; (4) numerous industry leads, as well as sidings, housetracks and complimentary crossovers, are either within the approach control limits or very close thereto.

Interlocking Protection Between Railroads

Assurance that the home signals on the opposing railroad are locked out before a home signal, for a given route, can operate to the proceed position is accomplished by the method of controlling the three approach stick relays. Referring to the diagram, QAS is the stick relay for the Burlington single track main line, WBAS for the Rock Island westward main and EBAS is for the Rock Island eastward main. The control circuits for these stick relays are similar, each being controlled thru relays performing the same function for their respective track.

Referring to the control circuits for relay QAS, it will be noted that contacts, either front or back, on relays 5NP, 6NP, WBAS, EBAS, QNTER, 5TPP, 6KR, 5AP, 6A, QAS, 6S, and 5S, and contacts on time releases WB, EB, and Q, are utilized.

Relay 5NP repeats the normal position of Signal 5, i.e. 5NP is energized

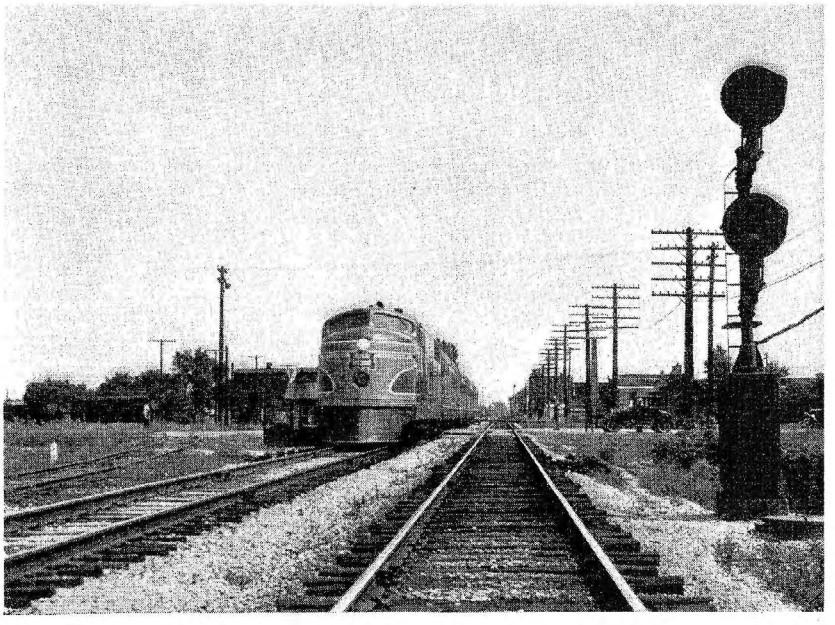


Southbound Burlington train passing Signal 6. Instrument house at crossing in background

Interlocking

James H. Molloy,

Assistant Engineer, Signal Department
Chicago, Rock Island & Pacific



Westbound Rock Island "Rocket" passing Signal 4A-B

when Signal 5 displays the Stop aspect and is de-energized when Signal 5 is cleared. Relay 6NP, likewise, repeats the position of Signal 6 in a similar manner.

Relays WBAS and EBAS are the stick relays for the Rock Island tracks, with control circuits similar to those of relay QAS.

Relay QNTER is a special time element relay to provide protection against the possibility of a quick change from a clear route on the Burlington to either or both of the routes on the Rock Island.

Relay 5TPP is a repeater of relay 5TP which in turn indicates the occupancy or non-occupancy of the entire section of track between Signal 5 and Signal 6; relay 5TP is controlled over front contacts on track relays 5T and 5TZ and track relay repeater 6TP; these constitute the three track circuits between Signal 5 and Signal 6, track relay 5TZ being of particular interest in that it is the track relay representing the occupancy or non-occupancy of the trap circuit on the Burlington over the crossing.

Polar relay 6KR is the switch position repeater for the switch in advance of Signal 6.

Relay 5AP is the approach relay for the southward C. B. & Q. approach, being utilized normally to indicate, when de-energized, the occupancy of the approach section north of Signal 5. Relay 6A, in a similar manner, indicates the occupancy of the northward C. B. & Q. approach to the rear of Signal 6. Each of these relays, when once de-energized by a train on the respective approach, remains de-energized with the section within interlocking limits occupied; the purpose of this is involved in the control of the relays 6S and 5S.

The contact on QAS in its own control circuit is the feature which makes relay QAS a stick relay.

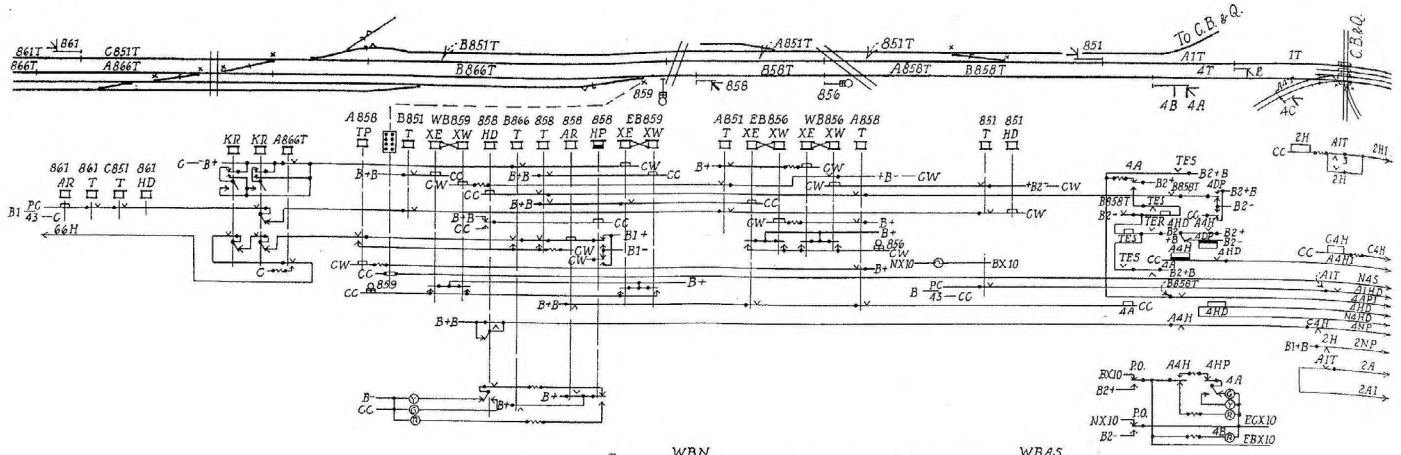
Relay 6S is a normally de-energized stick relay, the primary function of which is to prevent the clearing of Signal 6 behind a southbound C. B. & Q. train as it occupies the northward approach while receding from the crossing; as a southbound C. B. & Q. train passes Signal 5 and enters the interlocking limits relay 5T drops, relay 5TP drops, relay 5TPP drops and relay 6S is energized over a back contact on 5TPP and a front contact on 6A; since it is a slow drop-away relay it remains picked up as the train enters O6T and drops 6A, being re-energized as soon as 6A closes its back contacts, energy being fed over a back contact on 6A and the stick contact on 6S; it is released when the southbound train clears the northward approach in receding from the crossing. Relay 5S performs a similar function when a northbound train is receding from the crossing and occupies the southward approach. The relays 6S and 5S are directional and do not both pick up at the same time due to the carry over of the control for approach relays 6A or 5AP into the track circuit repeater 5TP i.e. for the movement just described 5S cannot be energized due to the southbound train continuing to hold 5AP down until after the entire train has passed Signal 6, thereby preventing a closed pick-up path.

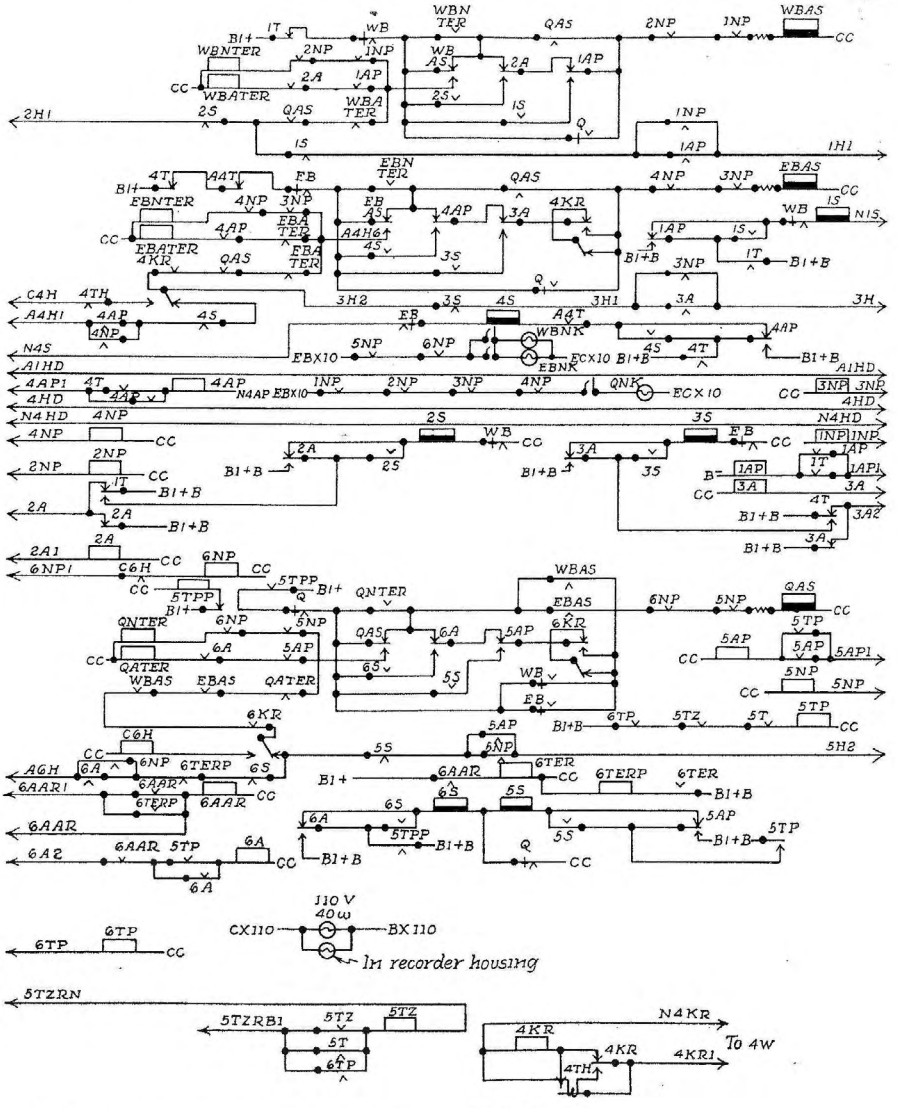
Time releases WB, EB, and Q are the usual types of emergency manually operated clockwork time releases, located in cast iron release boxes at the crossing.

From the above discussion of the relays involved in the control of relay QAS, it is evident that QAS is normally energized over front contacts on 5NP and 6NP, a normal polar and a front contact on 6KR, a front contact on 5AP, a front contact on 6A, a stick contact on QAS, a normally closed contact on manual time release Q, and a front contact on 5TPP.

When a southbound train approaches on the Burlington and crosses LaSalle street, it de-energizes the right side of the interlocking relay provided for crossing protection at Third street. De-energization of this side of the interlocking relay breaks the controls of relay 5A at Signal 5, which when de-energized breaks the controls of relay 5AP at the crossing. When the armature of relay 5AP drops, the control circuit of QAS is broken and battery is fed over the front contact of 5TPP (in QAS control circuit), over the back contact of manual time release Q, over a back contact of an automatic time element relay QATER, over front contacts on Rock Island stick relays WBAS and EBAS, over a front neutral and polar normal contact on 6KR, over a back contact on 5S, over a back contact on 5AP (relay 5NP is energized as long as Signal 5 is normal), over a back contact on 5TES, a special time element stick-repeater whose function will be described later, and over a back contact on 5WS, another special stick switch-repeater, to the operating mechanism of Signal 5, resulting in the display of a Clear aspect on that signal.

When the armature of approach relay 5AP dropped, the normally closed hold-up circuit for the Burlington approach stick relay was opened, thereby closing a path for energy to be delivered to the operating mechanism of the searchlight home Signal 5. It should be noted that, when the relay QAS became de-energized, while it closed the circuit for Signal 5,

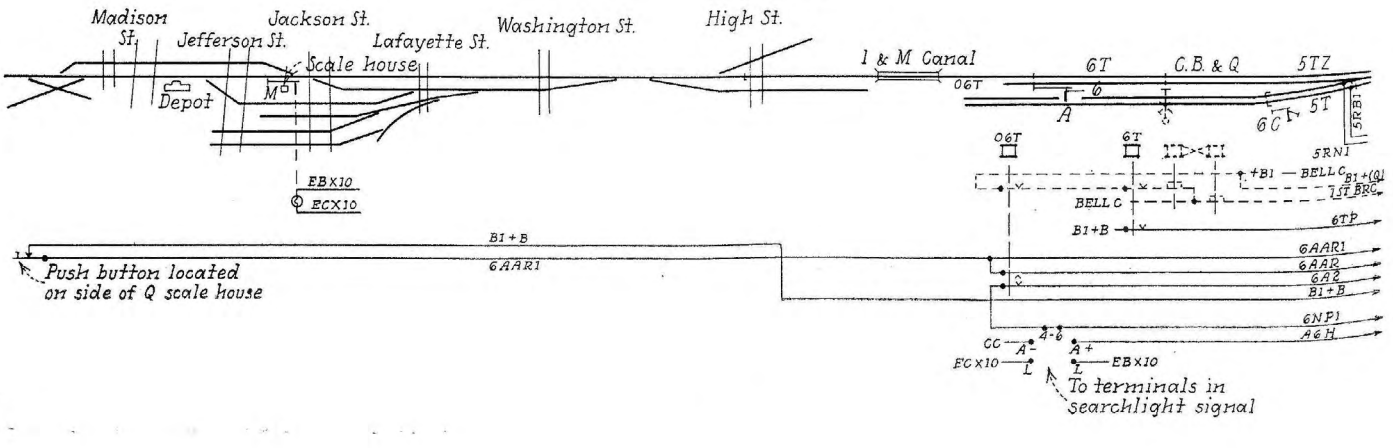


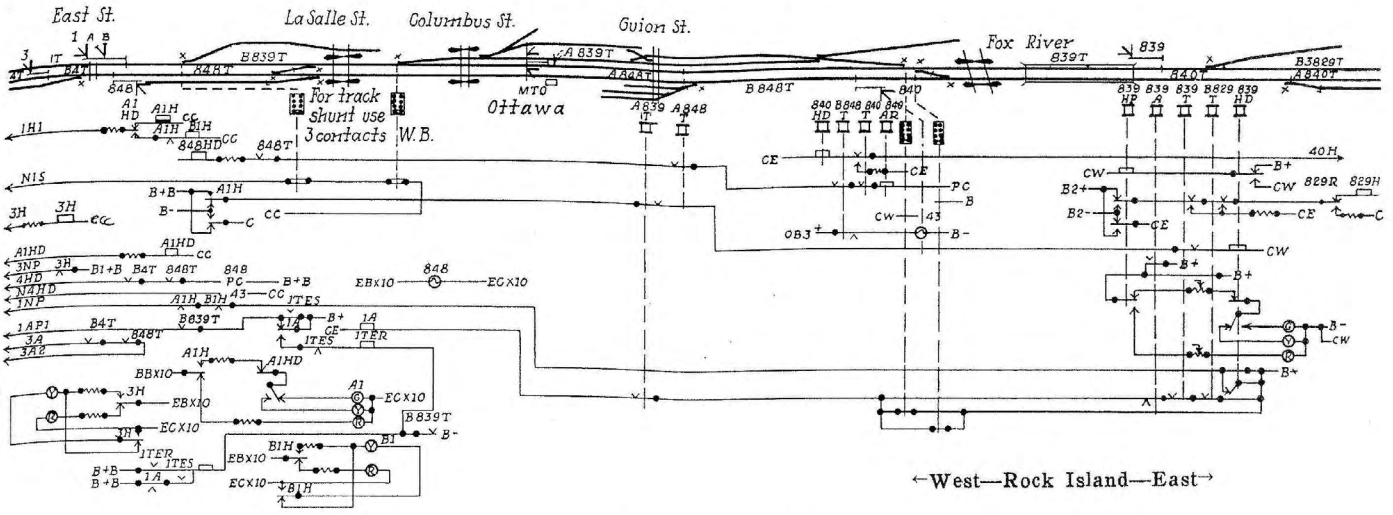


Above — Track layout and principal control circuits on the Rock Island

Right — Principal control circuits at central location at crossing

Below — Burlington track layout and principal control circuits





it at the same instant opened the control circuits for all of the Rock Island home signals and also closed a by-pass around the approach relay contacts in the Rock Island approach stick relays WBAS and EBAS. This latter action prevents the Rock Island approach stick relays from dropping if a Rock Island train enters one of its approach sections while the home Signal 5 is clear for the Burlington.

As the train proceeds past the signal and enters 5T track section, relay 5TP and relay 5TPP are de-energized, and battery is disconnected from Signal 5 control circuit causing the signal to display the Stop aspect. Battery is applied to pick up 6S over a back contact on 5TPP and a front contact on 6A. When 6A drops, 6S remains picked up (slow-acting) over a back contact on 6A and its own stick contact. As 6S picks up it breaks the control circuit for high home Signal 6. When 5AP, 5TP and 5TPP are re-energized as the train leaves the interlocking limits, a pick-up circuit is established for QAS over 5TPP front contact, Q time release normal contact, 6S front contact, 6A back contact, 5AP front contact, 6KR front neutral and polar normal contacts, and 5NP and 6NP front contacts. QAS having been picked up, the circuits are returned to normal and one or both of the Rock Island routes may be cleared in a similar manner for Rock Island trains approaching the plant.

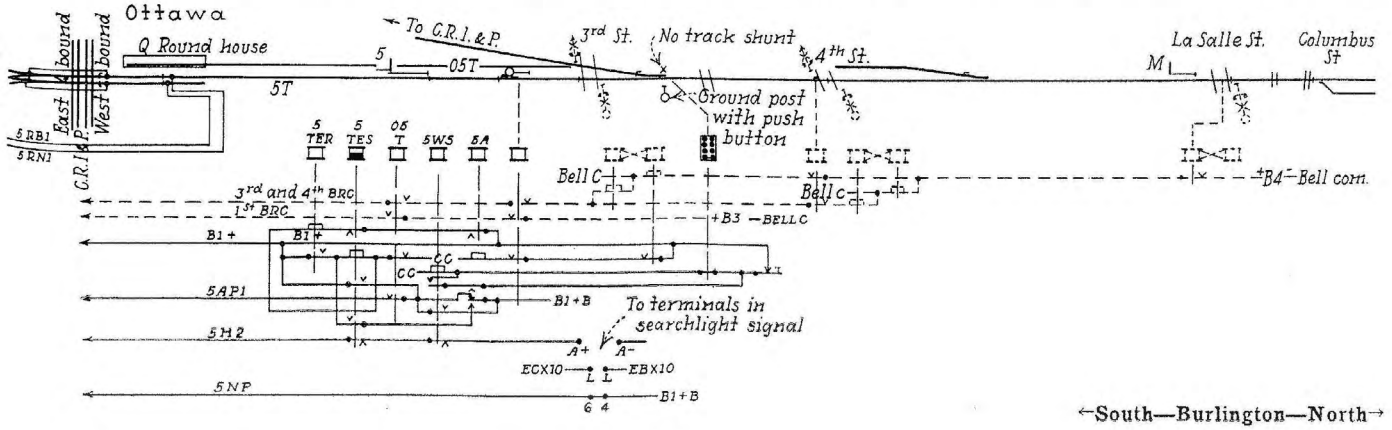
For a northward through C. B. & Q. movement, relay 6A drops, dropping relay QAS, and, if Switch 6 is normal, high home Signal 6 is cleared over a back contact on approach relay 6A. As the train enters 6T track section 5TPP drops, relay 5S picks up locking out Signal 5, while the train is receding from the plant, and high Signal 6 displays the Stop aspect.

As noted previously, approach stick relays WBAS and EBAS for the Rock Island tracks perform the same general functions and are controlled in the same manner as QAS, the approach stick relay for the Burlington. The lockout of the opposing road is obtained in each instance by breaking the home signal control circuits of that road over front contacts on the approach stick relay for the other road and by maintaining the approach stick relay of one road energized over a back contact of the approach stick relay or relays of the road for which a signal has been cleared. For instance, the controls of Signal 1, 2, 3 and 4 on the Rock Island are broken over front contacts on QAS, while back contacts on QAS cut around the approach relay contacts in the control of WBAS and EBAS to maintain those relays in their energized position regardless of the presence of approaching trains on the Rock Island after a route has been given to the Burlington. Likewise, the controls of Signals 5 and 6 on the Burlington are broken over front contacts on WBAS and EBAS and back contacts on WBAS or EBAS cut out the approach relay contacts in the control of QAS on the Burlington.

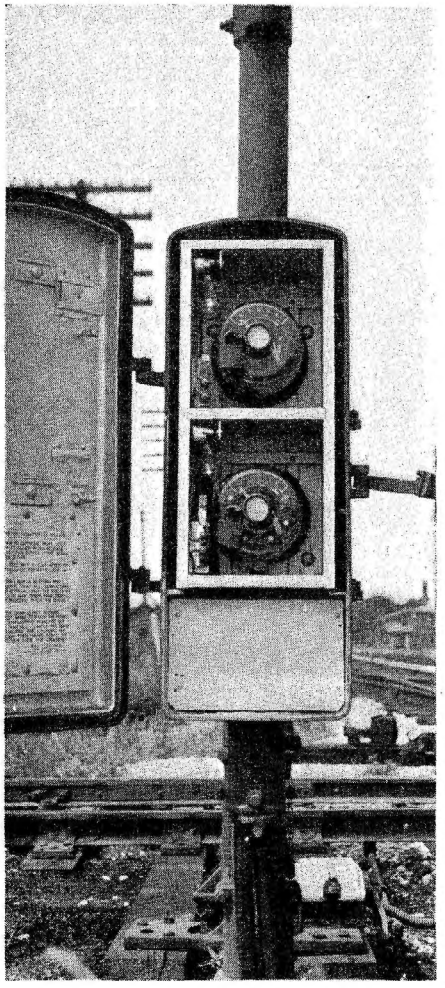
Time Must Elapse Between Route Changes

The approach time element relays WBATER, EBATER and QATER prevent the sudden change from a clear signal indication to a Stop aspect due to the failure of an approaching train to continue its shunting out of the track relays in the approach section, whereas the relays WBNTER, EBNTER and QNTER impose a minimum time interval between the changing from a Clear aspect to a Stop on one road and the clearing of a signal on the opposing road due to a train having lost its shunt for the full time interval of the approach time element relay or due to the home signal being set at stop by a break in its control circuit. In the first instance the two time intervals occur in sequence while for the second, there is only the time interval of the NTER relay.

Assuming a westbound Rock Island



train to have entered the westward approach on the westward track, relays 1A and 1AP will have dropped, de-energizing WBAS and, assuming the interlocking and advance track sections to be clear, Signal 1 will display the Clear aspect. A branch of the



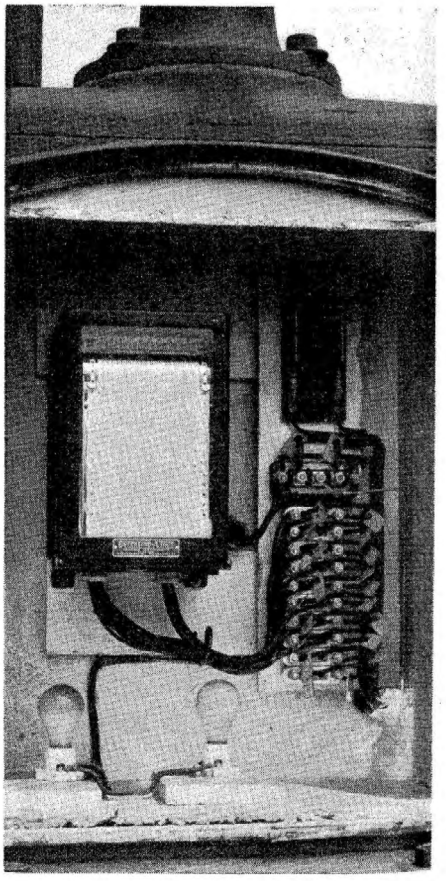
Burlington manual time releases

control circuit for Signals 1 and 2 feeds WBATER over front contacts on approach relays 2A and 1AP, being connected to the back contact on WBAS which energizes the signal control circuits upon the approach of a Rock Island train; another branch, connected at the same point feeds WBNTER over front contacts on 2NP and 1NP. If the approach relay, 1AP, picks up momentarily due to the Rock Island train failing to maintain a continuous shunt, Signal 1 would suddenly display the Stop aspect for the approaching train if the special feature were not used involving the time element relay WBATER and the 1NP back contact by-pass of the approach clearing contact in the control circuit for Signal 1. If Signal 1 assumes a Clear aspect the indication will be continued until the train passes the signal, backs out of the approach, or the time interval imposed by relay WBATER has elapsed. This is a relay of the type with a slow break back mercury contact, and on a momentary loss of shunt will not be energized for a sufficient length of time to open its back contacts. However, if the loss of shunt continues, and 1AP is energized for two minutes, WBATER will open its back contact. When the back contact opens, the control circuits for Signal 1 will be broken where it breaks over a back contact on WBATER, causing Signal 1 to display the Stop aspect, relay 1NP will pick up, and the control circuit to WBNTER will be closed, which causes a second time interval to be imposed. This relay has a slow-pick-up mercury type contact which after a one minute time interval will close its front contact and establish a pick-up circuit for WBAS, cutting around the stick contact in the controls of that relay. Therefore, if a Burlington train has approached and is occupying either of the approach sections on that road, the C. B. & Q. route approach stick relay QAS can be de-energized and traffic rights will be transferred to the Burlington. It will be noted that an interval of two minutes has been introduced from the time the Rock Island westward approach shunt was lost and the Rock Island signals placed in the stop position, while an additional interval of one minute has been introduced between the placing of the Rock Island signals in the stop position and the clearing of the Burlington signals. The operation of this time element feature for the westward track is made operative in placing the westward track signal, No. 1, at stop, even if another Rock Island train approaches from either direction on the eastward track; however, traffic rights are not transferred to the Burlington until both WBAS and EBAS have picked up, which will be the case (EBAS picked up) when the train on the eastward track completes its movement through the interlocking limits, or, if not doing so, when the time element relays EBATER and EBNTER have functioned for the eastward track.

On the Burlington track, mercury type relays QATER and QNTER perform the same function as either of the sets of two time element relays do for each of the Rock Island tracks. Due to the lower speeds at which Burlington trains are operated, the time provided between loss of shunt and clearing of the Rock Island signals for an approaching Rock Island train totals two minutes, QATER and QNTER each having a slow-pick-up time of one minute; one minute is allowed between the time the previously selected Burlington signal is placed at stop, and the clearing of the desired Rock Island signal. Signal 1 is controlled, also, so as to permit the display of a red-over-yellow, Slow Speed aspect if the interlocking or advance section between the interlocking and the advance signal are occupied.

Water-Station and Enginehouse Lead Cut-Out Features

A water tower and an enginehouse lead are located within the limits of the southward approach on the Burlington just north of Signal 5. The enginehouse lead continues westward to form a transfer connection with a Rock Island side track west of the crossing. The circuits in this vicinity have been arranged to perform two functions (1) to allow the reversion of traffic rights over the crossing to the Rock Island if a southbound Burlington train for any reason consumes more than three minutes in traversing the first three track circuits (1915 ft.) of the southward approach, as for instance stopping to take water; and (2), to prevent the establishment of southbound Burlington traffic rights when the enginehouse lead switch is reversed for a northward switching movement, while at the same time al-



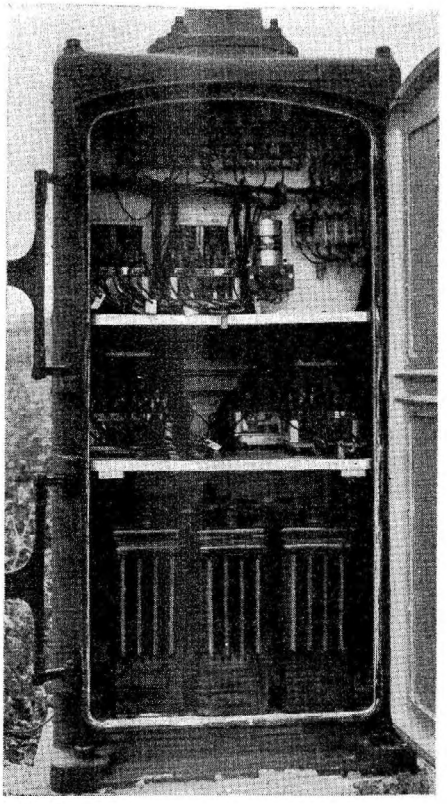
Automatic recorder at crossing

lowing for southbound Burlington traffic rights to be obtained by such an engine if it desires to reverse its motion and proceed over the crossing.

The first function is obtained by the use of a three-minute slow-pick-up mercury type time-element relay,

5TER, a stick repeater, 5TES, of that relay, and a short clearing section, O5T, in approach to Signal 5. When a southward Burlington train enters the track circuit south of LaSalle street, the right side of the interlocking relay used for crossing protection purposes at Third Street is de-energized, breaking the controls of relay 5A at Signal 5. The de-energization of 5A breaks the control of approach relay 5AP at the crossing and if no trains are approaching on the Rock Island, drops approach stick relay QAS, establishing traffic rights for the southward Burlington train. However, a back contact on relay 5A simultaneously completes a circuit applying energy to time-element relay 5TER which functions to close its front contacts after a three minute interval unless O5T is de-energized within that time. In other words, if the southbound Burlington train does not shunt O5T within three minutes after entering the southward approach, relay 5TER will close its front contact. As it does so it picks up normally de-energized stick relay 5TES, which when picked up directly breaks the control of Signal 5, cuts off the flow of current through 5TER, applies energy over a front contact to the control wire for the approach relay 5AP at the crossing, thus withdrawing the southward traffic rights previously established for the Burlington due to occupancy of the track circuits controlling relay 5A. If the Burlington train occupying these track circuits should leave them, either by reversing its direction and proceeding northward, or by entering the enginehouse lead, 5A will pick up, breaking the stick circuit control of relay 5TES and the Burlington southward control circuits will be restored to normal. However, if the Burlington train proceeds toward Signal 5, shunting track circuit O5T, relay 5TES will be de-energized as soon as O5T drops, and the control of 5AP at the crossing will also be broken, through the opening of its control circuit at the front contact on O5T, thus re-establishing Burlington rights for a southward movement over the crossing, provided no Rock Island trains have priority.

The second function is accomplished by the use of a normally de-energized switch repeater stick relay, 5WS, and a push-button to be operated by train crews of trains leaving the enginehouse lead and desiring to reverse direction and proceed over the crossing. When the enginehouse lead switch is reversed to permit a northward movement, switch repeater stick relay 5WS is energized, and, in picking up, shunts out the front contact on 5A which is in the controls of 5AP. When the movement is made out onto the main line, therefore, and 5A is de-energized, 5AP at the crossing is retained energized, and no selection for southward Burlington traffic is made. When the switch is placed normal, after 5A is de-energized, 5WS remains energized over its own stick contact and a back contact on 5A. As the train leaves the approach section northbound, 5A is re-energized, the control of 5WS is broken and the circuits in this vicinity are restored to normal. If the engine desires to make a movement over the crossing, a push-button is provided which, when operated by a member of the crew, will break the control circuit for 5WS, thereby establishing its presence in the approach circuit and causing Signal 5 to assume the Clear aspect.



Batteries and relays at home signal

Lengthening Out the Burlington Northward Approach Control

In order to minimize the possibility of having to stop heavy tonnage trains on the ascending grade approaching the crossing on the C. B. & Q. from the south when conflicting Rock Island moves might obtain prior rights due to the short 610 ft. approach section on the C. B. & Q., a special arrangement involving a push-button and a stick relay has been introduced to provide for lengthening out of the northward approach. Approach relay 6A at the crossing is controlled normally over a front contact of O6T and a front contact on a normally energized stick relay, 6AAR. Under normal conditions a typical train approaching northbound de-energizes relay 6A when it enters approach track section O6T. However, if a C. B. & Q. tonnage train is involved, the crew may lengthen out their approach control and establish prior right to the crossing earlier by operating a normally closed push-button mounted on the side of the Q scale house south of the crossing. Operation of the push-button releases normally energized stick relay 6AAR, which in turn drops 6A, establishing northbound traffic rights for the Burlington, provided the interlocking is clear of opposing moves. The operation of 6AAR in thus lengthening the northward approach is effective only for three minutes, for when 6AAR drops it energizes 6TER, a slow-pick-up mercury relay, which closes its front contact after three minutes, completing the circuit for 6TERP; when 6TERP picks up, 6AAR is picked up, providing the push-button at Q scale house is normal. In order to retain any priority obtained through operation of the push-button, therefore, a northbound train must have entered track section O6T within three minutes after such operation when Rock Island trains are present on their respective approaches. When 6AAR picks up, 6TER and 6TERP are de-energized, thus restoring these circuits to normal.

The elimination of tonnage train stops is important on the heavy ascending grade of the northward approach not only from the viewpoint of cost and time saved in the operation of trains, but also because the obstruction of grade crossings in the vicinity is thus greatly minimized.

Time-Control for Station-Stops and Switching Cut-Outs on the Rock Island

The westward approach control for the Rock Island on the westward track is established when a westbound train enters A829T track section at a point 4908 ft. in approach to Signal 839, the distant signal for home Signal 1. When a train passes that point approach relay 1A is de-energized, 1AP is de-energized and traffic rights are established for the Rock Island, if the interlocking is clear of opposing movements, through the de-energization of WBAS. At the time 1A drops it closes a control circuit for a 6-min. mercury type time-element relay and stick relay repeater combination which applies battery directly to the control circuit of 1AP, regardless of the occupancy of the track circuits controlling 1A. If the train, in the elapsed 6 min. interval, has not shunted track circuit B389T due to the fact that it

has consumed more than 6 min. in making a station stop at the Rock Island Ottawa station, or is making switching moves in the area included in A829T, B829T, 839T, and A839T track sections, or is approaching the crossing slowly, relay 1AP will then be picked up and the circuit for WBATER will then be closed which adds 2 more minutes to the period that the Rock Island would retain its route for a westward train movement. If the train wishes subsequently to proceed over the crossing it may reestablish its rights, clearing Signal 1 for the second time if the interlocking is clear, by entering B839T, a clearing section 813 ft. in length in approach to Signal 1. Switching cut-outs for the crossover and turnout tracks just west of Champlain street are provided by cut-around circuits established through the switch circuit controllers of these switches to prevent the establishment of a route over the crossing when not required.

A similar automatic time release for the eastward main track has recently been added to the plant to cancel the Rock Island route cleared by occupancy of the approach sections west of B858T which serves to re-establish a route in the same manner as described for the westward route. The time element for this zone is a total of 6 minutes.

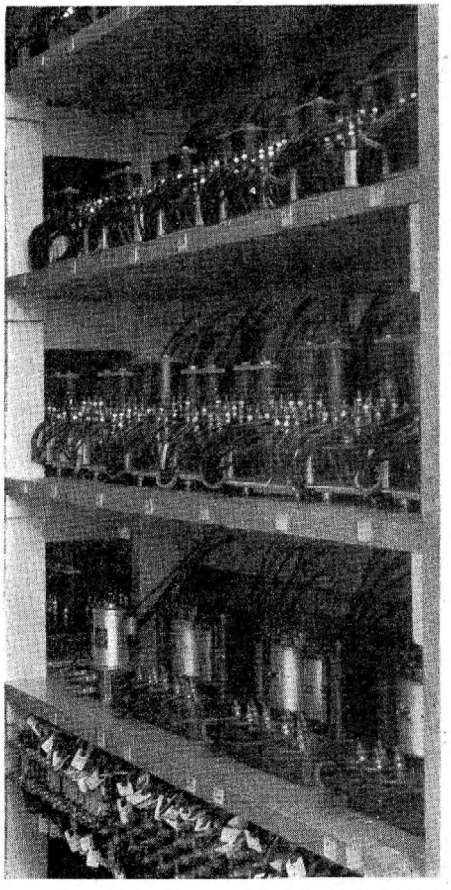
Manual Time Releases

Manually operated clockwork time releases are provided in special cases at the crossing for each of the tracks involved, the C. B. & Q. release, for use by C. B. & Q. trainmen, being located in one pedestal-mounted case, and the two Rock Island releases being in another pedestal-mounted case. These releases are utilized in the usual manner to switch traffic rights from one road to the other in case a train stops in an approach section, track circuits fail or automatic time releases have not completed their operation. Since no automatic release is provided on the eastward approach on the westward track nor on the westward approach on the eastward track of the Rock Island, it is necessary for the C. B. & Q. trainmen to operate their manual release whenever these sections are occupied by Rock Island trains or switching units which are not proceeding over the crossing at that time. Likewise, it is necessary for the C. B. & Q. trainmen to operate their release whenever the Rock Island is making switching movements on the westward approach between Signal 1 and LaSalle street. The Rock Island releases must be operated whenever the C. B. & Q. approaches are occupied by trains not intending to use the crossing and the automatic release features fail, when track circuits on the C. B. & Q. fail, and when the clearing sections on the C. B. & Q. are occupied by trains not destined for the crossing. Each of the manual releases, when operated, functions to introduce an interval of 1 min. 30 sec. between the opening of the reverse contact and closing of the normal contact.

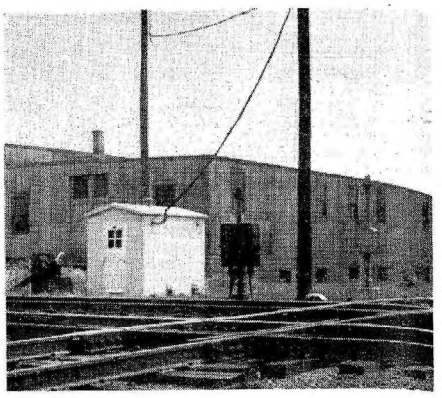
A thermal relay has been applied in the control of 4KR so that an interval of one minute is introduced between the operation of the switch and the clearing of Signal 4C, to create a fixed delay to the operation from siding to main track. Each time that 4KR is de-energized by operation of the switch, a stick contact is broken and thermal relay 4TH is energized; after an interval of one minute it closes a pick-up cut-around to energize 4KR.

Materials

The general control relays for this installation were manufactured by the Union Switch & Signal Co., which also supplied the home signal units and the distant signal units on the Rock Island. All time-element relays, with the exception of 4TH, are of the mercury contact type manufactured by the Adams & Westlake Co. The major portion of the control apparatus



Relays mounted on shock absorbers at crossing. Mercury relays below



Relay house and manual release boxes at the crossing

is housed in a concrete house in the southeast corner. Cast iron instrument cases are utilized at the home signal and outlying locations. An Esterline-Angus Co. automatic recorder, in the northeast corner 40 ft. from the Rock Island westward track and 100 ft. from the Burlington track, provides a continuous record of the occupancy of track circuits 1T and 4T and the de-energization of 1AP, 2A, 3A, 4AP, 5TP, 5AP, 6A, 1NP, 2NP, 4NP, 5NP, and 6NP. The recorder, therefore, records the entrance of a train into an approach, the clearing of the home signal, the entrance of the train into the plant, the restoral of the home signal to normal behind the train, and the departure of the train. Neutral d-c. track circuits are used throughout, bonded with two Copperweld bonds with 9/32-in. channel pins to each joint. Where necessary, local runs of underground cable with steel armor manufactured by the Okonite Co. have been provided throughout the interlocking, the circuits being carried in No. 14 copper conductors; in a few instances lead-covered cable was utilized. The line circuits, in general, were placed on No. 10 line wire; however, from the crossing to the northward home signals on the south side the circuits are in a handmade cable constructed of weather-proof RCSD copper wire. Track leads consist of No. 9 single-conductor underground cable. Three to five Edison 500 a.h. cells are used, connected in multiple on each track circuit, with 4-ohm, DN-11 track relays. Automatic signals on the Rock Island are supplied from 17 or 20 Edison primary cells, while 5 Exide 120 a.h. Style EMGS7 storage cells floating on RX21 rectifiers with W-10 transformers are provided at the concrete instrument house, at the eastward Rock Island home signal, and at the westward Rock Island home signal for line and lighting circuit feed.

This installation was designed and installed by Rock Island signal department forces under the direction of Leroy Wyant, signal engineer.