CIRCUIT DESCRIPTION
OF
AUTOMATIC INTERLOCKING
DWG. TE30A9

The circuits shown on TE30A9 are for a simple automatic interlocking involving the crossing formed by two single track lines, using approach-lighted searchlight distant signals on one line and approach cleared and lighted searchlight home signals on both lines.

As will be noted from the drawing, all controlling apparatus is contained within one housing located at the crossing with signal control wires emanating therefrom. This system involves no more line wire or cable than would be used, if the apparatus were distributed at various signals, and in addition, economizes on housing requirements, allowing for a more compact arrangement for ready inspection; therefore, reducing maintenance.

The principal features of this circuit arrangement are detailed on the right of the drawing and are explained in the following circuit description.

Two features of this arrangement of circuits which are worthy of note are in the use of polarized relay contacts to maintain the route and check against the clearing of a signal on the conflicting route irrespective of whether or not the polarized relay is energized; and a neutral relay RLR used to prevent the energization of the polarized relay RR when that relay should not be energized to change its

polar contacts. The arrangement of circuits affords a ready means of checking this locking relay in its de-energized position before a signal may be cleared as will be developed later.

OPERATION

Control of Route Selection Relay "RR"

Let us assume that no trains are within the limits of the interlocking and that all apparatus is normal as shown on the circuits. Now a train enters track circuit A3T which will cause signal 3 to clear and permit a move over the crossing. The shunting of track relay A3TR opens the stick control of 3ASR which completes a circuit for energizing relay RR so that it closes its polar contacts to the right. The circuit for the RR relay is: Battery, front contacts 2ASR and 1ASR, back contacts 2SR and 1SR, front contacts RLR, 2RGPR and 1RGPR, coils of RR, front contacts 3RGPR and 4RGPR, back contacts 3SR, 4SR and 3ASR, and normal contact on emergency release 1-2TE to C. This circuit checks that, the approaches of the other route are unoccupied (1ASR-2ASR), all signals are at stop (RGPR), locking relay RLR is picked up, and stick relays of all routes are de-energized (SR). The use of front contacts on the SR relays will become apparent later.

Control of Locking Relay "RLR"

Prior to the opening of relay 3ASR, relay RLR was energized by battery passing over front contacts 1ASR and 2ASR, polar contact RR to the left, coils of the RLR relay thence to common over front contacts 1TR and 3TR but when the RR polar contact reversed the RLR became de-energized and in due time dropped due to contact 3ASR being open and the alternate pick up circuit is open at contacts 4SR and 3SR. The

locking relay RLR may thus be checked de-energized in the signal control circuit.

Control of Signal #3

With route selection relay RR poled to the right the circuit for clearing signal 3 is completed by battery through back contact RLR, normal contacts 3-4TE, 1-2TE, front contacts 1TR, 3TR, polar contact RR to the right, front contacts 1RGPR, 2RGPR, checking contacts 2ATER, 1ATER, front contact 4ASR, back contacts 3ASR, and 4SR, front contact 4RGPR to signal mechanism 3G and to common over a polar contact of RR to the right. This causes 3RGPR to drop. The RLR contact checks that the lock relay is de-energized, 3-4TE, 1-2TE, 2ATER and 1ATER check that time releases and thermal relays are in their normal positions so that the full time interval will be measured when they are used, 1RGPR and 2RGPR check that conflicting signals are at stop, 1TR, 3TR and 4ASR check that the track circuits in the route are unoccupied, 3ASR approach clears the signal, 4SR prevents signal 3 from clearing when a train receding from the crossing enters track section A3T and 4RGPR checks that the opposing signal is at stop.

Control of Receding Stick Relay "3SR"

When the train accepts signal 3 and enters track section 3T relay 3SR will pick up to prevent signal 4 from clearing after the train clears 3T track section passes signal 4 and occupies A4T. The circuit for 3SR is, battery, back contacts 3TR and 3RGPR, coils of relay, normal contact on 3-4TE to C. The purpose of the 3-4TE contact will be explained later. The shunting of 3TR opens the control of signal 3 and picks up 3RGPR but 3SR remains stuck up through 3TR down and later when A4T track section is occupied through 4ASR down

and front contact of 3RGPR. The SR relays have resistor snubs to retard their release so that their front contacts will remain closed even though the circuits to the relays should be opened as may occur when single units of equipment move at high speeds through the interlocking, in which case, detector relay 1TR or 3TR may pick up before the ASR relay drops to retain the stick circuit. After train has passed over the crossing and cleared track section A4T, relay A4TR will pick up which in turn will pick up the 4ASR and 3SR will drop. Let it be assumed that train does not recede track section A4T, but desires to again pass over the crossing by clearing signal 4. As already explained signal 4 is prevented from clearing, when 4ASR is down, because 3SR is up but by operating the 3-4 emergency release the 3-4TE contact will open and drop the 3SR which will in turn allow signal 4 to clear in the regular signal network manner already outlined for signal 3 and after the 3-4TE contact closes.

If no other trains have entered the approach section during the above operation, all the relays except the RR relay will have returned to the condition in which they were found before the train entered A3T track section. The RR relay will be de-energized with its polar contacts to the right, due to battery now being on both sides of relay.

Locking out Signal Clearing for Conflicting Route.

If a train entered the conflicting route, say AP1T track section, while the train movement already described was in track section A3T, relay 1ASR would drop but relay RLR could not pick up to allow the RR relay to change because of de-energized contact 3ASR.

Clearing Signal for Train on Conflicting Route after First Train passes over the Crossing

When first train cleared 3T track section, 3SR would have been picked up and slow pick-up relay RLR would pick up by battery over back contact 4SR, front contact 3SR, polar contact RR to the right, coils of RLR and front contacts 1TR and 3TR to common to permit the reversal of RR. The circuit for reversal of RR is: B, front contacts 3SR and RGPR, coil of relay RR, front contacts RGPR and RLR, back contacts SR and 1ASR, normal contact 3-4TE to C. The direction of current through the relay is now opposite to that previously traced and relay RR will close its polar contacts to the left thus de-energizing slow release relay RLR because relay 1ASR is de-energized and permitting signal 1 to clear over a circuit which is similar to that described for signal 3.

Routing Trains by Sequence of Entrance on Approach

It will be apparent from the control of relay RR that if another train should follow the train approaching signal 3 or receding from the crossing after having passed signal 3, the entrance of a train on the conflicting route will cause a change in route when the first train clears the detector circuit for then relay 3SR will be energized and complete the circuit for reversal of relay RR through front contact of 3SR and back contact 1ASR as previously described to effect the clearing of signal 1.

Preventing Change of Route or the Loss of Approach Cleared Signal by Loss of Shunt on the Approach

Thermal relays ATER have been introduced into the control of ASR relays to prevent the loss of an approach cleared signal within a set time and, in combination with relay RLR, prevent the clearing of a conflicting signal for a longer time in event of loss of shunt

on an approach circuit. This is effected by preventing the ASR relay from picking up until the thermal relay has operated to introduce the desired time delay. The circuit for 3ATER is B, front contact A3TR, back contact 3ASR to heater of 3ATHR. (Relays 1ASR and 2ASR are controlled over line circuits from the distant signals so relays ASPR are introudced into the control of the ATER relays to permit operation of the thermal relays from local battery.) When 3ATER front contact closes, the circuit is complete through A3TR and 3ATER to energize 3ASR. The de-energized position of the ASR relay maintains the signal clear during the heating time of the thermal relay.

Should the loss of shunt exist for a long enough period of time to permit relay RR to reverse its polar contacts, the thermal relay would have to reclose its checking contact before a signal for a conflicting route would clear. This introduces a time period greater than the heating time of the thermal relay during which the train which has lost shunt will either stop or enter the detector section.

Front contact 3SR or 4SR which is closed when a train accepts signal 3 or 4 provides a pick-up circuit for the respective ASR to avoid the time delay which would otherwise be introduced by the thermal relay.

Circuits for Preventing Change of Route through Momentary Failure of Detector Circuit with Train on Approach

If track relay 3TR should momentarily drop for any reason while the first train was on A3T section approaching signal 3 clear, the signal would go to stop due to the opening of 3TR contact in the signal control. 3SR would also pick up for the occurrence produces exactly the same circuit operation as though the train had in fact

passed signal 3. When 3TR picks up signal 3 will immediately clear and open the RR circuit at the 3RGPR contact. A circuit is also completed for abrief period to energize RLR through a back contact of 4SR, front contact 3SP, polar contact RR to the right and front contacts 1TR and 3TR to common. As RLR has a slow-pick-up characteristic the SR relay will drop before relay RLR closes its front contact and no change in the position of RR'S polar contact will occur to interrupt signal 3.

Preventing Loss of Route by loss of Shunt on Detector Section after Train has Passed Home Signal

After a signal has been passed, the slow pick-up feature of the RLR relay may be depended on to introduce the necessary delay in change of route if a momentary loss of shunt should occur on the detector track circuit.

Train Entering and Receding without Passing over the Crossing

If a train enters an approach and recedes without passing over the crossing the thermal relay must operate to pick up the AS^R relay after approach track section is cleared before the route may be automatically changed for another move.

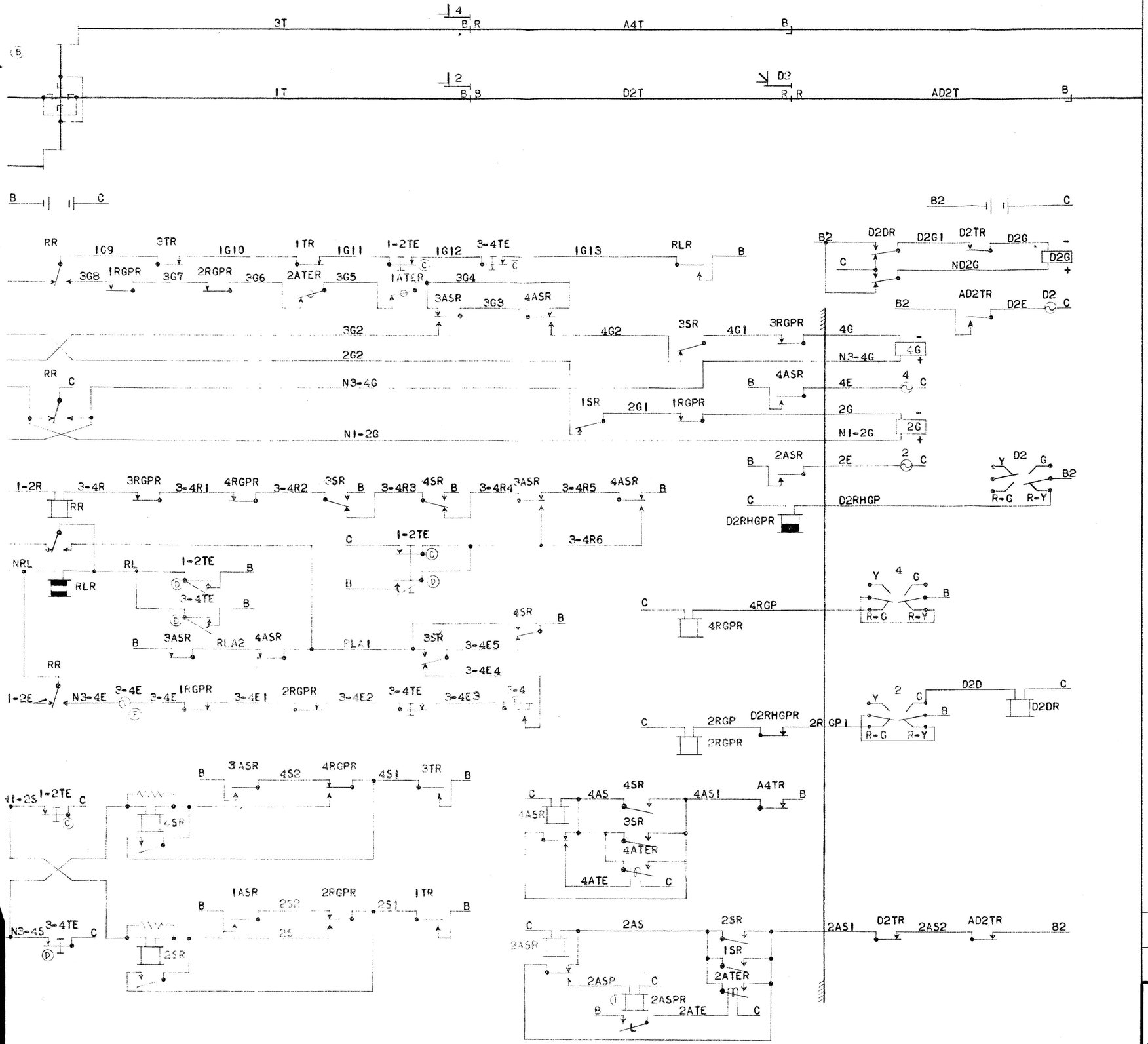
Changing Route by Emergency Release

To illustrate this operation, let us assume that a train has entered A3T track section, that signal 3 has cleared and that a second train enters the conflicting route, say on AD1T track section, proceeds to signal 1 which is at stop. If the first train is not to proceed over the crossing a trainman may annul the route set up and establish circuits for the clearing of signal 1.

Under the above circumstances, when a trainman opens the door of the housing containing the 1-2 release, lamp 1-2E will be dark due to open contact 3RGPR.

Now, if time release 1-2TE (unlatched type) is operated, the circuits for signal 3 and relays 1SR and 2SR will be interrupted immediately at normal contacts 1-2TE in their respective circuits. The operation of the release handle to its extreme reverse position winds up the release, which, after the handle is released, will start to run down. When within 30 seconds of the end of its operating time mid-stroke contacts 1-2TE in the control of RLR will pick up relay RLR closing its contact in the RR circuit which in turn will cause it to move its polar contacts to the left. After 20 seconds these mid-stroke contacts on 1-2TE will open and thus de-energize relays RLR and RR. Ten seconds later front contacts 1-2TE in the control of 1SR, 2SR and the signals will close and permit signal 1 to clear through a circuit similar to that previously traced for signal 3.

When time element 1-2TE completed its operation and returned to normal lamp 1-2E should be illuminated as polar contact RR is now closed to the left. If signal 1 fails to clear and lamp 1-2E is illuminated the trainman will know that the signals on the crossing road are at stop and that it is safe to proceed over the crossing in accordance with the operating rules in effect at that point.



NOTES

(A) = ALL APPARATUS CENTRALIZED IN ONE HOUSING.

(B) = MANUAL TIME RELEASE HOUSING.

(C) = CONTACT ON TC-10 TIME RELEASE (PL. J1705). CLOSED IN NORMAL (RUNDOWN) POSITION.

(D) = CONTACT ON TC10 TIME RELEASE (PL. J1705). CLOSES 30 SEC. BEFORE AND OPENS 10 SEC. BEFORE REACHING NORMAL (RUNDOWN) POSITION.

(E) = MANUAL RELEASE HOUSING DOOR CONTACT IF DESIRED.

(F) = LIGHT INDICATOR IN MANUAL RELEASE HOUSING.

APPARATUS

(1) = L10 RELAY. (PL. E-5080 REF. Aa)

PRINCIPAL FEATURES

1 - PREVENTS THE LOSS OF AN APPROACH CLEARED SIGNAL WITHIN A SET TIME AND PREVENTS THE CLEARING OF A CONFLICTING SIGNAL FOR A LONGER TIME IN EVENT OF LOSS OF SHUNT ON AN APPROACH CIRCUIT.

2 - PREVENTS THE LOSS OF A ROUTE BY THE MOMENTARY OPENING OR LOSS OF SHUNT ON THE DETECTOR TRACK CIRCUIT.

3 - PREVENTS CHANGE OF ROUTE CIRCUIT TO CONFLICTING ROUTE UNTIL FIRST TRAIN CLEARS THE DETECTOR CIRCUIT OR BACKS OFF APPROACH SECTION.

4 - PERMITS A SIGNAL TO CLEAR FOR EITHER A CONFLICTING ROUTE OR REVERSE MOVEMENT BY OPERATING MANUAL TIME RELEASE.

5 - INTERLOCKING FEATURE ACCOMPLISHED BY POLAR RELAY.

6 - A ROUTE WILL BE ESTABLISHED IN THE SAME SEQUENCE IN WHICH THE TRAINS ENTER THE APPROACH SECTION EXCEPT THAT A CONFLICTING TRAIN MOVEMENT, ENTERING THE APPROACH AFTER A SECOND TRAIN THAT IS FOLLOWING A FIRST TRAIN, WILL GAIN CONTROL OF THE CROSSING BETWEEN THE TWO TRAINS.

7 - A TRAIN LEAVING THE REAR OF ITS TRAIN ON AN APPROACH WHILE THE HEAD END PASSES OVER AND CLEARS THE DETECTOR CIRCUIT WILL NOT HOLD OUT A CONFLICTING TRAIN.

8 - LIGHT INDICATION IN MANUAL RELEASE HOUSING DESIGNATING THAT CONFLICTING SIGNALS ARE AT STOP, DETECTOR CIRCUITS ARE UNOCCUPIED AND ROUTE CIRCUIT HAS LOCKED OUT CONFLICTING SIGNAL CONTROL.

REVISIONS

3	5-20-38

REDRAWN TO ELIMINATE LINE WIRE, APPARATUS & HOUSINGS AND REVISED TO SHOW MANUAL RELEASE LIGHT INDICATION CUT THROUGH TRACK CIRCUIT

Ema HSY

REFERENCES

DOCKET 3945

U. S. & S. CO. OPERATING DESCRIPTION D2.7.12

SINGLE-TRACK, TWO-ROAD CROSSING, NORMALLY ENERGIZED APPROACH-LOCKING FEATURE, D.C. SCHEME.

SEARCHLIGHT HOME AND DISTANT SIGNALS, TIME ELEMENT EMERGENCY RELEASE, POLAR CONTACT CONFLICTING ROUTE CHECK. (SEE FEATURE 1)

DESIGNED EMA
DRAWN CAB-B
TRACED NS-SAO
CHECKED
OK'D

AUTOMATIC INTERLOCKING SYSTEM
GRADE-CROSSING PROTECTION
TYPICAL SYSTEM CIRCUITS

U. S. & S. CO., SWISSVALE, PA. SCALE: NONE

APPROVED HSY DATE 3-1-38
1 SHEETS SHEET No. 1
DATE 2-1-38

TE 30A9