American Railway Signaling Principles and Practices

CHAPTER XXVI

RELAY INTERLOCKING

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AMERICAN RAILWAY SIGNALING PRINCIPLES AND PRACTICES

Following are the titles comprising this series of educational chapters:

I—History and Development of Railway Signaling
II—Symbols, Aspects and Indications
III—Principles and Economics of Signaling
IV—Centralized Traffic Control, Part 1 (Series line systems)
IV—Centralized Traffic Control, Part 2 (Multiple line systems including carrier control operation)
V—Batteries
VI—Direct Current Relays
VII—Non-Coded Direct Current Track Circuits
VIII—Transformers
IX—Rectifiers and Battery Chargers
X—Alternating Current Relays
XI—Non-Coded Alternating Current Track Circuits
XII—Semaphore Signals
XIII—Light Signals and Light Signal Lamps
XIV—Definitions
XV—Block Signal Systems
XVI—Interlocking
XVII—Mechanical and Electro-Mechanical Interlocking
XVIII—Electro-Pneumatic Interlocking
XIX—Electric Interlocking
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XXVI—Relay Interlocking

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CHAPTER XXVI

RELAY INTERLOCKING

General

Early types of interlocking, as described in Chapters XVII—Mechanical and Electro-Mechanical Interlocking, XVIII—Electro-Pneumatic Interlocking and XIX—Electric Interlocking, provided mechanical locking between the levers of the control machine to enforce a predetermined sequence of lever operation.

When the need arose to control field functions some distance from the control machine, relay circuits were developed in which all locking is done by circuiting rather than by means of mechanical locking of the levers.

Relay interlocking makes it possible to use very compact control machines to replace large and cumbersome mechanical, electro-mechanical, electro-pneumatic and electric interlocking machines. Relay type machines permit more efficient use of existing space without requiring the construction of special control towers. As a result, modern towers can be designed with a minimum of space and with a saving in initial cost.

Compact control panels, free-operating miniature levers, and continuously displayed indications increase the capabilities of the operator. As distance is no longer a barrier, extensive interlocking consolidation is readily attained.

The use of simple, reliable relays instead of mechanical devices provides low-cost maintenance, and ensures speed and absolute integrity of operation.

There are today three general types of relay interlocking: namely, local control, remote control, and automatic. Local and remote control interlockings use either individual lever type or route type control machines. Local control interlocking uses direct wires to control and indicate field functions. Remote control uses either direct wire, coded direct current or carrier, or selective carrier frequencies to control and indicate field functions. Automatic interlocking, of course, does not require a control machine.

Because of its many advantages, relay interlocking is rapidly replacing older types and is used for new installations.

Chapter I—History and Development of Railway Signaling lists in chronological order the development of the various types of relay interlocking.

Control Machines

The Signal Section, Association of American Railroads, defines Control Machine for relay interlocking as: An assemblage of manually operated levers or other devices for the control of signals, switches or other units, without mechanical interlocking, usually including a track diagram with indication lights. Other indicating devices such as point indicators are sometimes used.

Control machines, and associated circuits in the field, incorporate the following features:

1. Levers, knobs, or buttons are free-working and can be moved at any time. Any improper manipulation cannot create an unsafe condition.
2. Under normal conditions, track switch points and derails can be moved at any time that they are not electrically locked in an established or occupied route.
3. Operative signals can display a Proceed aspect only when there is an established route.
4. Electric locking guarantees the integrity of the route and provides that no track switch or derail in a route can be moved while locking is effective and

no opposing or conflicting functions can be operated until the route or section thereof is released.

Individual lever type machines.

Individual lever type machines, Figs. 1 through 8, have levers on the machine panel for the control of each switch, signal, electric lock, derail, etc.

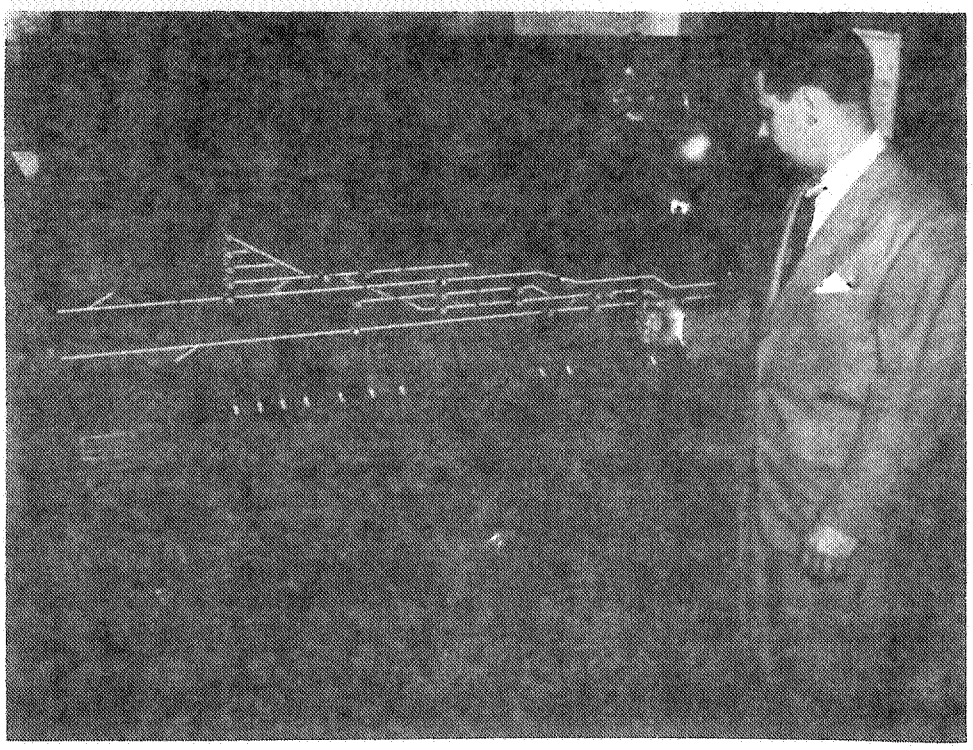


Fig. 1.
Control Machine with Signal Levers in the Track Diagram and Movable Route Indicators.

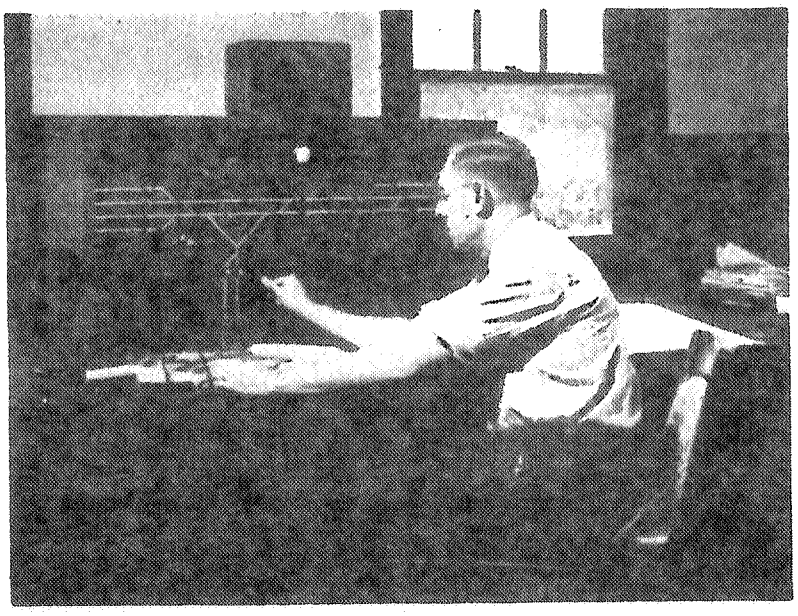


Fig. 2.
Control Machine with Signal Levers in the Track Diagram and Rotary Switch Levers.

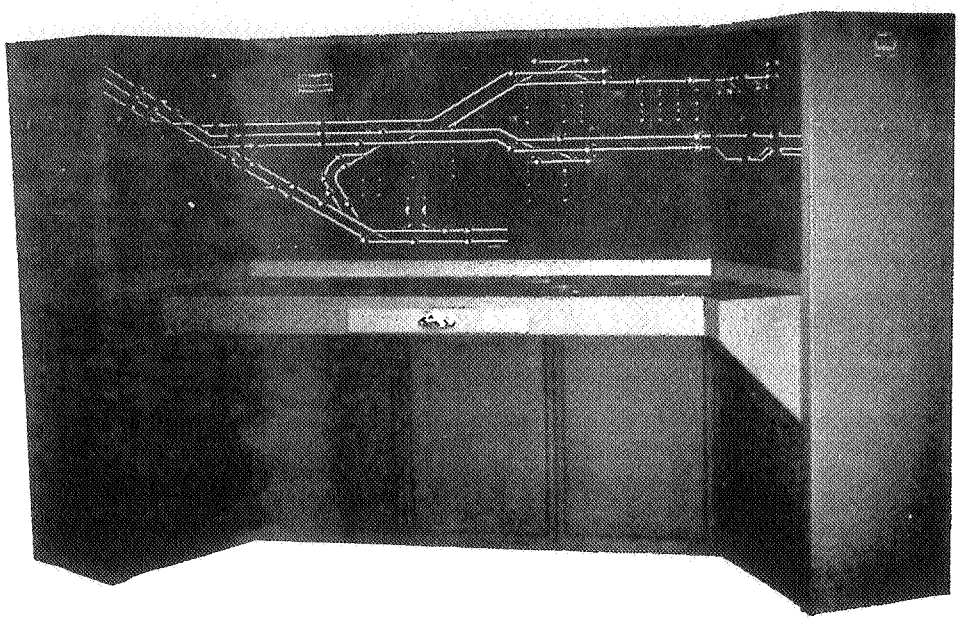


Fig. 3.
Wing Type Control Machine with Signal Levers in the Track Diagram.

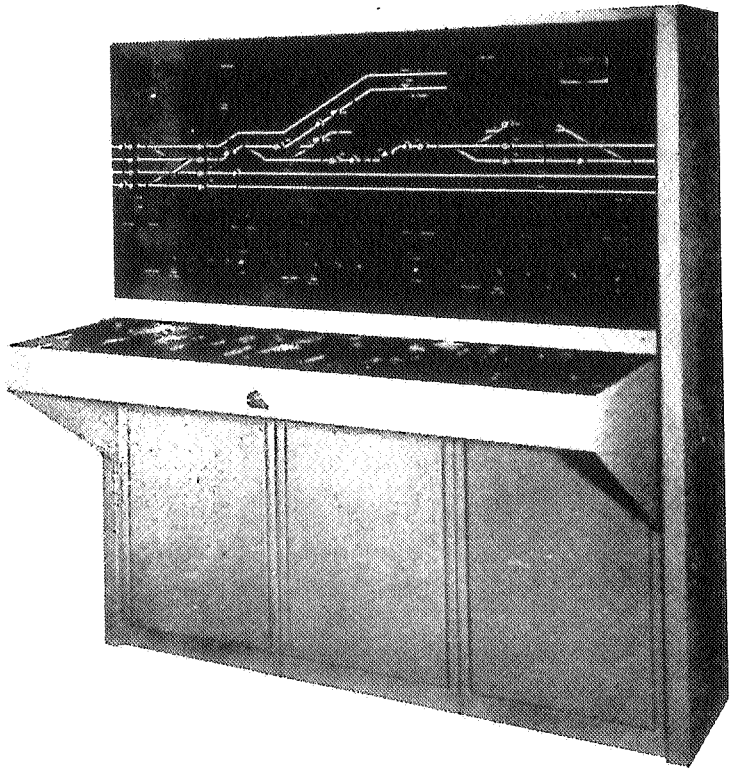


Fig. 4.
Control Machine for Coded Remote Control.

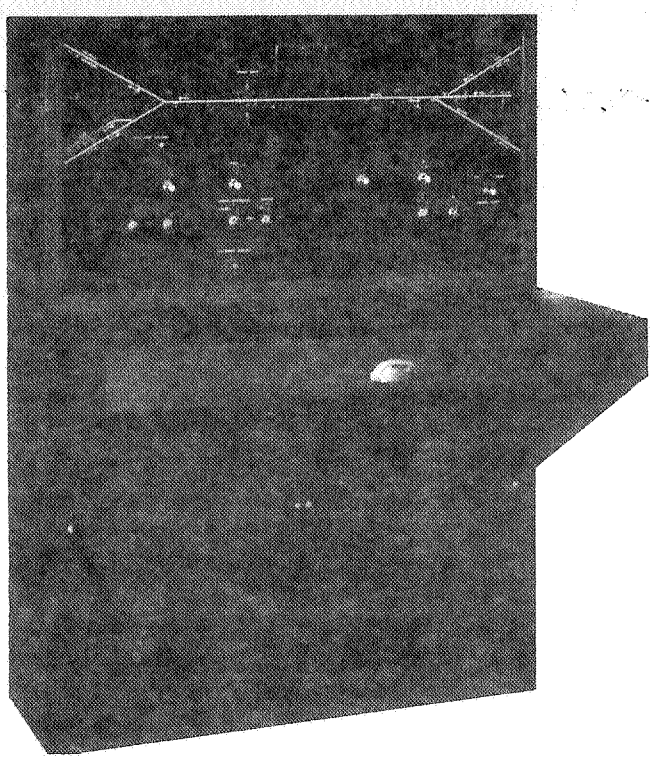


Fig. 5.
Control Machine with Switch and Signal Control Levers Below the Track Diagram.

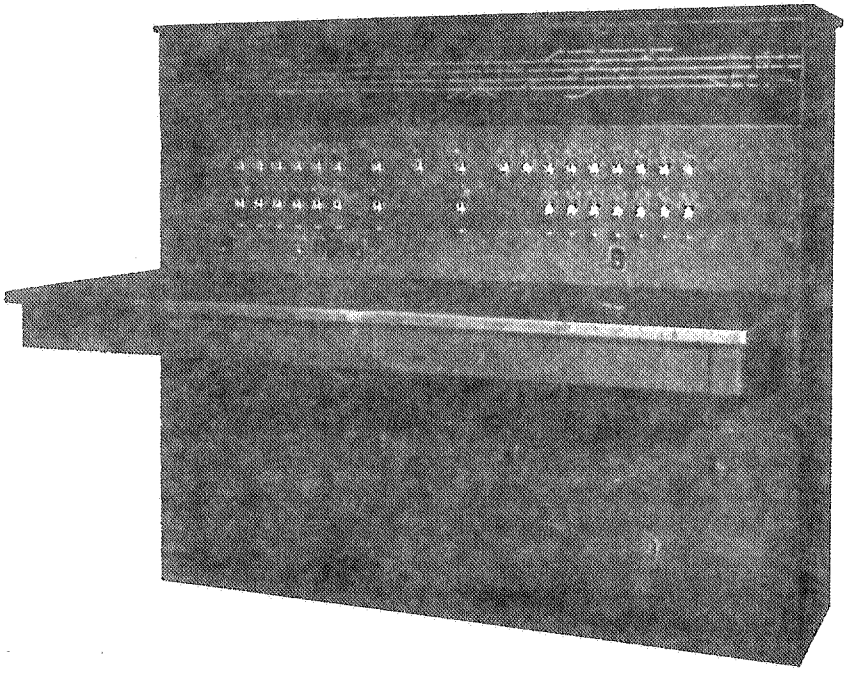


Fig. 6.
Unit Lever Control Machine—Levers Below Track Model.

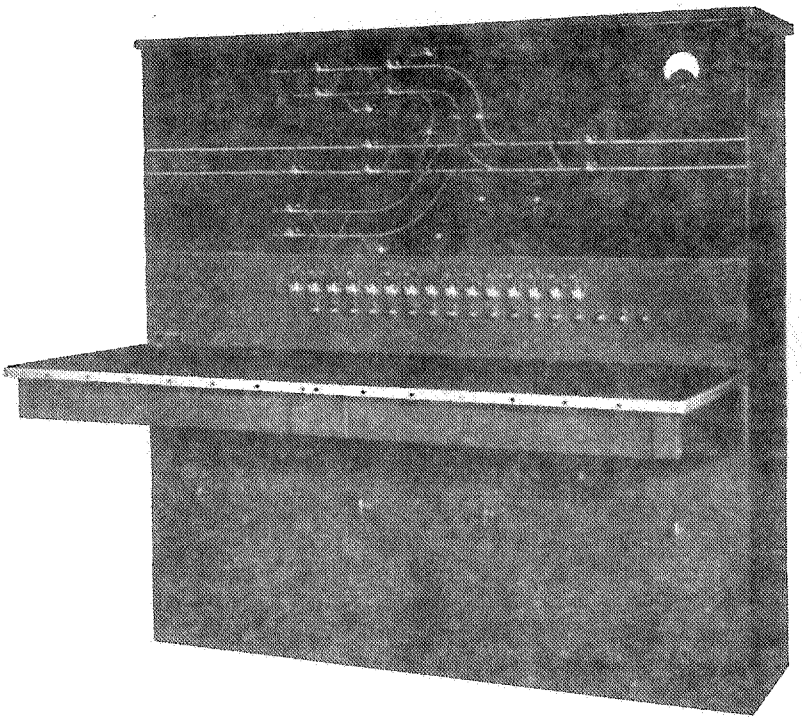


Fig. 7.
Signal Levers in Track Model.

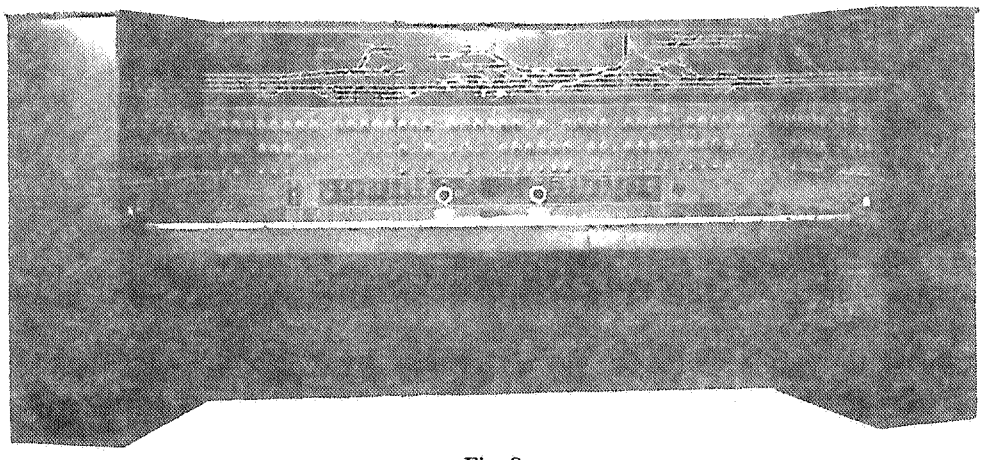


Fig. 8.
Push-Turn Signal and Switch Levers Below Track Model.

Several arrangements of these levers in common use are:

1. Signal and switch levers located below track diagram:

   Referring to Fig. 9. Two lamps above a three-position rotary signal lever indicate, when illuminated, that the signal is cleared to the left or right. A third lamp indicating the signal at stop, can also be provided. The indication that time locking is in effect is provided by extinguishing all lights over the lever. The two-position rotary switch lever usually has two indication lights: namely, normal and reverse. A third light indicating that field locking is in effect is also commonly provided. A two-lamp arrangement where one lamp is used to indicate that the switch machine is out-of-correspondence with its lever and the other to indicate field locking is in effect is also provided.

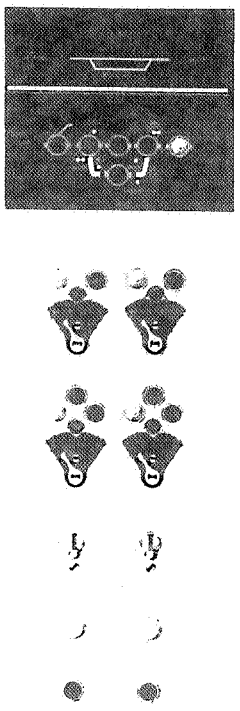


Fig. 9.
Typical Arrangement of Levers Below Track Diagram.

Referring to Fig. 10. This type of machine is generally furnished with the control panel normally dark. Individual directional indicating lamps are located above the three-position rotary signal lever to indicate, when illuminated, that the signal is cleared to the left or to the right. When desired, an indication lamp can be provided in the barrel of the signal lever to indicate that the signal is cleared. The direction in this case is indicated by the position of the lever. The two-position rotary switch lever contains a switch correspondence light in its barrel which is illuminated when the switch point position does not agree with the position of the lever. The lock light, located on the panel below the switch lever, is illuminated whenever the electric locking is in effect. This locking includes all detector locking, route locking, time locking, or other types of locking that may be required. Indications other than those stated can be provided as required.

2. Signal levers located in track diagram, switch levers below:

   Referring to Fig. 7. Signal indications are located adjacent to the two-position signal lever in the track model. One light indicates signal

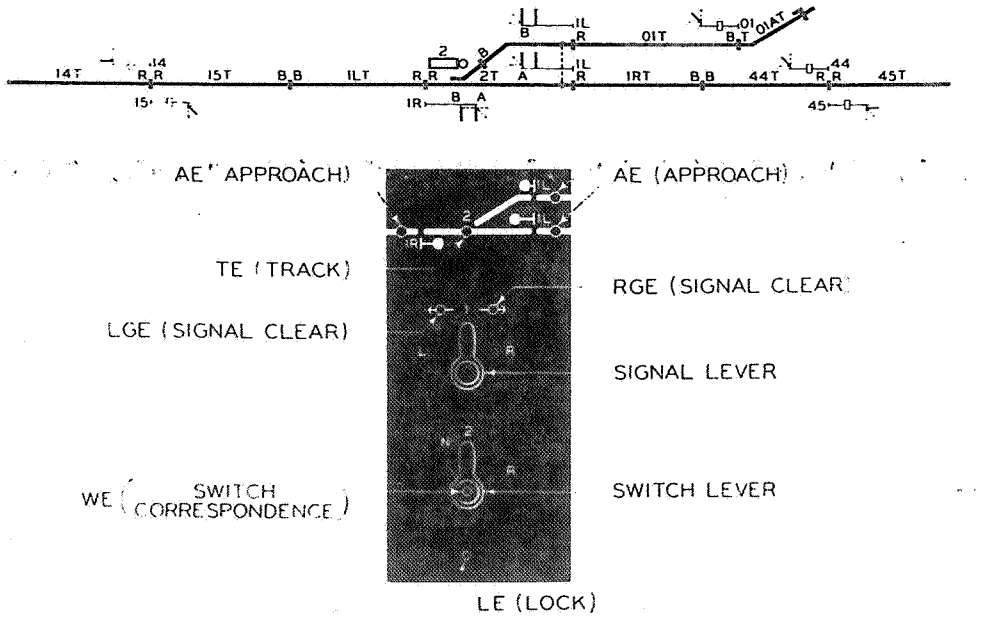


Fig. 10.
Diagram of Typical Control Panel.

clear, the other light indicates signal at stop. Variations of the above indications are sometimes used to indicate preliminary clearing of signal, time locking, etc.

Two-position switch levers are arranged with three indication lights each, one for normal position, one for reverse position, the other for locked indication. The combination of the normal and reverse indication lights indicates out-of-correspondence.

Referring to Fig. 11. A flashing light in the barrel of the signal lever indicates the signal is called to clear; a steady light that the signal has cleared. An alternate method is the use of the two separate colored lamps, both located in the barrel of the signal lever. Indications for the signal levers are the same as for Fig. 10.

3. Switch levers located in track diagram, signal levers below:

   Switch levers, when combined with movable route indicators, have two lamps in the barrel for correspondence and lock indications. Indications for the signal levers are the same as for Fig. 10.

Special levers, knobs, switches, and lights may be provided on the machine panel, for example: traffic levers, maintainer call switches, power-off indication lights, etc.

Track lights, located in the track diagram, are illuminated when corresponding track sections are occupied by a train. Occupancy of approach track circuits may be accompanied by an audible indication.

Route type machines.

Route type control machines are illustrated in Figs. 12 through 15. On the track diagram at all route entrances are knobs or controllers which physically represent interlocking signals in the interlockings. Push buttons, or other controllers, also located in the track diagram, represent exits of routes. Complete routes may be established through the interlocking by manipulation of the entrance knob or controller at the entering end of the route and the push

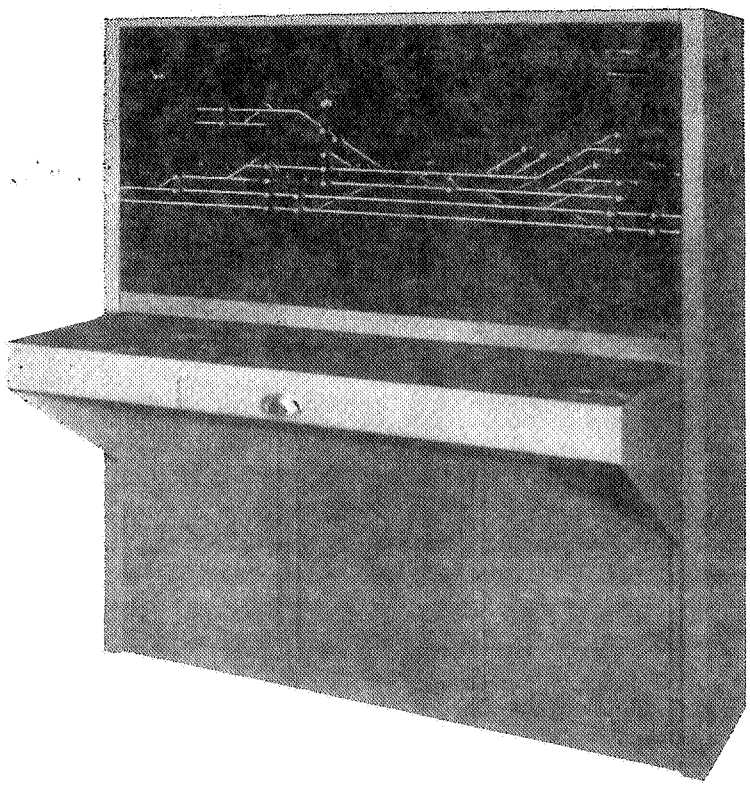


Fig. 11.
Control Machine with Signal Levers in Track Diagram,
Switch Levers Below.

button or controller at the leaving end. Such manipulation of levers automatically establishes the route, throwing the required switches and clearing the required signals. The proper sequence of operation is established by relay circuits associated with the control machine. A route as lined up on the control panel can be displayed by the movable route indicator system or the line-of-light system.

The movable route system, Fig. 16, employs electrically operated point indicators mounted in the track diagram. The movable points pivot across the white track lines at the point of divergence so the route set up shows as a solid white line. The route locked up is shown by the illumination of red lock lights at the points of the route indicators. Track lights are provided on the track diagram to show the progress of a train over its route.

With the line-of-light system, Figs. 17 and 18, an established route is outlined from entrance to exit by illumination of light panels in the track diagram. When a train enters the route, light sections representing respective track circuits in the interlocking change from white to red, denoting occupancy. These same sections go dark behind a train as the route or sections of the route are released unless fleeting movements are in progress in which case they will return to white. If the route has not been accepted by a train, the line sections continue lighted white while the route is approach or time locked. In line lighting, the track diagram is normally dark, and lighting appears only when the machine is activated by the establishing of a route, by an approach becoming occupied, or by manipulation of individual switch levers for operation or test. Switch positions are indicated by normal or reverse light sections being lighted steadily for "correspondence" or flashing for "out-of-correspondence" between the switch and its control.

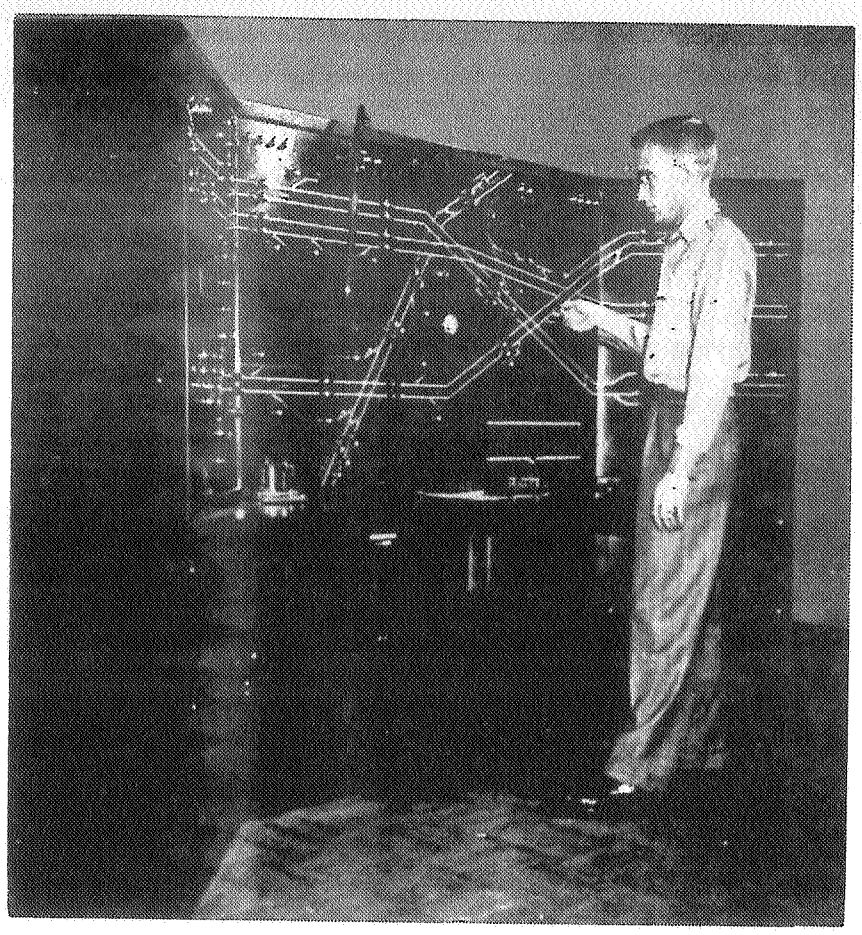


Fig. 12.
Route Type (NX) Control Machine with Movable Route Indicators.

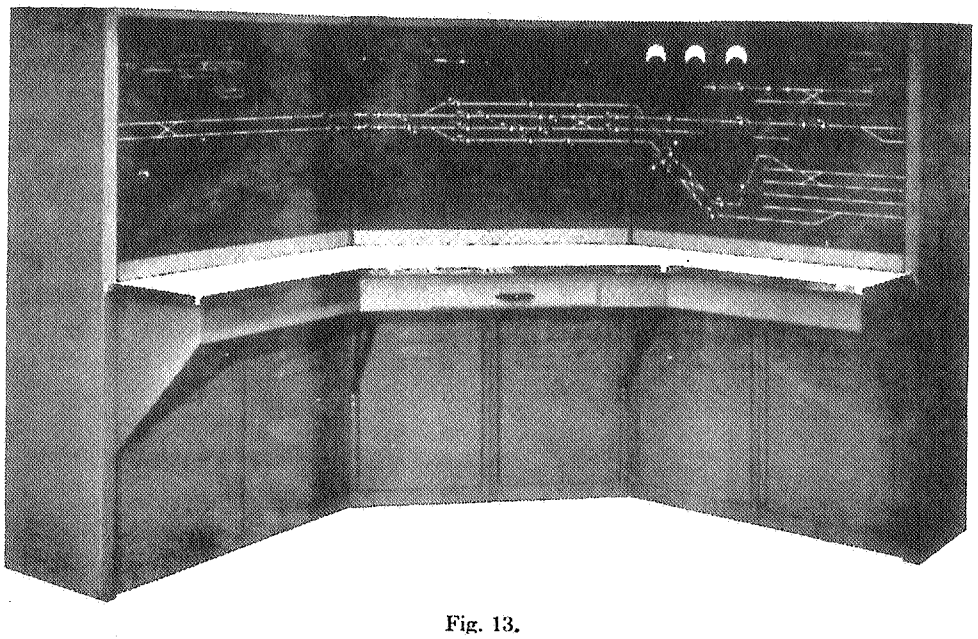


Fig. 13.
Route Type (NX) Control Machine with Line-of-Light.

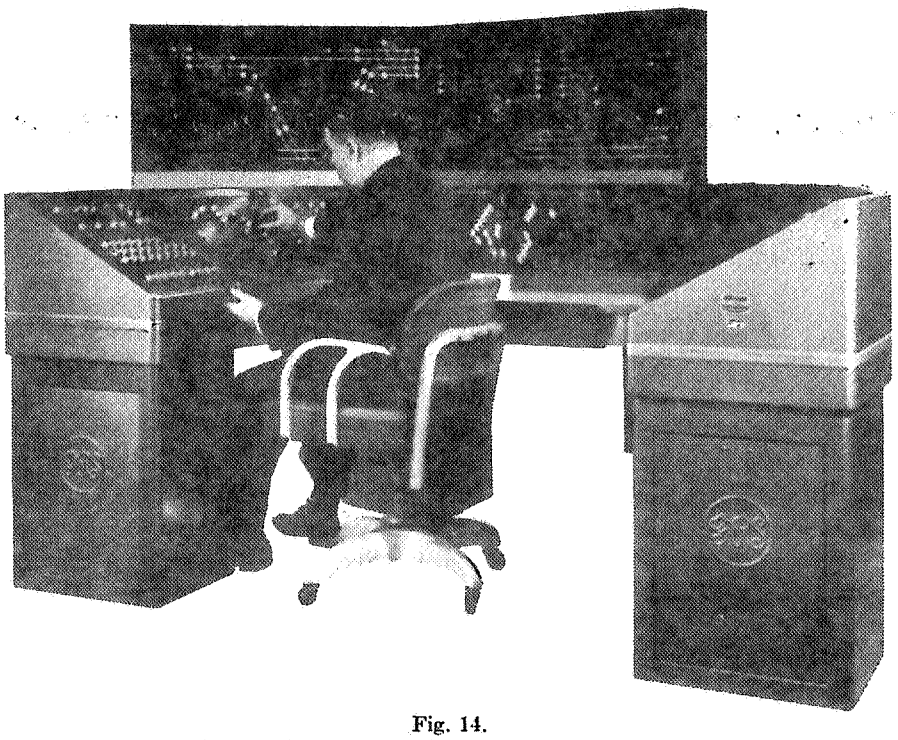


Fig. 14.
Console Route Type (NX) Control Machine with
Separate Track Diagram.

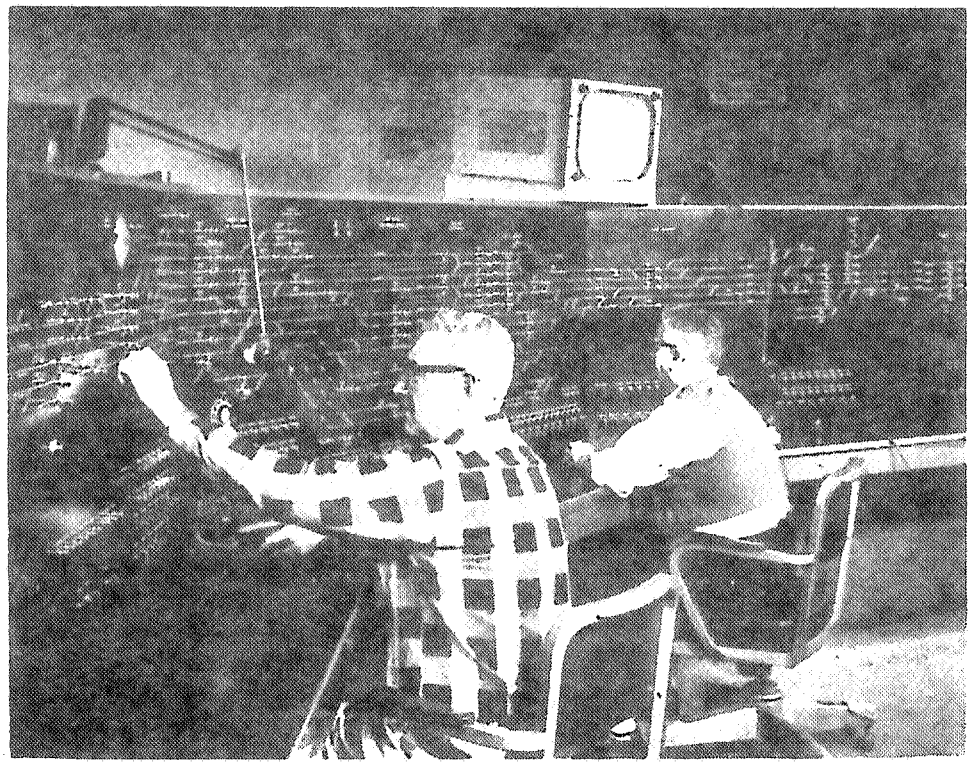


Fig. 15.
UR Line-of-Light Control Machine.

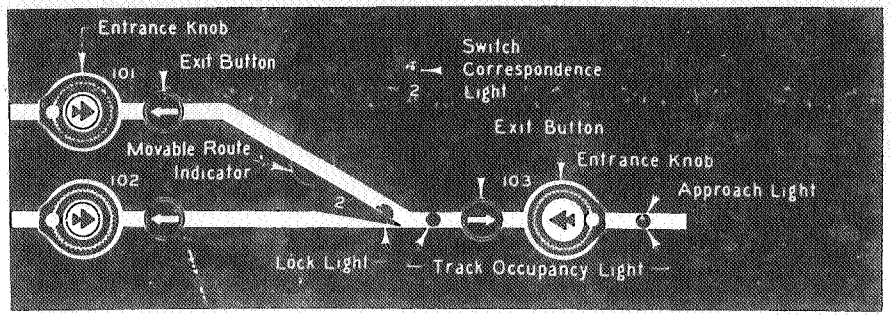


Fig. 16.
Movable Route Indicator Panel.

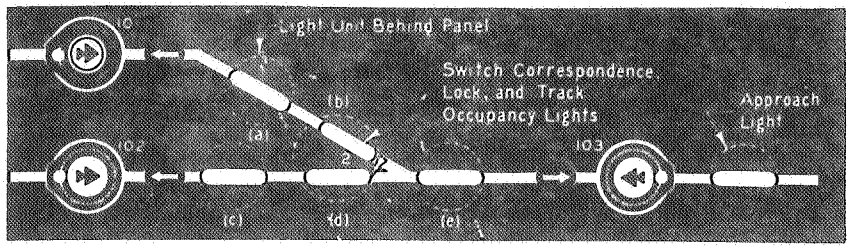


Fig. 17.
Line-of-Light Panel.

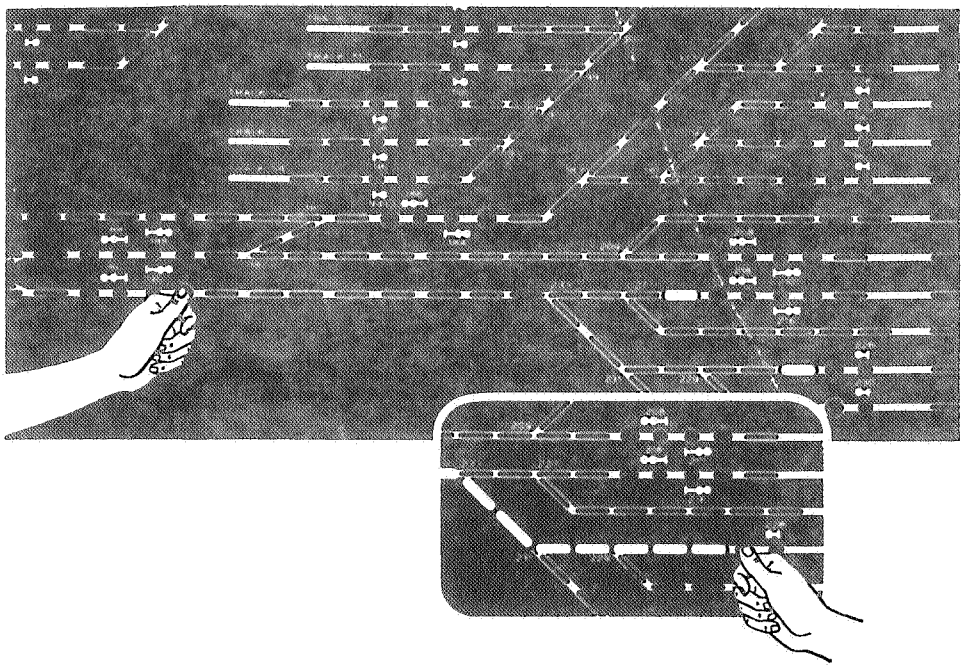


Fig. 18.
Line-of-Light Track Indication.

Individual auxiliary switch levers are usually included on the control panel of route type machines to provide means for the individual operation of the switches in the interlocking. Individual operation may be necessary for testing purposes, for preselection of a route, or for use in an emergency.

The entrance buttons or controllers employed on route type machines are usually arranged to be pushed, pulled, and/or turned. Pushing the entrance button and the exit button in sequence establishes a route. Automatic restoration of the route is accomplished by passage of the train, thus permitting the aligning of other routes as the sectional locking becomes released; pulling the entrance button will cancel the route if such route has not been accepted by a train. Turning the entrance button holds the route for a succession of trains or "fleeting" movements. In this case, the controlled signal operates similar to an automatic signal and repeatedly reclears automatically after each train vacates the block. Turning the entrance button downward or with a separate calling-on button the signals may be cleared for restricted movements into occupied tracks. In either case, when setting up the route for fleeting or calling-on, the entrance and exit buttons must be pushed first to set up the desired route.

Many interlockings provide two or more possible routes between entrances and exits. The system is so arranged that a preferred route will be set up for usual operation and a secondary route automatically set up when any part of the preferred route is not available. Where the interlocking layout is such as to provide for additional choices, other alternate routes are automatically selected as traffic conditions dictate. Alternate routes may also be set up by the use of the individual auxiliary switch control levers.

Several methods are available for indicating routes initiated and completed. One method, using a single white lamp in the entrance knob, causes this lamp to flash when the route is initiated. On completion of the route, when the switches are over and locked and the signals cleared, the flashing white light becomes steady white. These indications are similar to those on a centralized traffic control machine. Another method uses two lamps in the entrance knob, which may be used in two different ways. A steady red light indicates that the route is initiated, and a steady green light indicates the signal is clear; or a flashing red light indicates the route is initiated, a steady red light the route is complete but the signal has not yet cleared; a flashing green light indicates the low-speed signal is clear, and a steady green light that the high or medium-speed signal is clear.

A method utilizing the line-of-light for track indication illustrated in Fig. 18 operates essentially as follows: When the entrance button is pushed a red light is displayed indicating the entrance selected; at this same time all available exits are indicated by illuminating the individual line-of-light sections adjacent to their respective exit buttons. Upon selection of the desired exit, all switch lever indicating lamps flash red to indicate movement of the switch to the desired position. When all the switches are in the proper position, the entire route becomes lighted with a white line-of-light. The entrance light or signal indication light changes from red to green, indicating the signal is clear. A flashing green indication light is sometimes used when the signal is cleared for a restricted move. Various other deviations such as color of lamps, whether flashing or steady, have also been used for certain indications.

One form of route interlocking, designated NX (eNtrance-eXit) makes use of separate push-pull-turn entrance knobs and push exit buttons or a single push-pull-turn knob which serves as an entrance or exit depending upon the sequence of operation of the knobs. Another form, designated UR (Union Route), uses the single push-pull-turn controller for entrance and exit purposes. The first

controller operated actuates functions to establish an entrance, while the second one determines the exit. In either case, a maximum of two buttons is used to line up a route.

A feature termed "through-routing" or "end-to-end route line-up" can be provided in the route type system whereby it is unnecessary to use intermediate control knobs or controllers for a complete route through the interlocking. Controls are usually provided so that upon actuating a given entrance, an exit may be taken at any intermediate exit or at the last exit, as desired.

Push button control centers.

As the territory covered by one traffic control system increased, the control machine increased in size and it became difficult for one man to manipulate the controls. A recent approach to this situation was the development of more compact control machines with a push button control console separate from the track diagram panel. Less space is required, providing for ease of control of increased territory by one operator.

One form of push button control center, designated "Traffic Master," comprises a desk-sized console and separate illuminated track diagram (Fig. 19). The track diagram shows the layout of the controlled territory and displays all the indications, such as track occupancy, switch position, signal clear, etc. The console has push buttons for location selection and for control of the wayside functions. Push buttons are grouped on small detachable panels, which can be removed for maintenance or replacement.

On the track diagram the field locations are designated by numbers. Switches and signals at each location are numbered in arithmetical sequence beginning with 1. Thus, at all locations having one switch and associated signals, the number 1 is assigned. When more than one set of switches and signals are involved, the second set is numbered 2, the next is 3, and so on for as many as may be required.

On the console there is a location selection push button for each location in the controlled territory. The location selection buttons are numbered to correspond with location numbers on the track diagram. There are also on the console a number of push button panels numbered in sequence, beginning with 1. Switch and signal push buttons on each of these panels control the like-numbered functions at any location previously selected by a location

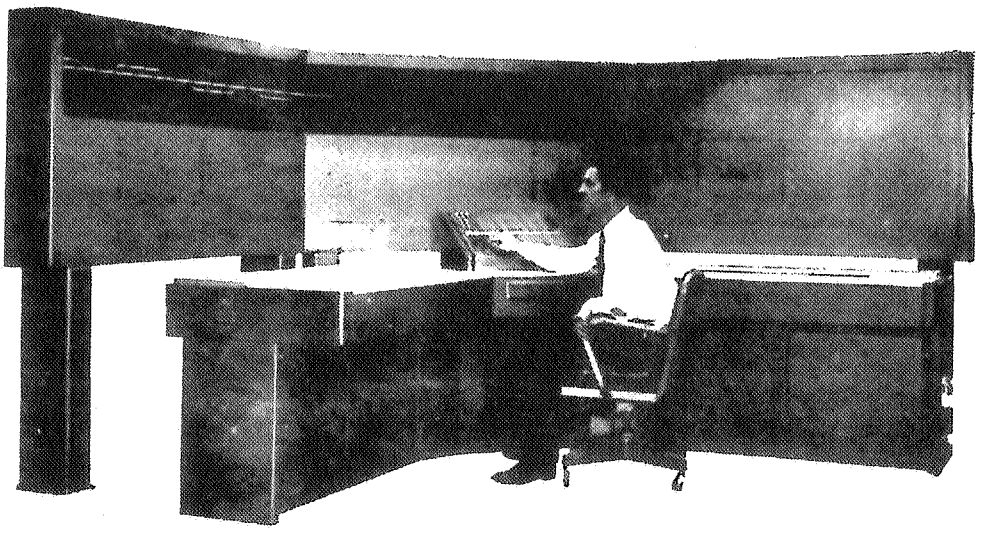


Fig. 19.
Traffic Master Control Center.

button: that is, panel 1 carries buttons for controlling all switches 1 and signals 1 in the system. If, for example, location button 1 is first pushed, pushing the switch and signal buttons on panel 1 causes operation of switch 1 and signal 1 at location 1. If location button 2 had been pushed instead of 1, pushing the same switch and signal buttons on panel 1 would have caused operation of switch 1 and signal 1 at location 2.

One such control unit, illustrated in Fig. 20 and designated "Style TCC Traffic Control Center," has the controls concentrated in a control console located in the center of the desk. A miniaturized track diagram is provided to make the control machine more compact. (Thus permitting the inclusion of larger territories.) The usual train graphs and communication panel are provided.

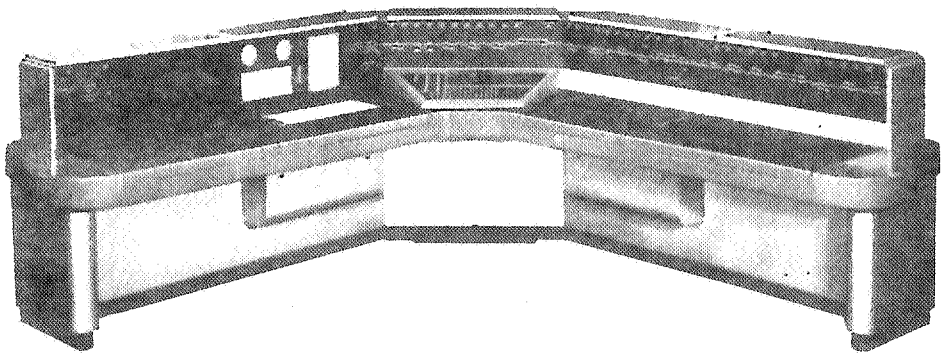


Fig. 20.
Style TCC Traffic Control Center.

The track layout is divided into similar sections or locations and each location is given an identifying number. Each location has the switch and signal functions numbered the same for similar operations. The track diagram is built up in uniform sections or modules so that additions or changes are readily made. The usual indications are provided.

The control console, Fig. 21, is equipped with push buttons instead of the levers used with the usual centralized traffic control machines. Buttons are provided for station selection, switch and signal selection, and such auxiliary

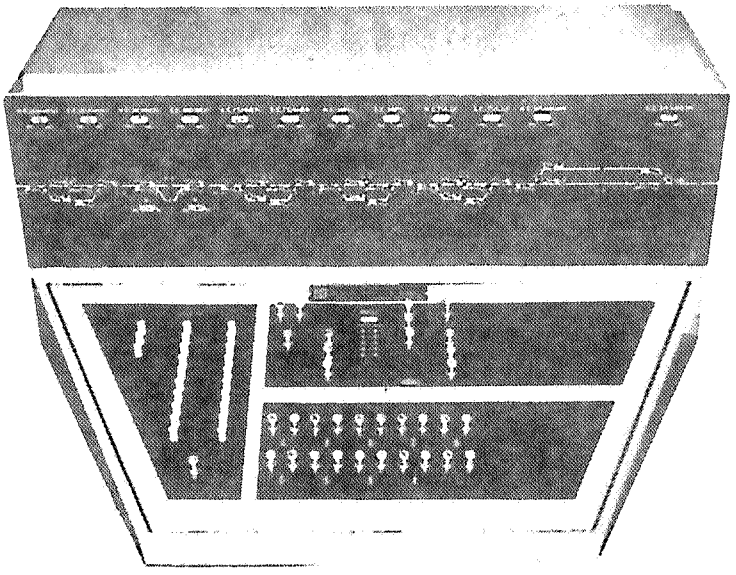


Fig. 21.
Console for Style TCC Traffic Control Center.

controls as required. Where the number of locations does not exceed 99, only two buttons must be pressed to select a location. Then the buttons for switch and signal control are pressed. As in other control machines, the intended controls are stored in circuits until the start button is pushed or the conditions canceled. With the control console mounted in the center of the desk, the dispatcher may remain in one position to operate the entire center.

Control

Relay interlocking systems are controlled by direct wire, code or carrier. Regardless of the method of control, the same principles govern and the same general pattern is followed in the design of the safety circuits surrounding the functions in the field.

As shown in Fig. 22, control of field functions from the individual lever type control machine or the route type control machine (through route network relays) can be accomplished by direct wire (near group), direct wire (far group), or by code and carrier systems. The near group direct wire scheme requires a relatively large number of line wires. When the distance between the control machine and the control relays becomes great enough, it is no longer economical to use the near group direct wire arrangement. Combining control and indication information on a fewer number of direct wires, far group control,

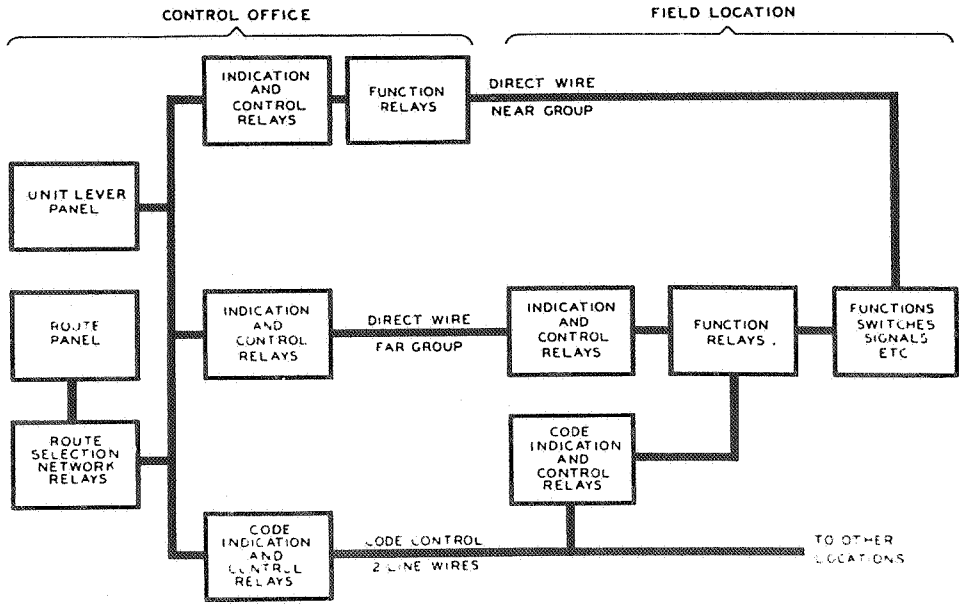


Fig. 22.
Interrelation of Systems.

eliminates many of the line wires. Even this method has its limitations as distance to the field locations increase. The code and carrier systems provide the means for reaching out to distant remote points with only two line wires. Code and carrier systems are advantageous for consolidating control of scattered interlockings. Widely used systems of code control of interlockings and the apparatus used are described in detail in Chapter IV—Centralized Traffic Control.

New systems of code control have been developed in the interest of simplicity in the control of a single interlocking from a remote location, for increasing the speed of coding, to handle more dense traffic, and to control a number of smaller interlockings from a central point with greater speed and

facility. The first three systems described hereafter are of the first type; the fourth system is of the latter type.

One type of code control system, designated "Syncrostep," is an all-relay system for the remote control of a single remote interlocking. The system is simplex in operation, that is, the line circuit can carry only one control code or one indication code at a time. All controls for a given cycle are scanned and delivered progressively to the function relays. Indications are also delivered progressively to the control office. The transmission and reception of codes depend upon step-by-step operation of relays at the control office and field location working in synchronism. Control codes consist of polarized pulses of equal duration. The individual character of each control code is determined by the sequence in which the positive and negative pulses are arranged. The indication portion of the system uses the same office and field relay stepper units. However, in place of a polar code on the line, the negative line energy is interrupted in the field causing a pulse-open condition of the line. Thus, an indication cycle is a series of opens and pulses that are actuated from the remote interlocking by opening and closing the line.

A time code control system, designated "Form 510," is a single station system to control one interlocking from a remote location. It is an all-relay system designed on the principle of having a series of impulses transmitted from the control point to the remote interlocking for "controls," and another series of impulses transmitted from the interlocking to the control point for "indications." Each impulse of a "control" positions its particular relay at the remote location to one position if the impulse is short and to the opposite position if the impulse is long. Each impulse of an "indication" positions its particular relay at the control point to one position if the impulse is short and to the opposite position if the impulse is long.

The line circuit from the control point to the remote location consists of two wires. The line is normally energized from a d.c. source located at the control point. The impulses or codes are transmitted over this line by alternately opening and closing the circuit. Coded carrier may be used.

Two sizes of equipment are available. One produces codes consisting of 20 impulses, 18 of which are available for the control of two-position functions and indications. Another produces codes consisting of 32 impulses, 30 of which are available for the control of two-position functions and indications. Means for increasing or decreasing the functional capacity are available.

The "516-A Code Control System" is a higher speed single station system in which control and indication information are transmitted concurrently. A code to or from any one of a group of functions, therefore, automatically contains information to position all control and indication functions. The number of controls and indications that can be handled by one system is determined by the maximum length of code practicable for the installation involved. A 516-B System with twice the capacity of the 516-A System is also used.

The system may be operated over a two-wire line circuit by four separate and distinct carrier frequencies, two originating at the office (control frequencies) and two originating at the field location (indication frequencies). Where the distance is not too great, operation may be accomplished by d.c. over five line wires. One wire corresponds to each frequency and the fifth wire is common. The control energy is normally off and the indication energy normally on.

Coding operation can be initiated by either field or office. The office starts coding by a local initiating action. The field initiates coding at the office by removing one of the indication frequencies in the carrier system.

Each code consists of a starting or synchronizing step, a number of operating

steps (depending on the size of the interlocking to be controlled), and a reset step. The starting step consists of a period during which both control frequencies are on and a period during which both frequencies are off.

Each operating step consists of a period during which one of the control frequencies is on. The "on" frequency determines the position of the controlled function—normal or reverse. The reset is accomplished at the end of the code by both frequencies being off.

Concurrently, on each of the operating steps and the reset step, two two-position indication relays at the office are operated to either of two positions in response to whether the independent indication frequencies are on or off.

The stepping rate of the system is approximately 25 steps per second. Controls and indications can, therefore, be delivered at the rates of 25 and 50 respectively per second.

Another type of code control system, designated "Syncroscan," consists of two separate systems, one for controls and the other for indications, operating independently over the same two line wires. The all-relay control system makes use of relays utilizing the free oscillations of identical mechanical oscillators—one at the control office and one at each remote interlocking—to create the synchronized steps of a control cycle. These steps are equal units of time in the cycle, information being conveyed by the polarity of energy on the line during each of the steps. The electronic indication system operates on two carrier channels between the control office and remote interlockings. The scanning of indications is accomplished by sending synchronizing pulses from the office via a carrier channel to the various remote interlockings and, in turn, checking the field functions to be indicated at each remote point and transmitting indication pulses to the control office on a different carrier channel.

Automatic Interlocking

The Signal Section, AAR, defines Automatic Interlocking as: An arrangement of signals, with or without other signal appliances, which functions through the exercise of inherent powers as distinguished from those whose functions are controlled manually, and which are so interconnected by means of electric circuits that their movements must succeed each other in proper sequence, train movements over all routes being governed by signal indication.

An automatic interlocking is operated through the medium of track circuits upon the approach of a train. Referring to Fig. 23, and assuming that no trains are within the limits of the interlocking on either road, a train entering upon track circuit E will automatically clear the route for movement of this train over the crossing, and home signal 3 and approach signal 4 will indicate Proceed. Before these two signals display the Proceed aspect, home signals 6 and 7 on the crossing line must indicate Stop and approach signals 5 and 8 indicate Approach. Therefore, should a train approach on the crossing line at this time, it will not receive signals to proceed over the crossing until the train which has entered track circuit E has passed over the crossing and cleared track circuit C; or in other words, has passed beyond the opposing home signal 2 on that line.

Provision is generally made at automatic interlockings whereby a train which may be stopped at a home signal on one line due to a train standing on the approach circuit of the crossing line and not ready to proceed over the crossing, may send a trainman to the crossing and by operating a device, cause the signals already cleared for the standing train to assume the Stop position and thereby allow those for the second train to assume a Proceed position after a predetermined time has elapsed. In other cases, a trainman proceeds to the

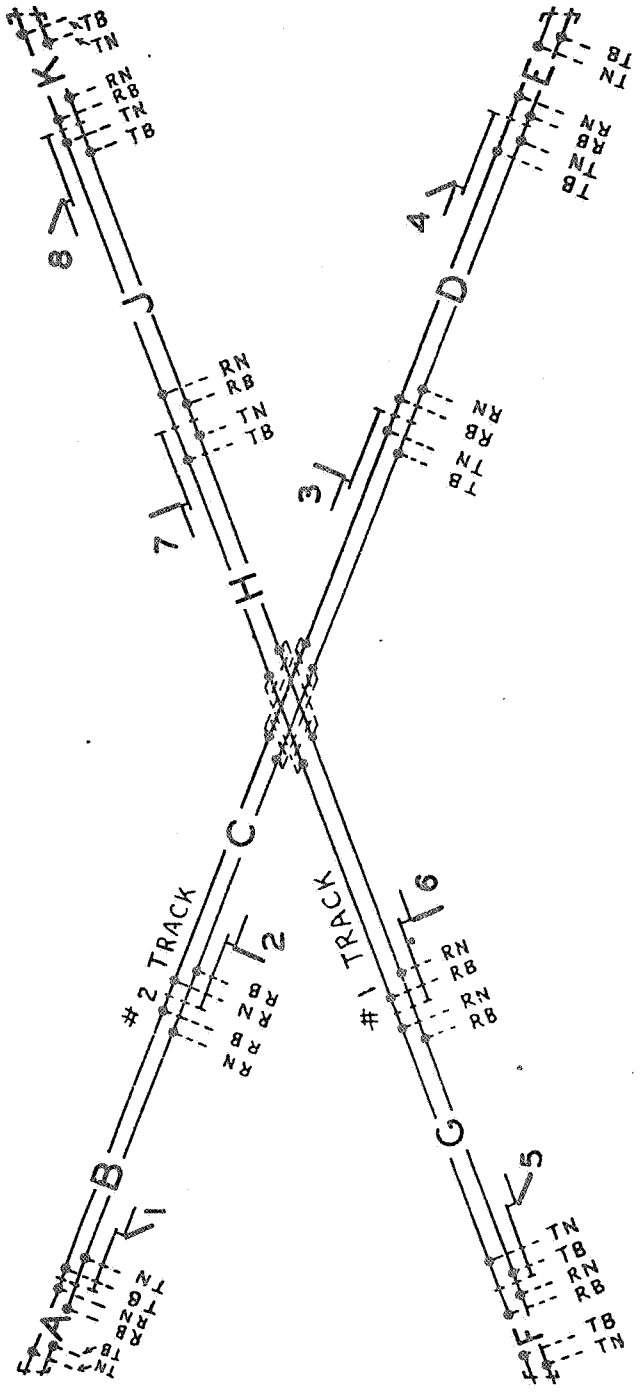


Fig. 23.
Diagram of Automatic Interlocking Layout.

crossing and opens a switch which disconnects the signal control system placing all signals at Stop, and then advances the train over the crossing in accordance with established rules.

Automatic recorders for making a permanent record of train movements are usually provided at automatic interlockings, with the necessary number of pens to record track occupancy by trains, signal performance, etc.

Switch Machines

Switch machines for relay interlockings are essentially the same as used in other types of interlocking except that they are always relay controlled. As in interlockings, these are switch-and-lock movements. Switch machines for remote interlocking may be equipped with a dual-control arrangement so that trainmen can operate the switch readily by hand. Older style switch machines are covered in detail in Chapter XIX—Electric Interlocking. Improved designs of these machines are described here briefly.

One series of electric switch machines, designated Models 5E, 5F, 5G and 5H, illustrated in Figs. 24-28, are designed for relay control. The Models 5E and 5F use external control and overload relays; the Models 5G and 5H each have a built-in biased-neutral controller, and the Models 5F and 5H are equipped with a dual-control mechanism. The machines have a magnetic detent to hold the motor armature against drifting from vibration. A moisture-repellent cover surrounds the motor commutator to keep off moisture and to prevent frost accumulation. Heavy duty, knife-edged point detector contacts provide more positive electrical contact despite possible frost conditions.

The M series of switch machines is now represented by the Styles M-3, M-23A and M-23B. See Figs. 29, 30 and 31. They are all designed for relay control. The differences in design from previous styles lie principally in details of gearing and in the point detector feature of the circuit controller. The M-23A and M-23B dual-control machines are distinguished by the new arrangement of the selector and hand-throw levers which are now on a common axis. This simplifies the change from left hand to right hand and vice versa. The M-23A machine when hand-operated will move the switch points and lock up if the switch is in alignment. The M-23B machine does not lock up when hand-operated.

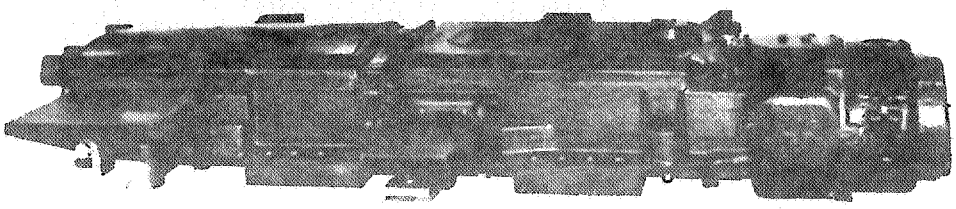


Fig. 24.
Model 5E Switch Machine.

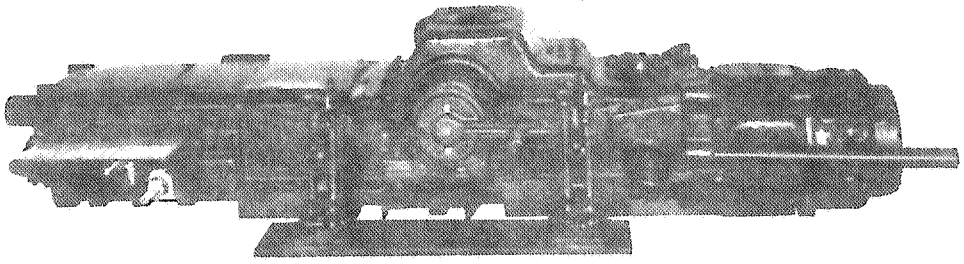


Fig. 25.
Model 5F Switch Machine.

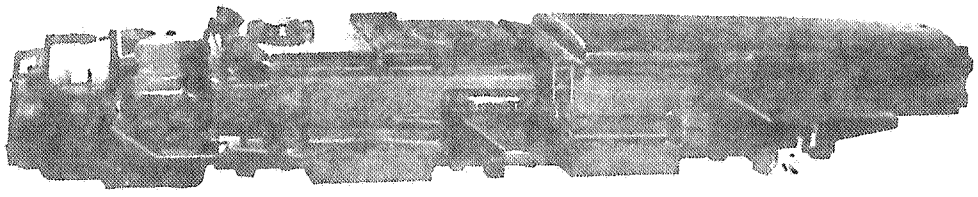


Fig. 26.
Model 5G Switch Machine.

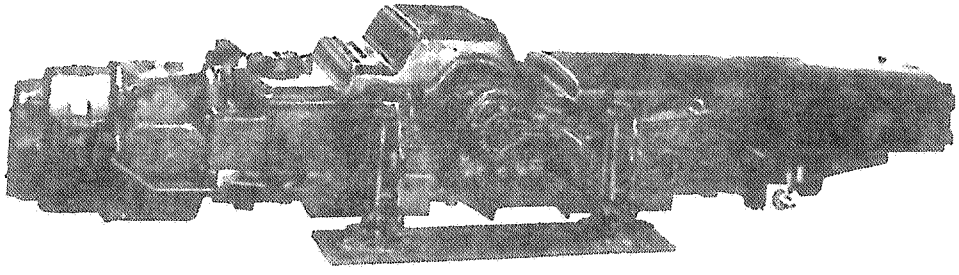


Fig. 27.
Model 5H Switch Machine.

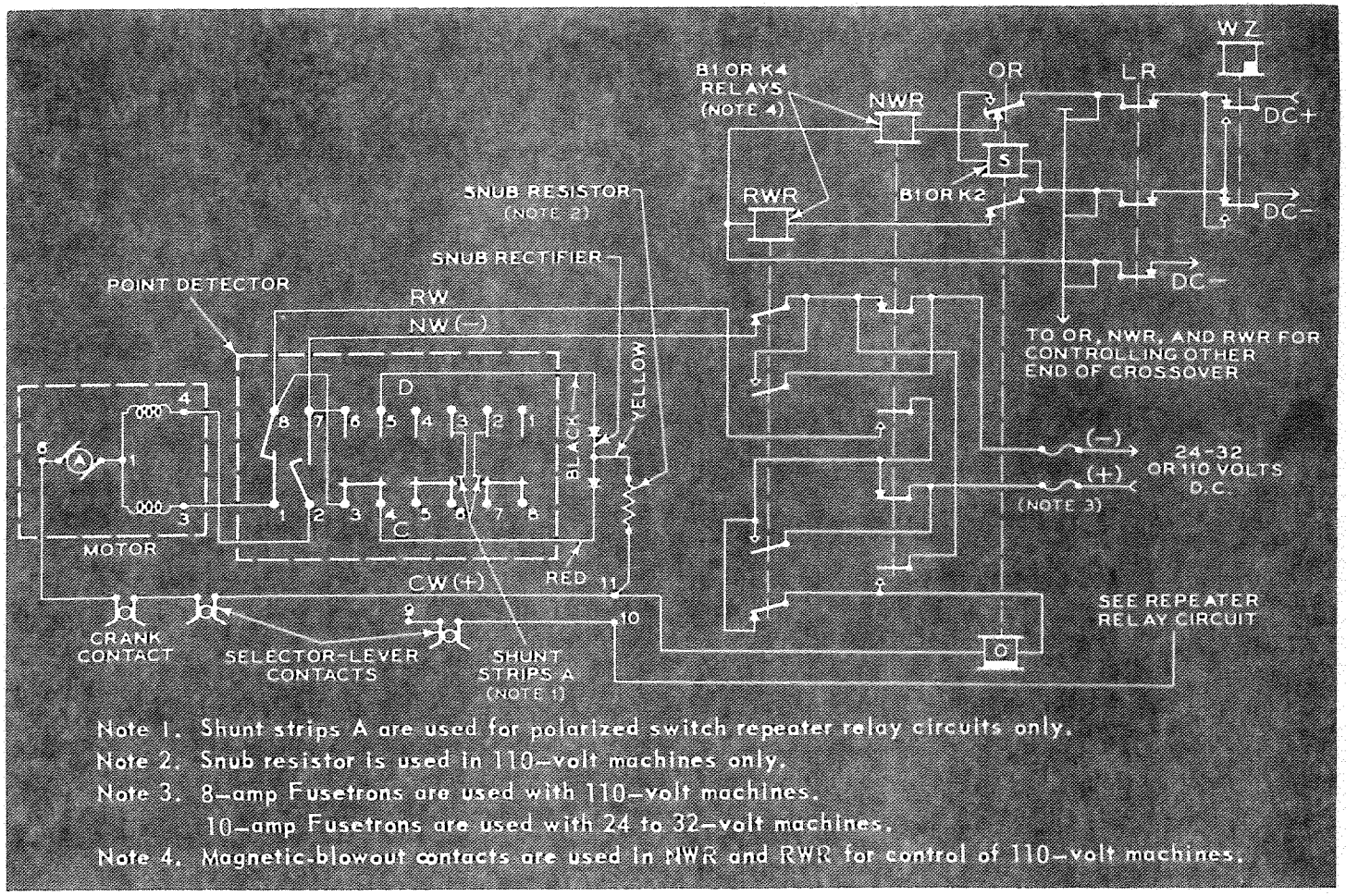


Fig. 28.
Typical Control Circuit for Models 5E and 5F Switch Machines.

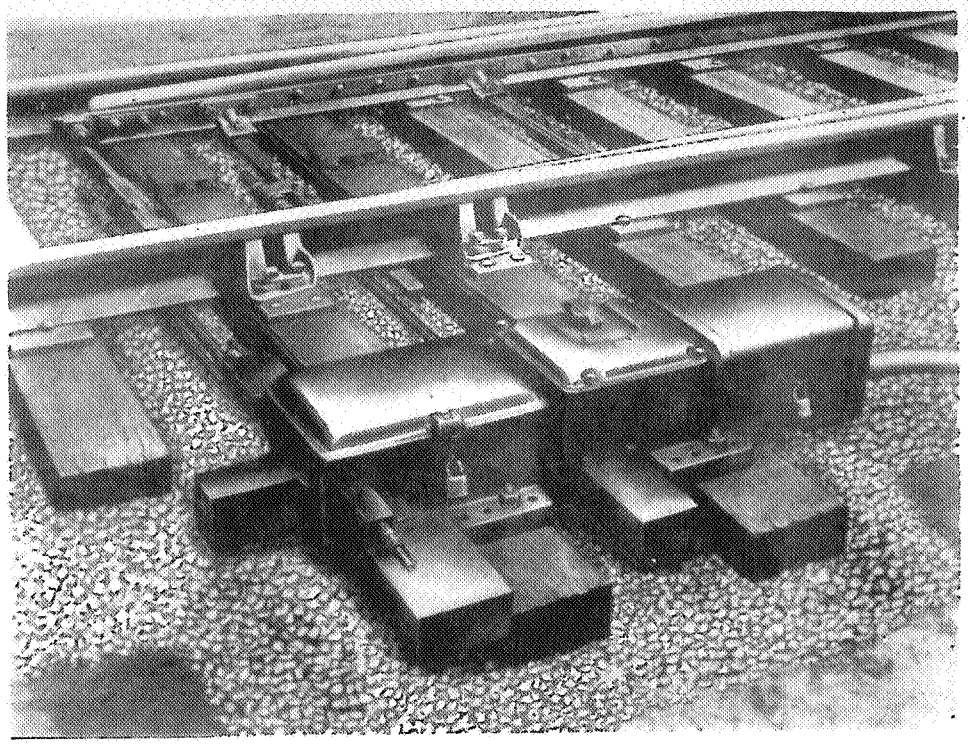


Fig. 29.
Style M-3 Switch Machine.

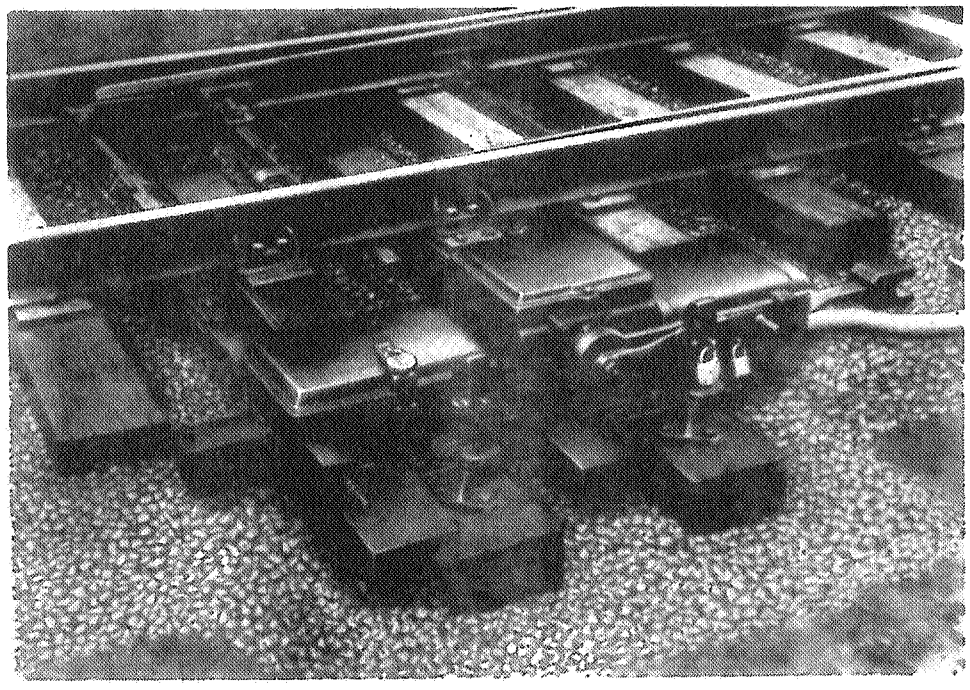


Fig. 30
Style M-23A or M-23B Switch Machine.

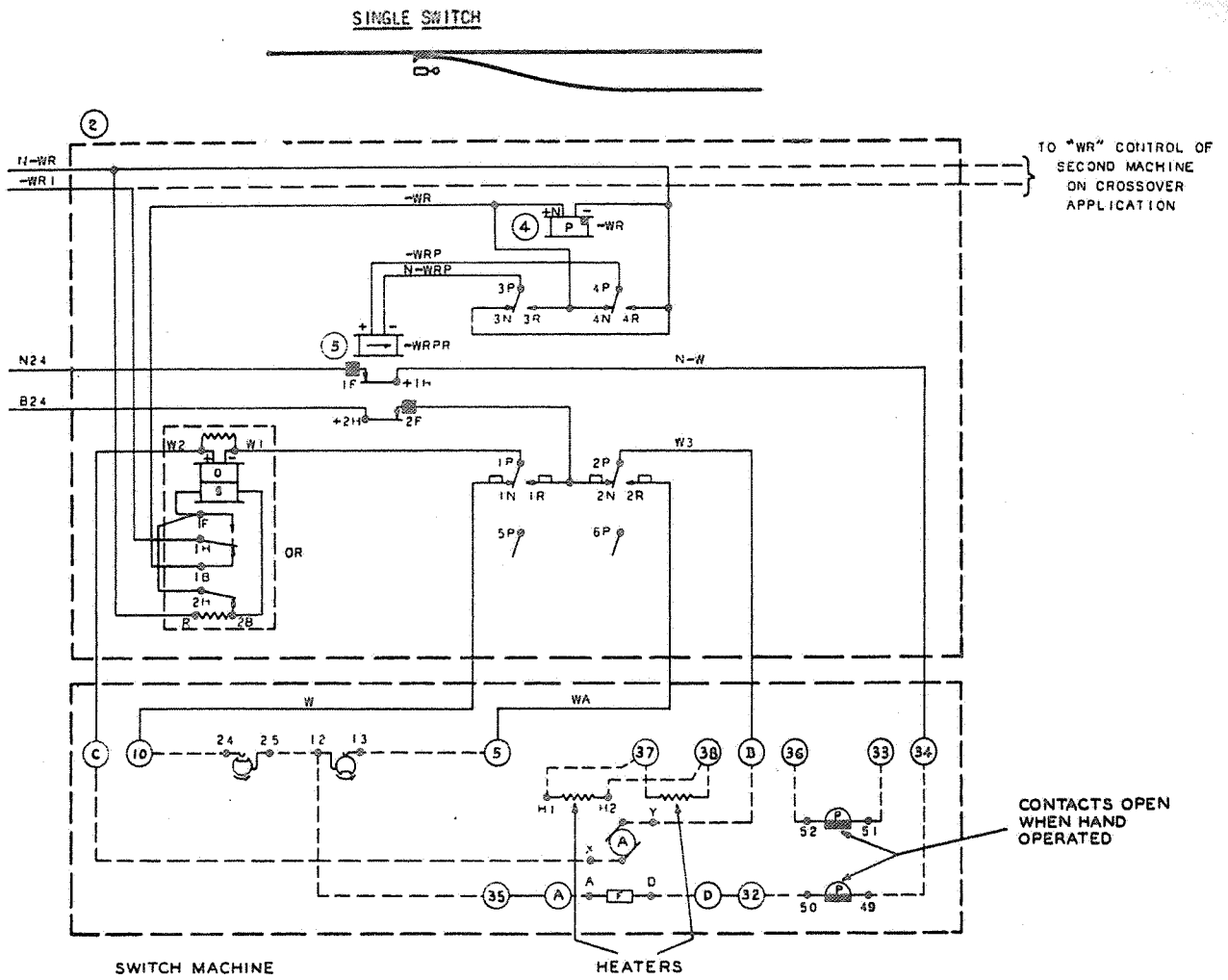


Fig. 31.
Typical Control Circuit for Low-Voltage Styles
M-3, M-23A and M-23B Switch Machines.

At the back of this chapter will be found typical circuits for relay interlocking: namely,

Typical Remote Control Switch and Signal Circuits, Direct Wire Control—AAR Sig. Sec. 8030A (2 sheets), 8031A (2 sheets)

Typical Circuits Remote Control Switch and Color Light Signals, Code Control—AAR Sig. Sec. 8058A (2 sheets), 8027A (6 sheets)

Typical Remote Control Relay Type Interlocking Circuits—AAR Sig. Sec. 8036A (3 sheets)

Typical Relay Type Interlocking Circuits, Local Control—AAR Sig. Sec. 8071A (7 sheets)

Typical Relay Type Interlocking Circuits—AAR Sig. Sec. 8010A (4 sheets), 8025A (6 sheets), 8043A (4 sheets), 8055A (4 sheets), 8056A (4 sheets).

Typical Circuits for Automatic Interlocking—AAR Sig. Sec. 8070B (2 sheets)

Typical Relay Interlocking Circuits for Movable Bridge—AAR Sig. Sec. 8034A (2 sheets)

The following descriptions* are given to enable the student to more readily understand circuits of a similar nature, the details of which, however, will differ somewhat, depending on the practice of the individual railroad.

AAR Sig. Sec. 8030A and 8031A.

Two schemes of control are shown, both being arranged to provide for the remote control and indication of a layout consisting of a single switch and associated signals, such as the end of a passing siding. Both Schemes 1 and 2 are direct wire schemes, using a split battery with three line wires and common for basic controls and indications. Scheme 2 requires an additional line wire for approach indication.

The major difference between the two schemes is in principle of operation. Scheme 1 requires that the operator wait until the switch in the field is in correspondence with the switch lever before turning the signal lever. Scheme 2 does not require switch machine to be in correspondence with switch lever before signal lever is turned. In either scheme the subsequent operation of the switch lever will not affect the signal control once it has been established, even though the signal itself has not yet cleared.

Both schemes prevent the storage of switch control. In Scheme 1 it is provided in the field on relay 3LSR. In Scheme 2 it is accomplished in the control office through the polar contacts on relay 3CWR and the stick contacts on relay 3LKR.

In Scheme 1 the lock relays are de-energized when the signal clears, no provision being made for preliminary drop and check of these relays. In Scheme 2 the lock relays are de-energized when the signal lever is positioned and are checked in the de-energized position in the signal control circuit.

Scheme 1 does not provide for a continuous visual indication of the locked condition of a switch, but an audible and visual indication of the expiration of time locking is provided by a flash of light 3TK and a tap on gong 3TX. Scheme 2 provides a continuous visual indication of switch locking.

The methods of providing switch and signal indication shown are different for the two schemes, Scheme 1 being a normally lighted panel and Scheme 2

* Descriptions appear in order shown above, but the typical circuits at the back of the chapter are in numerical order.

having a normally dark panel. In so far as these local circuits are concerned, the two principles are interchangeable for either scheme.

In Scheme 2 contacts of 3WKR and 3CWR in 3TK circuit prevent track indication during operation of the switch, and contact of 3LKR prevents track indication when switch is operated by hand.

In Scheme 2, 3WK is a switch correspondence light. It is lighted under the following conditions: (a) when switch lever and switch machine do not agree in position; (b) when switch is in transit; (c) when the switch is operated by hand, this being obtained by front contact of the 3LKR and a back contact of the 3WTKR; and (d) when operator changes switch lever position after route has been established.

With Scheme 1, the signal "clear" indication on the panel is removed and the signal "stop" indication displayed when the signal lever is restored to normal. With Scheme 2, the signal "clear" indication is retained on the panel until the signal in the field goes to Stop.

Scheme 1 provides a means for combining one approach indication with the detector track indication, but this approach indication will be displayed whenever the detector track is occupied.

AAR Sig. Sec. 8058A.

This is a coded remote control system with the functions individually controlled, single switch layout, track signaled in both directions.

A relay designated as HSR is provided at the field location which is equivalent to a signal lever repeater at an attended interlocking. These HSR relays are energized by a pulse received from the field code unit after a signal lever is operated by the control operator. Once the HSR relay picks up, it is provided with a holding circuit that may only be released when the interlocking track circuit is de-energized or the signal lever is moved to another position. This feature prevents storage of a signal control with a train within the interlocking limits and also cancels the established route when a train passes through the interlocking.

The NWSR and RWSR relays are used to control the position of the power-operated switch, and also used in the control of the switch correspondence relay, which checks that the switch control and switch machine are in correspondence before a signal may be cleared. The NWSR and RWSR relays are energized by a code pulse received from the field code unit, providing lock relay LR is energized. This feature prevents storage of the switch control. Once the NWSR or RWSR relays are energized the holding circuit retains the relay energized until the switch lever is operated in the opposite position, providing the lock relay is energized. The switch control in this scheme is so arranged that if the interlocking track circuit is de-energized while the switch is in transit, the machine will stop operating.

The use of relay 4HSPR provides a check that a route is available before de-energizing the approach stick relay which is included in the signal control to provide a check that the approach locking is in effect before allowing a signal to clear.

The signal control network checks switch correspondence relay energized, the switch locking relay de-energized, also that the opposing approach locking relay is energized.

Two-track approach locking release is provided for through train movements on the main track.

The following conditions are indicated from the field: switches in the normal or reverse position, signals clear, signals at stop, or time relay functioning approach, and interlocking track circuits.

AAR Sig. Sec. 8027A.

The circuits shown provide for track signaled in both directions, using three wire control. The circuit arrangement at the top of Sheet 1 uses retained neutral polar relay. The circuit at the bottom of the sheet uses the ordinary polar line control relay, with slow drop-away repeater relay.

Two types of directional stick relay control are shown. One scheme provides for single-track circuit pre-pick-up, while an alternate scheme provides for two-track pick-up. With the two-track circuit pick-up, the stick relay will not pick up when the train passes the cut-section to the rear, but can only be energized at the time of passing the signal location. The two-track pick-up scheme prevents picking a stick if a hand-throw switch, located in the approach track, shunts the track in lieu of opening and shunting the line circuit when reversed, also where signals are staggered and a single-track circuit is used between signals.

When the single-track circuit in the approach of the signal is used to pre-pick the stick relay, the opposing stick should be checked in the de-energized position. The stick relay must have sufficient slow release time to avoid the loss of the directional stick relay when a short high-speed train passes the signal, allowing the approach track relay to pick up before the HDR relay is de-energized. The use of a slugged slow release relay in lieu of a condenser to provide this slow release avoids the possibility of failing to pick the proper stick relay due to a condenser failure; this is very essential whenever the pre-picked stick circuit is used with color light signals.

The opposing stick relay may be checked in either the relay circuit for the signal in the opposite direction or in the feed circuit for the opposing signal to the rear. If the former arrangement is used, the opposing signal will not clear in the rear of a train movement. This arrangement is generally used on railroads where the rule which prohibits a reversal of direction of train movement, is in effect.

AAR Sig. Sec. 8036A.

These circuits have been designed to control switches and signals by unit type levers that are not mechanically interlocked. Relays are used to provide the equivalent protection usually provided by mechanical and electric locking of levers.

The route check network in the machine, shown on Sheet 1, provides a check that the route is lined in the field and indicated into the office before the signal control relay is allowed to pick up in the field. A relay is provided for each signal lever and designated HSR, which is energized when signal lever is turned, providing the route is lined. Each HSR relay is provided with a holding circuit that may only be released by restoring the signal lever affected to the normal position. A slow release relay, designated NLPR, which repeats the normal position of the signal lever, is provided to prevent storage of the signal control until a route is established; also, to prevent the storage for the control of a signal if the signal lever controlling an opposing signal has been operated.

The signal control network shown on Sheet 2 consists of circuits for direct control of searchlight signals. This network checks the switch correspondence relays energized, switch locking relays de-energized, and the opposing approach locking relays energized. Restricting signals are controlled through the first track section only. When a call-on aspect is desired on signal 2R or 6L for a following move into an occupied block, a call-on button is pushed, which energizes relay CO, which in turn energizes the relay COS. The call-on push

button, being of the spring return type, a stick circuit is provided for relay COS.

The switch control relays designated WR are controlled by switch lever in series with switch agreement relay WLPR. With this arrangement, if the switch lever is moved when its locking relay is de-energized, relay WR and switch agreement relay WLPR will not pick up until the switch lever has been restored to its initial position to agree with the position of the switch. This prevents storage of switch control.

Circuits are arranged to provide two separate indications on a single wire by the use of a full-wave rectifier in the office and a split battery in the field to pole change the control. With this circuit arrangement, both indications can also be brought in simultaneously by alternately coding the polarity of the control circuit through contacts of a 120 code transmitter.

Route locking stick relays provide switch locking as a signal is being cleared over a route. This provides sectional release locking of switches as train proceeds through the interlocking.

AAR Sig. Sec. 8071A.

This is a local control system with the route selecting buttons located in the track diagram. The signals are semi-automatic stick or non-stick with the restricting signal not track circuit controlled. Indication is provided by a combination of lights and movable indicators.

An entrance and exit button is operated in sequence to set up a route and clear the signal. Each entrance button is physically represented in the field by a wayside signal. A stationary arrow in the middle of the button indicates the direction in which the signal governs. The exit button is a spring return type with an arrow engraved on its face to show the direction in which the train leaves the route. The entrance button is arranged to push, pull, turn clockwise or turn counter-clockwise. When a route is set up by pushing the entrance and exit buttons the passage of the first train causes the signal to display a Stop aspect and cancels the route selection network. This route may be cancelled in advance of a train movement by pulling the entrance button. Conventional route locking circuit with approach or time locking will determine release of the route. When a route is set up by turning the entrance button up and pushing the exit button the route is held for a succession of trains. This route may be cancelled by turning the entrance button to center. Restricting signals are displayed by turning the entrance button down and pushing the exit button. This route may also be cancelled by turning the entrance button to center.

A route initiated by pushing the entrance button or by turning the entrance button up will be indicated by a steady red light in the entrance button. Clearing of the signal will be indicated by a steady green light in the entrance button. A flashing red light in the entrance button indicates that a route has been initiated by turning the entrance button down, also if the button is manually restored to normal before train accepts signal and time locking is in effect. A flashing green light in the entrance button will indicate that a slow speed signal has been displayed.

A route called for is shown on the diagram by movable route indicators. The route locked up is indicated by the illumination of lock lights located at the points of the movable route indicators. Switch correspondence lights, located below the test key for its respective switch, when lighted indicates the switch is out-of-correspondence with the position called for by the route. The light will remain lighted while the switch is in transit. Track occupancy is indicated by the illumination of track occupancy lights located in its respective

track section on the diagram. Test keys are located on the control panel enabling its respective switch or crossover to be operated individually. They are not used generally in regular operation. The handle of the test key moves in a vertical plane in three positions. The center position is the inoperative position; the downward position calls for its respective switch normal; and the upward position calls for the switch reverse. Test keys are normally left in the center position. A switch cannot be operated by the test key if it is locked by an established route. Likewise, if a switch is operated to a given position by its test key, a route can be given only over that position of the switch. Run around moves over switches 1 and 5 reverse, also switches 5 and 7 reverse, is prevented except by test key operation.

The function of the initiation circuits, one network for each direction is one of exploration, sending out branches to determine the available exit points. These circuits are shown on Sheet 1. To initiate a route from signal 14 to signal 4, the following is the sequence of operation: the operator pushes entrance button 14, which energizes signal lever relay 14GLPR over an N contact, closed when the button is pushed, and a front contact of 7TR. The front contact of 7TR provides for making the signal stick. Relay 14GLPR is stuck up by an N contact on 14 button. This route may be cancelled in advance of a train movement by pulling 14 entrance button. A steady red light is illuminated in 14 button over front contacts of 14GLPR, 14ASR and 14RGPR, as shown on Sheet 7. Operator now pushes exit button 4 and the circuit to exit relay 4XR is completed over an N contact of 14 entrance button, front contacts 14GLPR, 7TR, 14GLPR and back contacts, 14XR, 7RR, 7AYR, 5RR, 3RR, 1RR and 1AYR. A back contact of 4XR prevents an eastward initiation circuit from signal 4. Thus the operation of 4 entrance button will not disturb the route initiated.

In the completion networks as shown on Sheet 2, the front contact of 4XR closes the westward completion network from signal 4. Relay 1ANR is energized by a front contact of 4XR and a back contact of 1AYR. Relay 1ANR has three independent windings and its function is to call for switch 1 normal. A front contact of 1ANR connects battery to one of the windings of switch operating relay 1NWZR over front contacts of 1LR and 5LR, as shown on Sheet 6. If switch 1 is reverse it is operated to normal position. Negative energy NL is connected to 1 movable route indicator by a front contact of 1NWZR and a back contact of 1RWZR, as shown on Sheet 7, and the indicator snaps into position called for by the route. Switch lock light 1ALE is illuminated by front contacts of 1ANR and 1LR. If the switch operates from reverse to normal, switch out-of-correspondence light 1WE is lighted by back contacts of 1NWCR and 1RWCR, also shown on Sheet 7. The procedure for controlling movable route indicators, lock, and out-of-correspondence lights, and operating the switch machine as described for switch 1, is similar for all switches. Referring again to the westward completion network it will be noted that battery is now connected to one coil of 3NR over a front contact of 4XR and a back contact of 1AYR and front contacts of 1ANR and 1NWZR. Battery is relayed to 5ANR by front contacts of 3NR and 3NWZR and in a similar manner to 7ANR by front contacts of 5ANR and 4NWZR and a back contact of 7AYR. From this point, battery is connected to relay 14GZR by front contacts of 7ANR and 7NWZR. Referring again to the westward initiation network, it will be observed that a back contact of 1ANR has opened the control to 1AYR, a back contact of 3NR has opened the control to 6XR, a back contact of 5ANR has released 5BYR and a back contact of 7ANR has opened the control to 7AYR. Back contacts of these same relays performed similar function in the eastward initiation network thus preventing the initi-

ation of any route over crossovers 1, 5 and 7 and turnout 3 in the reverse position.

In the signal control network, Sheet 3, a front contact of 14GZR has closed the circuit to 14AHR and a back contact has opened the control for any eastward signal to signal 14. However, signal 14 will not clear until all switches in the route which are not normal have moved into that position as called for by the route. This condition is represented by normal switch correspondence relays 1NWCR, 3NWCR, 5NWCR and 7NWCR. It is also necessary to check that all switches in the route are electrically locked. This condition is represented by back contacts of switch locking stick relays 1LSR, 3LSR, 5LSR and 7LSR. Releasing of switch locking stick relays is accomplished by switch locking circuits as shown on Sheet 4. Referring specifically to the 1LSR circuit, it can be seen that a front contact of 1LR will open the control, unless by-passed by the stick circuit which includes back contacts of 1NWCR and 1RWCR. This insures that 1LSR will not be released while the switch is in transit. Since turnout 3 and crossover 5 are normal, relay 1LR is released by opening of a back contact of 3WGZLR in its control. Relay 3WGZLR is a preliminary switch locking relay, as shown on Sheet 4, and in this instance is energized by a front contact of 14GZR.

The releasing of relays 3LSR, 5LSR and 7LSR is brought about in a somewhat similar manner and completes the circuit to signal control relay 14AHR, as shown on Sheet 3. A back contact of 14AHR releases approach locking relay 14ASR, shown on Sheet 4. A front contact of 14ASR opens the control for westward route locking relay 7WSR, which in turn releases 3WSR. The release of 14ASR also completes the circuit to signal mechanism 14AG (see Sheet 3), and signal 14 clears releasing signal repeating relay 14RGPR (see Sheet 5). It can be seen on Sheet 7, that the release of 14RGPR extinguishes the steady red light in 14 entrance button and lights the steady green.

For a restricting signal for the route previously described or to a diverging route, relay 14GLPR remains de-energized, as can be seen by referring to Sheet 1. To initiate a route from signal 14 to signal 2, the operator turns the entrance button down. This picks up relay 5BYR with negative energy of contact R on 14 entrance button and back contacts of 14GLPR, 14XR, 7RR, 7AYR, 5BNR and 5ANR. A front contact of 5BYR relays energy to 2XR over a back contact of 1RR. It can be seen by referring to Sheet 7, that flashing red light will be illuminated in 14 entrance button by conducting interrupted energy to the filament by an R contact on 14, a back contact of 14GLPR and front contacts of 14ASR and 14RGPR. When the signal clears and 14RGPR releases, the flashing red will be changed to flashing green. In the completion network, relay 1BNR is energized by a front contact of 2XR. This in turn picks up relay 5RR over a front contact of 1BNR, 1NWZR and 5BYR. Relay 5RWZR is then energized by front contacts of 5RR, 3LR, 8ASR and 5LR, which operates switch 5 to the reverse position. In the westward completion network, energy is relayed to 7ANR over front contacts of 5RR and 5RWZR and a back contact of 7AYR. From this point signal clearing action is similar to that previously described.

Automatic route selection is provided. For example, the preferred route from signal 12 to signal 4 is over medium speed crossover 1 and the route would be selected as follows: operator turns entrance button 12 down and negative energy is conducted to the coil of 1AYR over an R contact of 12 entrance button, back contacts 12XR, 9RR, relay 9YR picks up, front contacts 9YR, backs, 7RR, 8XKR, A8XR, 8XR picks up, front 8XR, backs 5RR, 5BYR, 1BNR, 1ANR, relay 1AYR picks up, front 1AYR and 4XR picks up when 4 exit button is pushed. However, if a route previously had been cleared

from signal 2 to intermediate signal 8, switch 1 would be locked normal and a back contact of A8XR opened the circuit for the preferred route. The secondary route would automatically be selected over crossover 7 reverse as follows: negative energy over R contact on 12 entrance button, back 12XR, back 9RR, relay 9YR picks up, front 9YR, back 7BNR, back 7ANR, relay 7AYR picks up, front 7AYR, back 5RR, back 3RR, back 1RR and back 1AYR.

End-to-end, or through routing, arranges for clearing of signals 2 and 8 without the use of intermediate push buttons. This is accomplished by the operator pushing entrance button at signal 2 which initiates the route by energizing relay 2GLPR. A front 2GLPR relays energy to 1BYR over back 2XR, back 1RR and relay 1BYR picks up and over its front relays energy to 8XKR over back 5RR, back 8XR, front 5LR, back A8XR, back 8GZR, back 8GLPR, relay 8XKR picks up. A front contact of 8XKR closes the circuit to 7BYR over an N contact on 8 entrance button, front 9TR, front 8XKR, back A8XR, back 8XR, back 7RR and relay 7BYR picks up and completes circuit to 12XR when exit button is operated. In the eastward completion network, energy over a front contact of 12XR picks up relay 9NR and its front contact closes circuit to 7BNR over front 9NWZR, front 7BYR and 7BNR picks up, front 7BNR relays energy to 8GLPR over front 7NWZR and front 8XKR and relay 8GLPR picks up. Referring again to the eastward initiation network a front contact of 8GLPR closes the circuit to A8XR which picks up and releases slow release relay 8XKR. In the completion network, release of 8XKR closes the circuit to 8GZR. Closing of a front contact A8XR picks up 5BNR which relays energy to 1BNR over front 5NWZR and back 1BYR, relay 1BNR picks up and closes circuit to 2GZR. In the signal control network, picking up of 2GZR and 8GZR will clear both signals.

Special switch locking is provided to prevent the clearing of signal 8 unless crossover 5 is normal. Also the clearing of signal 8 locks 5 in the normal position by including a front contact of 8ASR in the control of 5NWZR and 5RWZR, as shown on Sheet 6. To indicate that the switch is locked, a dependent contact of 8ASR is in the 5BLE lamp circuit, as shown on Sheet 7.

AAR Sig. Sec. 8010A.

These circuits have been designed to control switches and signals by levers that are not mechanically interlocked and are not provided with electric locks or other mechanical means to restrict their movements. The use of relays provides the equivalent protection usually provided by mechanical and electric locking of levers.

The route check network shown on Sheet 1 provides a preliminary route check before a signal may be cleared, insuring that switch levers are in the proper positions to assure a complete route for the signal to be cleared; also that switches in the route correspond in position to levers controlling them, that opposing signal levers are not in a position to clear opposing signals and that opposing signals are in the stop position. A relay is provided for each signal lever in the route check circuits, that must pick up before circuit is completed to clear signal. These relays are designated HSR, and each is provided with a holding circuit that may only be released by restoring the lever of signal affected to the normal position, or by a train passing the signal and shunting the track relay. This prevents changing a cleared signal to "Stop" indication should an operator inadvertently move a switch lever in route or the opposing signal lever. Slow release relays designated NLPR, on Sheet 1, which repeat the normal position of the signal levers are provided to prevent the storage for the control of a signal until a route is established; also to prevent the storage

for the control of a signal if the signal lever controlling an opposing signal has been operated.

The signal control network shown on Sheet 2 consists of circuits for direct control of searchlight signals while the network shown on Sheet 3 consists of circuits for control of relays for color light signals. Both networks check all the switch repeating relays in the route energized, the switch locking and approach locking relays de-energized, also that the opposing approach locking relay is energized. Restricting signals are controlled through first track section only. When a call-on aspect is desired, on signals 2 and 6, for a following move into an occupied block, the call-on button is pushed, which momentarily energizes the NLPR, thus re-energizing the HSR, and energizing the COSR.

The switch locking relays designated LSR shown on Sheet 4 are controlled by track relays, route locking relays and approach locking relays. The approach locking relays lock switches as soon as route has been established and HSR relay has picked up. The common side of the circuit for each switch locking relay is selected over its own front contact and in multiple are agreement circuits, a normal polar contact of switch repeater relay and normal switch lever contact and a reverse polar contact of switch repeater relay and reverse switch lever contact. With this arrangement, if a switch lever is moved when its locking relay is de-energized, the relay will not pick up until switch lever has been restored to its initial position to agree with the position of switch which completes pick-up circuit of switch locking relay. This prevents the storage of switch control when the switch is locked.

Circuits that are not entirely in operating tower are double wire double break, except signal repeating relay circuits.

AAR Sig. Sec. 8025A.

This is a local control system with the route selecting push buttons in the track diagram, line-of-light indication, semi-automatic stick signals, with the restricting signals not track circuit controlled.

Two push buttons operated in sequence set up a route and clear the signals. After operation of the first route button, a red light appears at that button thereby marking the entrance to the route and indicating that a route has been initiated, but the signal has not yet cleared, also a white light appears in the last track section of each available route showing points to which a train may be routed. The operation of the second route button (at one of the designated illuminated sections) completes the route selection and extinguishes the lights marking other possible destinations. After the second button has been pushed a flashing red light appears at each switch which is not in position for the route, indicating that switch is in transit. When no flashing red lights appear, all switches are in proper position. Upon completion of the route a white line-of-light indicates that the route is set up and that it is locked. Following completion of the route the signal will clear, and this will be indicated by a green light at the route button at the same time the red light is extinguished. Attempting to set up a conflicting route cannot disturb a route once established. An occupied route may be reestablished for a call-on move by again operating the first and second route buttons. Call-on control is effected by the operation of a call-on button after the route is completed. Through-route control is provided by the operation of two buttons, one button at the entrance end and the second at the exit end of the route. A route to an intermediate signal in the through-route may be set up by the operation of a button at the entrance and the second button at the intermediate signal. Automatic release of the route is provided in the rear of the train. Means is provided for non-stick

control. Also means is provided for manual cancellation of a route. Automatic selection of alternate routes is effected under normal operation with provisions for manual selection.

The route selection circuits are shown on Sheet 1. To initiate a route from signal 14 to signal 4, the following is the sequence of operation: the operator pushes route control button 14 which picks up route selecting relay 7ANWR by the circuit which includes a push button contact of button 14, a back contact of 7ANER, a back contact of 14XSR, coil of relay 7ANWR, and back contacts of 7RWKR and 7RWR. The 7ANER relay is used to transfer the circuit when 14 is used as an exit button. Relay 14XSR selects the entrance and exit pick-up circuits. The circuit is selected over the back contact of 7RWR which checks that no route has been selected over 7 reverse. The back contact of 7RWKR is used to prevent the selection of any route over crossover 7 normal while crossover 7 is locked in the reverse position. Relay 7ANWR sticks over a front contact of 7 track relay, to provide automatic restoration, a pull contact of 14 is used for manual restoration.

The energizing of 7ANWR connects battery to the coil of relays 5ANWR and 5RWR. The negative side of 5ANWR includes back contacts of 5RER and 5RWKR. The back contact of 5RER checks that no route has been selected eastward which may include crossover 5 reverse. The negative side of 5RWR includes back contacts of 5ANER, 5BNWR and 5NWKR. The back contact of 5ANER opens the circuit if a route has been selected eastward on the upper track over 5 normal and the back contact of 5BNWR opens the circuit if a route has been selected westward on the lower track over 5 normal. The back contacts of 5NWKR and 5RWKR prevent the selection of conflicting routes when crossover 5 is locked.

The energizing of 5ANWR connects battery to the coils of 3RWR and 3NWR. The negative side of these relays includes checks similar to those described for crossover 5 above. Relay 3RWR up prepares the pick-up circuit for relay 6XSR in case button 6 is to be used as an exit. Relay 3NWR up, picks up the 1ANWR which includes the usual checks in the negative side. Energizing 1ANWR prepares the pick-up circuit for relay 4XSR when button 4 is pushed. Relay 5RWR connects battery to the coil of 1BNWR which prepares the pick-up of relay 2XSR in case button 2 is to be used as an exit.

Referring to Sheet 2, it can be seen that with relays 3RWR, 1ANWR and 1BNWR up, the white light in sections 3K, 1K and 5K are lighted indicating the available exits. The energizing of 7ANWR when the route was initiated, illuminated the red light at the entrance signal button.

To complete the route 14 to 4, the operator pushes button 4 which picks up 4XSR over the back contacts of 1RER and 1ANER, and front contacts of 4ASR and FR if traffic control is provided. 1RER and 1ANER prevents energizing relay 4XSR when an entrance has been established at 4. 4ASR prevents completing a route at 4 if approach locking is in effect and the FR contact is used to check that traffic is properly established. Relay 4XSR sticks over front contacts of 1ANWR, 1RWR and 1ANER or 1RER. This is to open the circuit when the route is cancelled by pulling button 14. Contacts in 1ANER and 1RER hold 4XSR up until relays 1ANWR and 1RWR open, thereby preventing 1ANER and 1RER from sticking up over 4XSR down.

The picking up of relay 4XSR energizes relay 1ANER which opens the negative side of 1RWR and 1RER; 1ANER up picks the 3NER which drops relay 3RWR. 3NER up picks the 5ANER which opens relay 5RWR. 5ANER up picks relay 7ANER which completes the route and at the same time all relays not involved in the route are released. Lights in sections 1K and 5K are extinguished. Section 7KB is illuminated when relay 7ANER is energized.

Referring to Sheet 6, it can be seen that the ANER and ANWR relays up will energize the NLPR relays for the switches involved which in turn pick the NWSR relays if the switches are unlocked. The NWSR relays energized, operate switches to their normal position. The NWKR relays which pick up when the switch completes its movement, energize relay 14RR (Sheet 3).

Energizing 14RR drops relay 14ASR causing route locking relays 1WSR, 3WSR and 7WSR (Sheet 5) to drop and the route indication relays 1SPR, 3SPR, and 7SPR to pick up. The energizing of the NWKR and SPR relays will complete the line-of-light indication on the control panel.

Sheet 3 shows the clearing circuit for 14AG. When signal 14 clears, relay 14RGPR drops which extinguishes the red light and illuminates the green light at the entrance button 14.

On Sheet 1, route 4 to 12 is an example of a through-route selection. Two routes are provided, one over 1 reverse and the other over 1 normal and 7 reverse. The route over 1 reverse is the preferred route and is the route normally selected. However, with a train being held by signal 8, the route over 7 reverse would be automatically selected. The operation of route button 4 and the route selecting relays are as previously described. The 8XR relay is controlled through the front contacts of 5BNER, 5TPR, 10-12ASR by-passed with a front contact of 7RWCR and through back contacts of 7BNWR, 8XSR, 8PBSR. 5TPR prevents clearing of signal 8 with a train occupying the section approaching 8 when route buttons 4 to 12 are pushed. 10-12ASR by-passed with 7RWCR prevents picking the 8XR and 8XSR if time locking is in effect for signals 10 and 12. The back contact of 7BNWR is used to prevent picking up relays 8XR and 8XSR if buttons 10 or 12 have been pushed as an entrance. Front contacts of 8XR and 8XSR are used to by-pass 7BNWR to prevent relays 8XR and 8XSR from becoming de-energized as a result of completing a route from 8 to 12 or 8 to 10 at which time 7BNWR is up. 8XR up picks 7BNER which in turn picks the 9NER converting button 12 into an exit. No through route is provided over 9 reverse. The route is then completed by pushing button 12. With the front contacts of relays 7BNWR and 8XR closed and 8PBSR down, relay 8ZSR is energized. 8ZSR picking up picks the 8XSR which in turn picks up 8PBSR which cancels 8XR and 8ZSR. 8XSR is held up over 5BNER and 8PBSR is held up over 9TPR.

To illustrate the selection of a secondary route, assume that a train is moving from signal 2 to signal 8. Relay 1NWKR would then be up preventing 1RER from picking when button 4 is pushed to initiate the route. The route selection would then be completed over 7 reverse. With no train occupying section 2 to 8 this alternate route is cancelled when 7BNER picks resulting in the cancelling of the 7RER relay.

Should it be desirable to provide run-around movements over crossovers 1 and 5 reverse or 5 and 7 reverse, the switch control of the second crossover in the route should be manually operated to the reverse position to control the route selection circuit. For example, if movements are provided eastward over crossovers 1 and 5 reverse, a reverse contact on lever 5 in series with a front contact of relay 1RER would be in the control for 5RER.

On Sheet 6 a scheme is shown for cascading the control of switch motor circuits, the purpose of which is to introduce a time element between the starting of successive switch operations in order to limit the flow of current in the d.c. mains, otherwise any number of switch motors could be energized simultaneously. This feature is obtained by using slow pick-up relays designated WZR. The circuits are so arranged that these relays are operated in proper sequence. Front contacts of this relay are placed in the switch control circuits.

This is a local control system with the functions individually controlled with signal levers in the track diagram, semi-automatic stick signals, with the restricting signals not track circuit controlled.

The signal levers are the push-pull-turn type, while the switch levers are toggle type.

The route check network on Sheet 1 provides a preliminary route check before a signal may be cleared, insuring that switch levers and switch call relays CWR are in proper positions to assure a complete route for signal to be cleared; also that opposing signal levers are not in a position to clear opposing signals. A relay designated HSR is provided for each signal, in the route check network, that must pick up before circuit is completed to clear signal unless a move is to be made into an occupied block from signals 4 and 10 in which case the call-on stick relay COSR is used.

To energize the HSR for signals 2, 6, 8, 12 and 14, a signal lever is turned. Once the HSR picks up it is provided with a holding circuit that may only be released by restoring signal lever to normal position.

The HSR for signals 4 and 10 is energized by pushing the signal lever if the first track circuit in advance of the signal is unoccupied; these are provided with a holding circuit that will be released by pulling the signal lever, or by a train passing the signal.

Signals 4 and 10 are provided with a call-on aspect for clearing a restricting signal into an occupied block. In this case, a call-on stick relay COSR is energized when the signal lever is turned. When energized, the COSR is held up through one of its front contacts, and it will not become de-energized until the signal lever is returned to its normal position.

The signal control network shown on Sheet 2 consists of circuits for control of relays for color light signals. This network checks all switch correspondence relays in route energized, the switch locking relays de-energized, also that opposing approach locking relay is energized.

The approach and time locking circuits are shown on Sheet 3. Signals 6, 8, 12 and 14 have time locking only without automatic release. Signals 4 and 10 have approach locking with automatic release. Signal 2 has time locking only with automatic release.

The switch control and indication circuits are shown on Sheet 3. If the lock relay is energized and the switch lever is moved, switch relay WR and switch call relay CWR are energized in the opposite direction and their contacts move to the other position. This causes NWCR or RWCR to be de-energized because the switch lever is out of correspondence with switch position. This causes the LSR to pick up and apply power to the switch to bring the switch position into correspondence with the switch lever. Then, RWCR or NWCR will be energized depending on switch position and switch lever position. This, in turn, causes LSR to be de-energized and removes power from the switch machine.

Storage of switch control is prevented. It is accomplished in the control of the WR relay through the contacts of relays CWR and LPR.

The switch locking circuits are shown on Sheet 4 and are controlled by track relays, route locking relays, approach locking relays, relay COS and relays HSR. The HSR and COSR contacts are added to the switch locking relays to provide preliminary locking which de-energizes the relays to complete signal control circuits and also prevent a misroute by the movement of a switch lever after a route is established before signal is cleared.

The lock stick circuits insure that switch will complete its movement after the lock relay is de-energized by pick-up of relay HSR or the relays COS.

The control panel and indication circuits are shown on Sheet 4. The route lined up is shown by movable point indicators which snap into the position called for when the switch lever is operated. The route locked up is shown by the illumination of the lock lights located above the switch levers.

Signal levers are provided with two indication lamps in the barrel of the lever. A red light indicates that relay HSR or COSR is energized, calling for the signal. A white light indicates that the signal is clear.

AAR Sig. Sec. 8055A.

This is a coded remote control system with the functions individually controlled. The signals are semi-automatic stick with the restricting signals controlled through the first track section only.

Route check network circuits are not provided in the control machine. Field circuits prevent storage of switch control. Storage of signal control is permitted. Indication circuits indicate track occupancy, switch position, signal clear, signal stop, and signal in time.

A "call-on" function is provided for high signal movements when the interlocking section is unoccupied and the advance section occupied. The "call" function is also required for movements against normal traffic.

If trains are blocked at this remote location additional circuits are required.

Switches are controlled by polar switch relays. Switch position and correspondence with control relay is provided by neutral relays. Route locking with sectional release of switches is provided. Approach locking is arranged for high signals only.

Signal and switch operation begins with the function control relays shown on Sheet 4. Switch function relays 1WSR, 3WSR, 5WSR and 7WSR are polar stick and remain in the last coded position until a code impulse is received to pole the relay to the opposite position.

The signal function relays 2RHSR, 2LHSR, 6RHSR and 6LHSR operate in a similar manner except that one coil is used to reset the relay to normal position after each train movement. This is accomplished by energy over its own polar reverse contact and an impulse from a back contact of the track relay and a front contact of the slow-releasing track repeater relay. Operation of "call-on" function relays 2COR and 6COR is similar to signal function relays.

Indication code starting circuits provide for initiation of a code and contacts in the indication circuits determine the character of the code. These circuits are also shown on Sheet 4.

The route check network shown on Sheet 2 is a non-stick neutral circuit and checks that switches are in position and in correspondence with control relays, that track circuits in the route are unoccupied and that opposing signals are at stop and not in time. For example, on Sheet 3, a back contact of the route check relay 2RHSPR would open the control for approach and time locking relay 2RASR. A front contact of 2RASR would open the control for switch locking relay 3-5LR. Back contacts of switch locking relays also open the control to switch function relays, Sheet 4. Thus an inadvertent sending of a code calling for a switch in an opposite position would not interfere with a previously cleared signal.

AAR Sig. Sec. 8056A.

These circuits have been designed to control switches and signals by levers that are not mechanically interlocked and are not provided with electric locks or other mechanical means to restrict their movements. The use of relays provides the equivalent protection usually provided by mechanical and electric locking of levers.

The route check network shown on Sheet 1 provides a preliminary route check before a signal may be cleared, insuring that switch levers are in the proper positions to assure a complete route for the signal to be cleared; also that switches in the route correspond in position to levers controlling them, that opposing and conflicting signal levers are not in a position to clear opposing or conflicting signals and that opposing and conflicting signals are in the stop position. A relay is provided for each signal lever in the route check circuits, that must pick up before circuit is completed to clear signal. These relays are designated HSR, and each is provided with a holding circuit that may only be released by restoring the lever of signal affected to the normal position, or by a train passing the signal and shunting the track relay. This prevents changing a cleared signal to stop indication should an operator inadvertently move a switch lever in route or the opposing signal lever. Slow release relays designated NLPR, on Sheet 1, which repeat the normal position of the signal levers are provided to prevent the storage for the control of a signal until a route is established; also to prevent the storage for the control of a signal if the signal lever controlling an opposing signal has been operated.

The signal control network shown on Sheet 2 consists of circuits for direct control of searchlight signals while the network shown on Sheet 3 consists of circuits for control of relays for color light signals. Both networks check all the switch repeating relays and track relays in the route energized, the switch locking and approach locking relays de-energized, also that the opposing and conflicting approach locking relays are energized. Restricting signals are controlled through first track section only. When a restricting signal is to be displayed on signals 2, 4 or 6, for a following move into an occupied block, a push button is pushed, which momentarily energizes the NLPR, thus re-energizing the HSR, and energizing the COSR.

The route check and signal control network circuits are selected through the track relays for all conflicting movements.

For movements from signal 8R there is an intermediate signal 4RA which affects the controls of the above mentioned signal. Relay 8RLPR, shown on Sheet 1, is used to take care of this condition, eliminating complicated selections in circuits of both networks.

The switch locking relays designated LSR, shown on Sheet 4, are controlled by track relays, route locking relays and approach locking relays. The approach locking relays lock switches as soon as route has been established and HSR relay has picked up. The common side of the circuit for each switch locking relay is selected over its own front contact and in multiple are agreement circuits, a normal polar contact of switch repeater relay and normal switch lever contact and a reverse polar contact of switch repeater relay and reverse switch lever contact. With this arrangement, if a switch lever is moved when its locking relay is de-energized, the relay will not pick up until switch lever has been restored to its initial position to agree with the position of switch which completes pick-up circuit of switch locking relay. This prevents the storage of switch control when the switch is locked.

Circuits that are not entirely in operating tower are double wire, double break, except signal repeating relay circuits.

AAR Sig. Sec. 8070B.

These circuits are so arranged that the first train entering an approach section receives the clear signal. The circuits are also arranged to prevent successive trains on one road retaining route when conflicting road occupies an approach section.

A relay designated as RR is provided for each road. The purpose of this relay is to provide a preliminary route check before a signal may be cleared, insuring that the signal controls on the conflicting road are open, and that the signals for conflicting movements are in the stop position.

The signal control circuits are arranged to check that all track circuits within the interlocking limits are energized, that its approach locking stick is de-energized, and that both time element relays are de-energized.

Directional stick relays are provided to prevent the reverse signal from automatically clearing after a move has been completed through the interlocking. Directional sticks are made slow release to protect against their becoming de-energized by short high-speed train movements.

If a reverse or back-up move is required, the push button associated with its own track must be operated to release the directional stick before reverse signal will clear for a back-up move.

If it is desired to change an established route, a push button associated with the conflicting route must be operated. This will de-energize the PBSR and ASR relays for the conflicting route, which will in turn de-energize the RR route relay and the signal of the established route. After the predetermined time interval the time locking will be released, allowing the signal on the conflicting route to clear. PBSR push button stick relays are automatically restored by the passage of a train.

Time locking on the established route is provided with two-track release to protect against release of a route in the event of a momentary shunt of one of the detector track circuits. Detector track stick relays are also used to provide additional protection against changing of a route due to momentary loss of shunt within the interlocking limits. A momentary shunt of either one of the detector tracks in front of an approaching train will put signal to stop until time locking is released by expiration of time interval.

AAR Sig. Sec. 8034A.

These circuits provide for control of signals which are interconnected with bridge devices by levers that are not mechanically interlocked nor provided with electric locks or other means to restrict their movements.

Signals are so interlocked with bridge devices that bridge device cannot be operated unless all signal devices have properly functioned to release the bridge.

Circuits are shown with rails normally locked for rail traffic. The signal control network shown on Sheet 1 checks that the rails are locked for rail traffic, that bridge lever is normal and bridge lock relay is de-energized; also, that the opposing approach locking relay is energized.

Approach locking relays, bridge lock relay and relays which check the position of the bridge are shown on Sheet 2.

Circuit controllers 1ENBRLCC, etc., are not mechanically connected to rail locks, but are actuated by rail locking devices to close normal contacts providing a check, in signal circuits, that rails are locked for rail traffic. When rail locks are withdrawn normal contacts in WNBRLCC, etc., are opened and reverse contacts are closed by a spring device which forms a part of the circuit controllers.

Circuit controllers EBCC and WBCC are connected mechanically to bridge rail locking machinery with contact closed when this machinery is in the rail locking position.

Circuits as shown presuppose that the several intermediate operations of the bridge machinery itself are interlocked with each other, either mechanically or electrically, to insure proper sequence, and that it is sufficient to check the

final operation of bridge machinery that rails are locked, at which time power may be cut off from the bridge machinery and the signal devices made free to establish rail traffic.

Where a movable bridge is to be signaled and the intermediate functions of bridge operating devices are not designed to operate in proper sequence, additional apparatus will be necessary to accomplish such sequence.

American Railway Signaling Principles and Practices

QUESTIONS ON

CHAPTER XXVI

RELAY INTERLOCKING

QUESTIONS ON CHAPTER XXVI

RELAY INTERLOCKING

1. What was provided in earlier types of interlocking that is not required in relay interlocking?

2. What are the three general types of relay interlocking?

3. What indications are usually provided on the control machine panel?

4. What advantages does the push button control center have over other types of centralized traffic control machines?

5. What factors determine whether direct wire or code system will be more economical for a remote control installation?

6. What does the term "switch correspondence light" mean?

7. Under what conditions will the switch correspondence light be lighted?

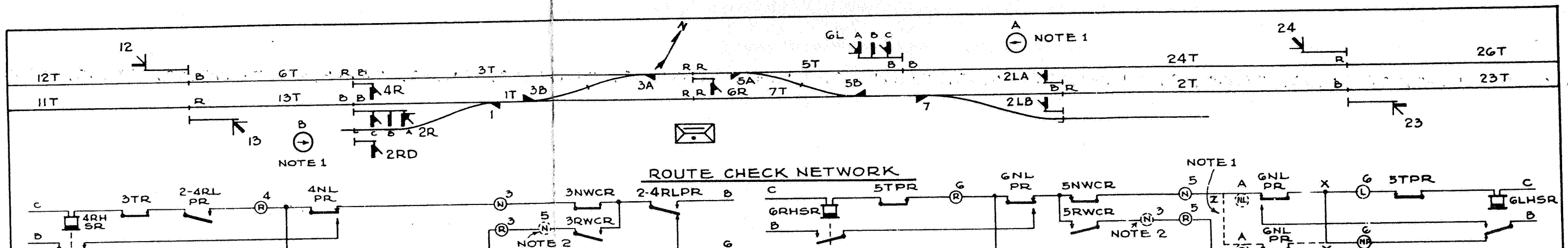
8. What is the function of the relays designated HSR?

9. What is the function of the relays designated NWSR and RWSR?

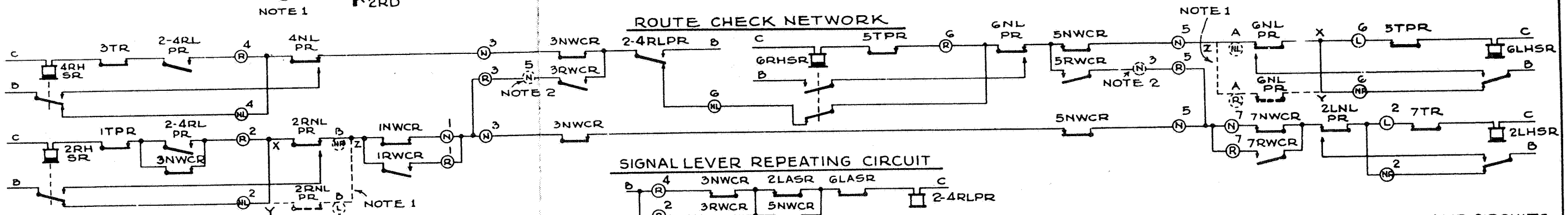
10. Why are the relays designated HSR provided with a holding circuit?

11. What is the purpose of relay designated RR at automatic interlockings?

12. Why are directional stick relays provided in automatic interlocking circuits?

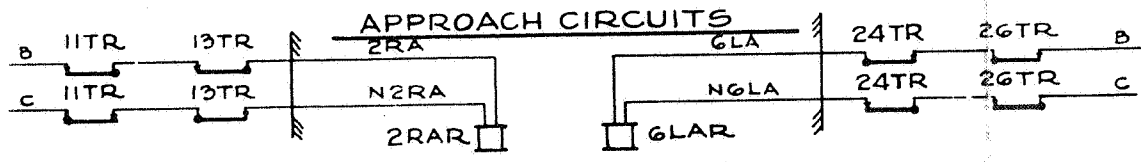


ROUTE CHECK NETWORK

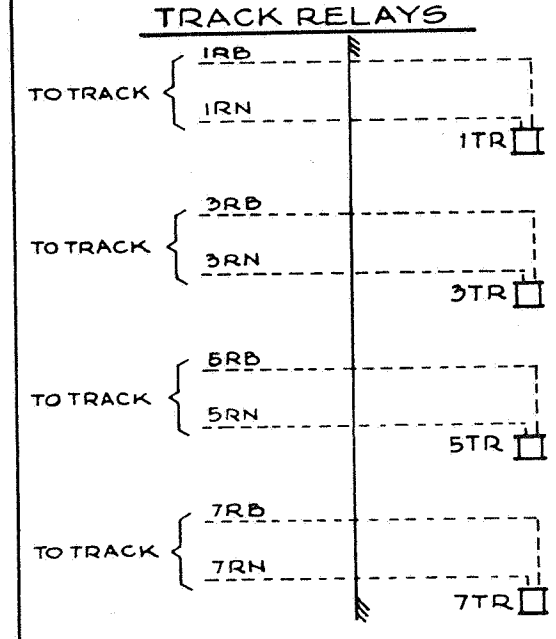


SIGNAL LEVER REPEATING CIRCUIT

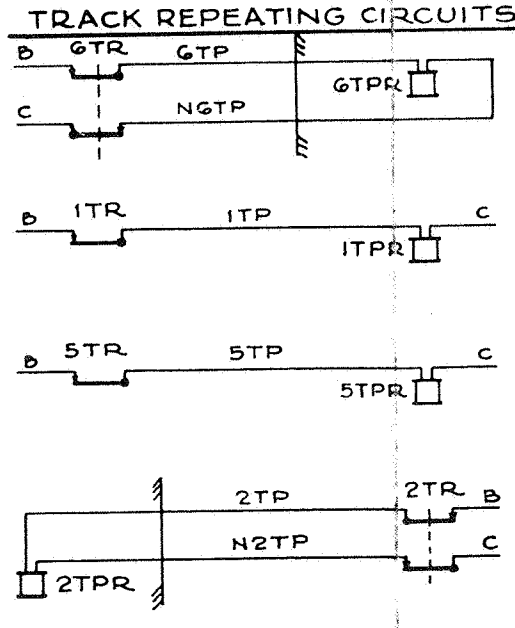
APPROACH CIRCUITS



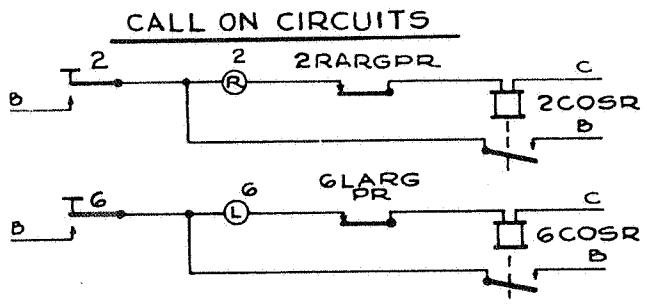
TRACK RELAYS



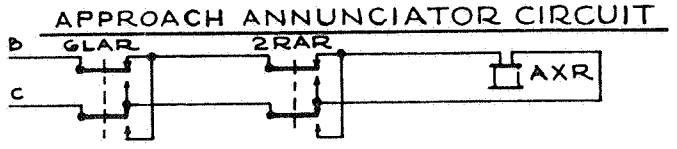
TRACK REPEATING CIRCUITS



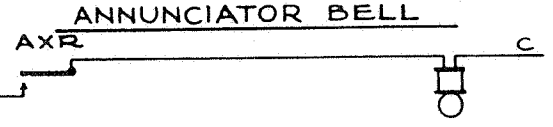
CALL ON CIRCUITS



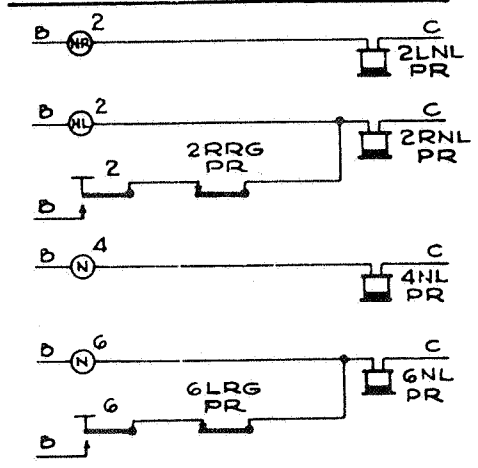
APPROACH ANNUNCIATOR CIRCUIT



ANNUNCIATOR BELL



LEVER NORMAL REPEATING CIRCUITS

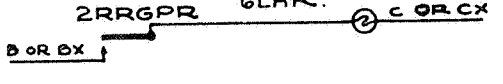


TRACK DIAGRAM LAMP CIRCUITS

TYPICAL FOR 1TK, 2TK, 3TK, 5TK, 6TK, 7TK, 2RAK, 6LAK.

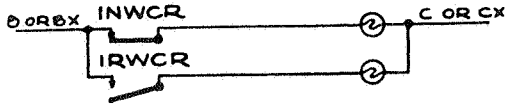
SIGNAL LEVER LAMP CIRCUITS

TYPICAL FOR 2RHK, 2LHK, 4RHK, 6RHK, 6LHK.



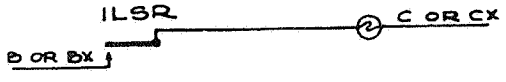
SWITCH LEVER LAMP CIRCUITS

TYPICAL FOR 1NWK, 1RWK, 3NWK, 3RWK, 5NWK, 5RWK, 7NWK, 7RWK,



SWITCH LOCKED LAMP CIRCUITS

TYPICAL FOR 1WLK, 3WLK, 5WLK, 7WLK



NOTE 1: OPTIONAL ADDITIONAL LEVER CONTROL FOR REVERSE TRAFFIC MOVEMENT. WHEN USED, INSTALL DOTTED CIRCUIT "YZ" AND OMIT CONNECTION "XY."

NOTE 2: OPTIONAL SELECTION TO PREVENT RUN-AROUND MOVEMENT

TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

LOCAL CONTROL—FUNCTIONS INDIVIDUALLY CONTROLLED—NO LEVERS IN TRACK DIAGRAM
SEMI-AUTOMATIC STICK SIGNALS—RESTRICTING SIGNALS CONTROLLED THROUGH FIRST TRACK SECTION ONLY.

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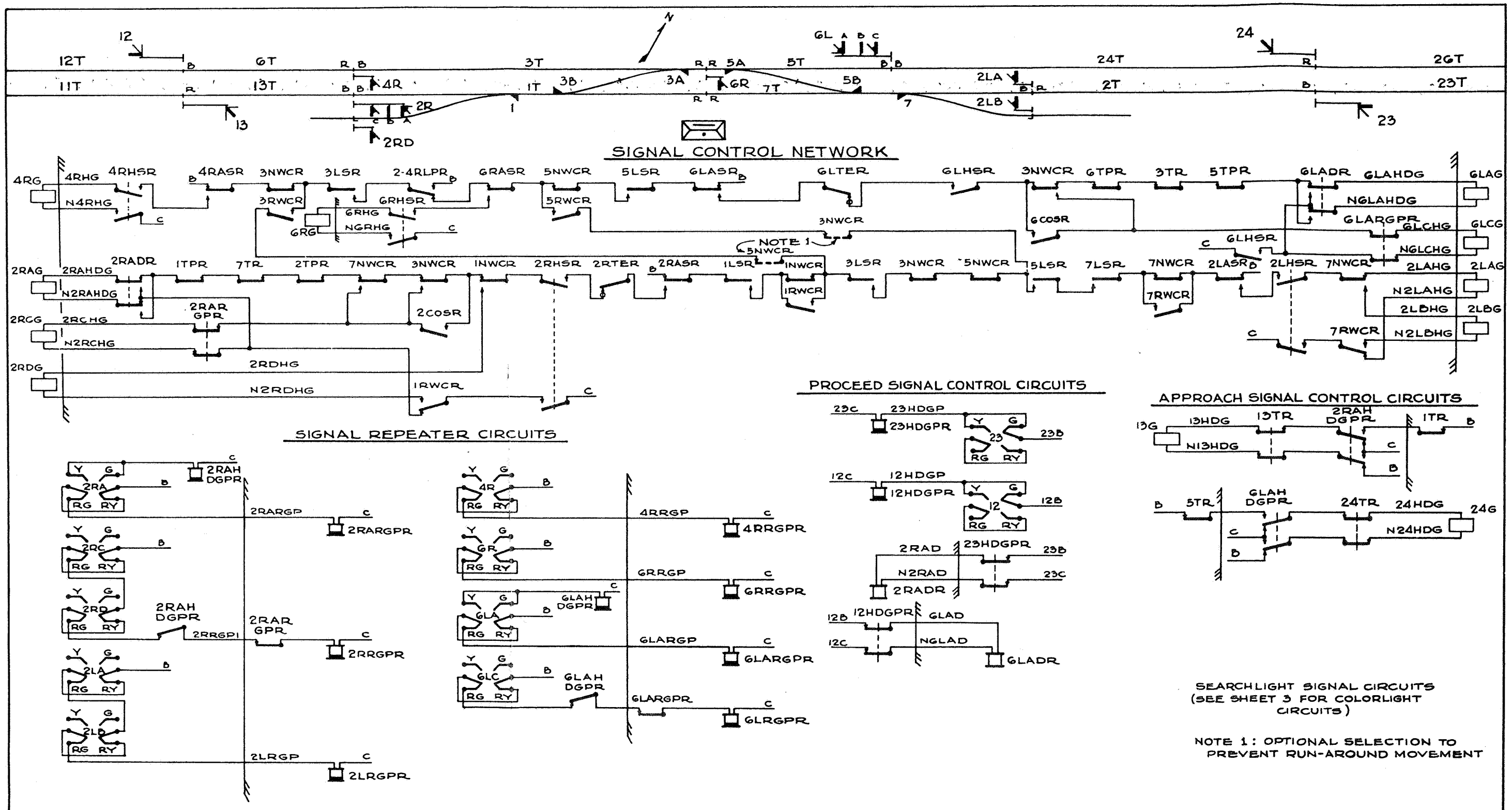
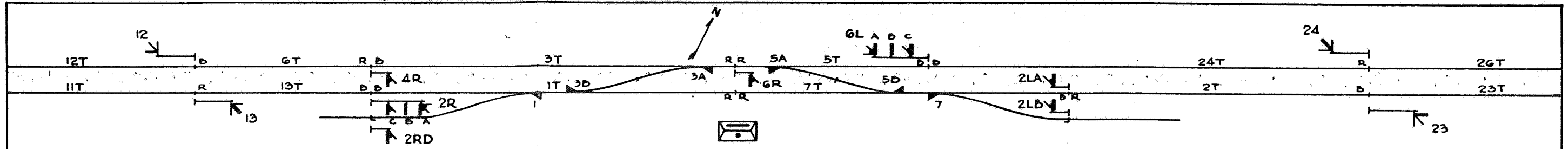


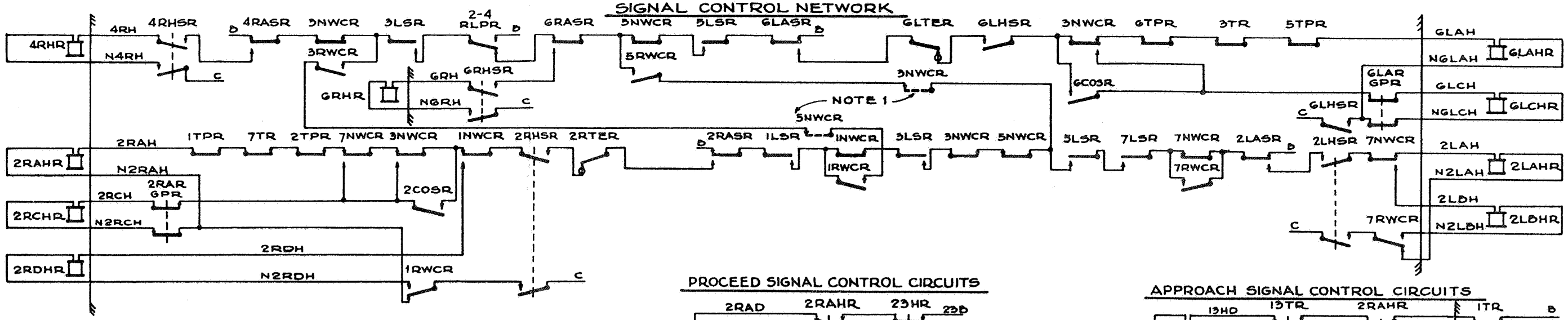
TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

LOCAL CONTROL – FUNCTIONS INDIVIDUALLY CONTROLLED – NO LEVERS IN TRACK DIAGRAM
SEMI-AUTOMATIC STICK SIGNALS – RESTRICTING SIGNALS CONTROLLED THROUGH FIRST TRACK SECTION ONLY.

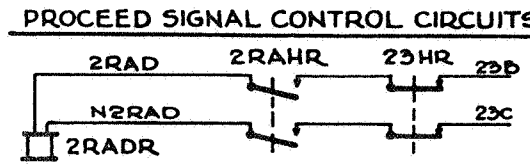
AAR SIG.SEC. 8010A
REV. 1947 A.M. SEPT. 1947



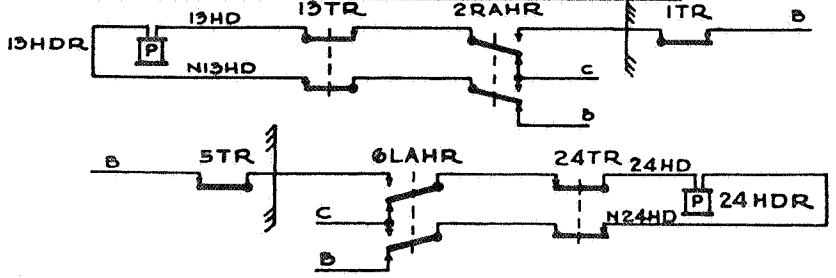
SIGNAL CONTROL NETWORK



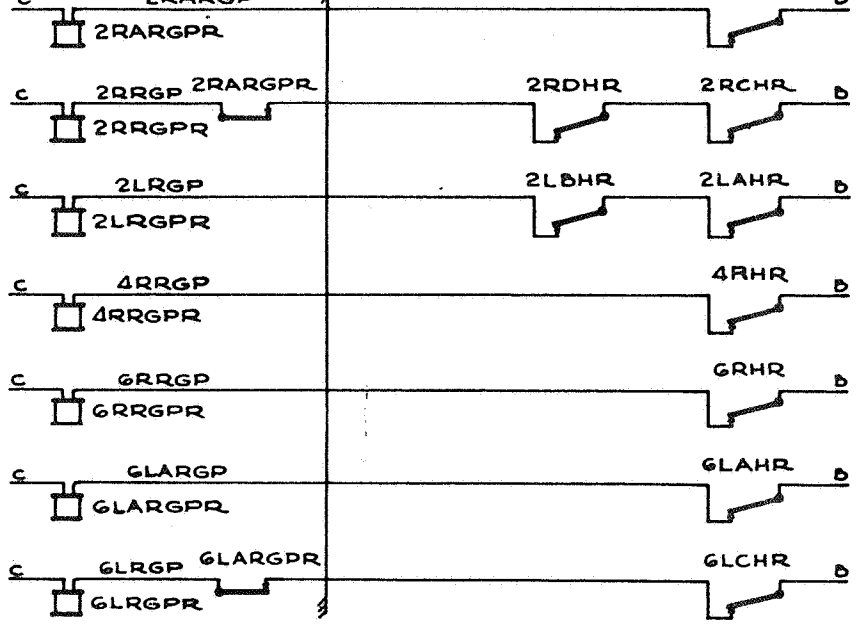
PROCEED SIGNAL CONTROL CIRCUITS



APPROACH SIGNAL CONTROL CIRCUITS

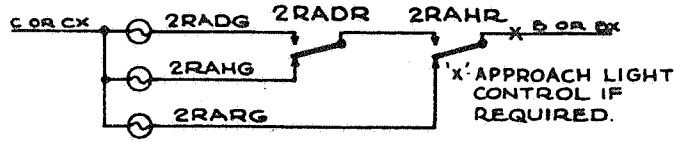


SIGNAL REPEATER CIRCUITS



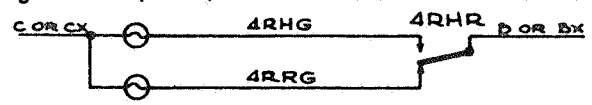
TYPICAL SIGNAL LAMP CIRCUIT

Signals 2RA and GLA



TYPICAL SIGNAL LAMP CIRCUITS

Signals 4R, 2RC, 2RD, GR, GLC, 2LA and 2LB



COLOR-LIGHT SIGNAL CIRCUITS
(SEE SHEET 2 FOR SEARCHLIGHT CIRCUITS)

NOTE 1: OPTIONAL SELECTION TO PREVENT RUN-AROUND MOVEMENT.

TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

LOCAL CONTROL – FUNCTIONS INDIVIDUALLY CONTROLLED – NO LEVERS IN TRACK DIAGRAM
SEMI-AUTOMATIC STICK SIGNALS – RESTRICTING SIGNALS CONTROLLED THROUGH FIRST TRACK SECTION ONLY

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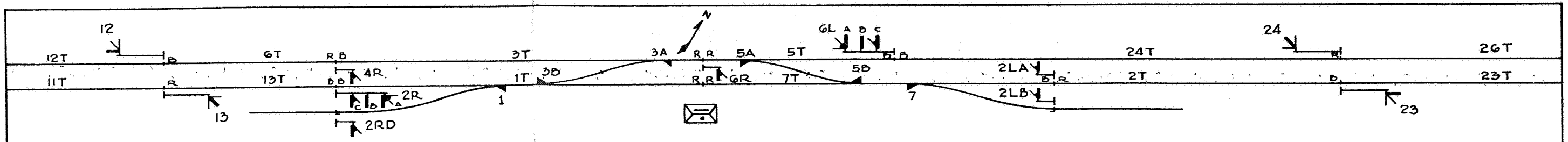
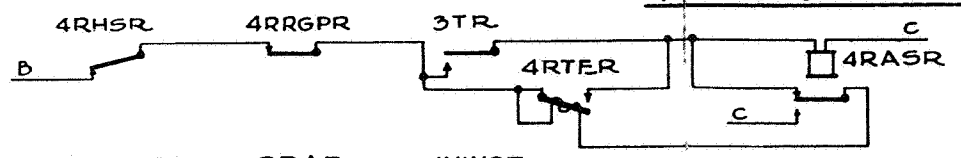
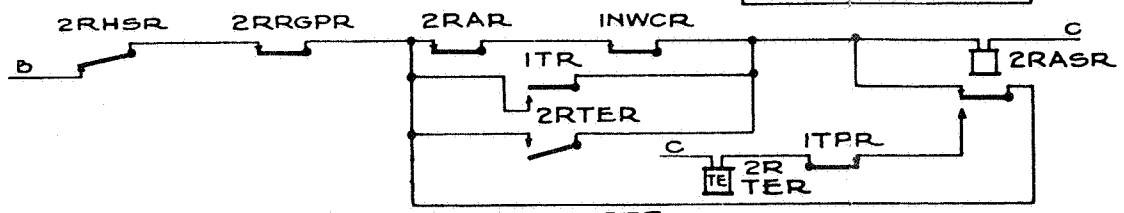
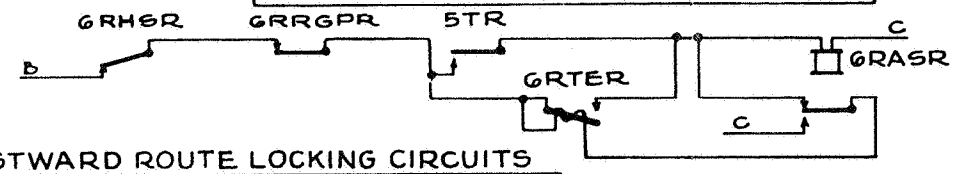


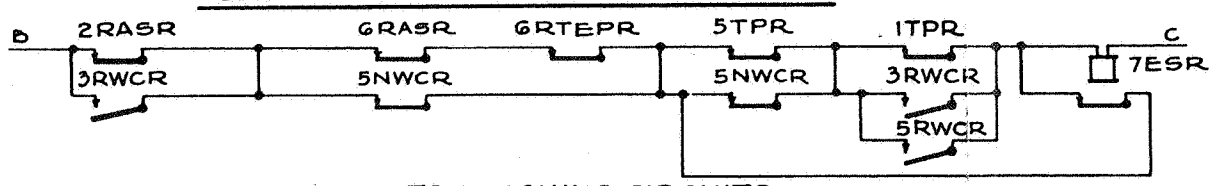
APPROACH AND TIME LOCKING CIRCUITS



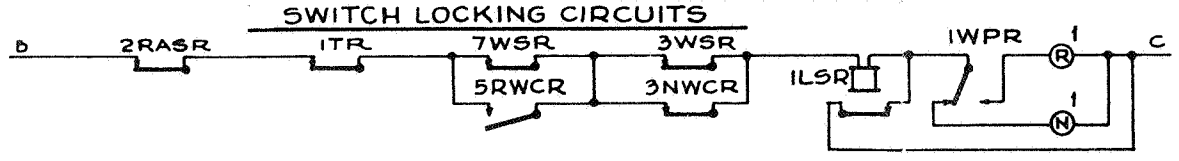


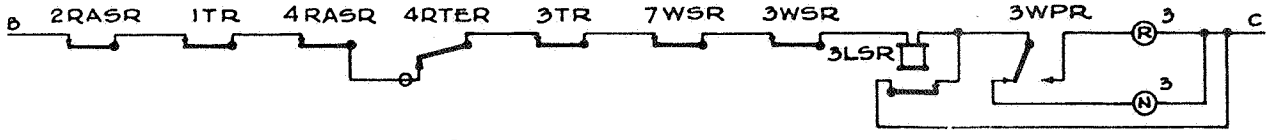


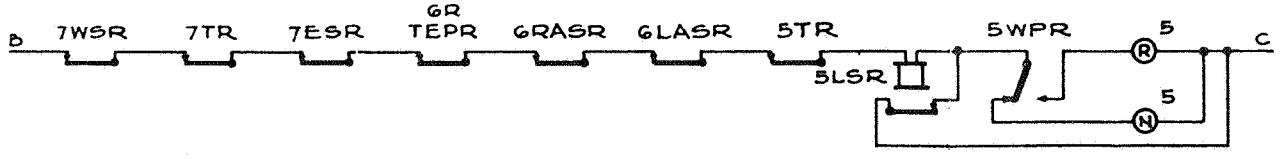
EASTWARD ROUTE LOCKING CIRCUITS

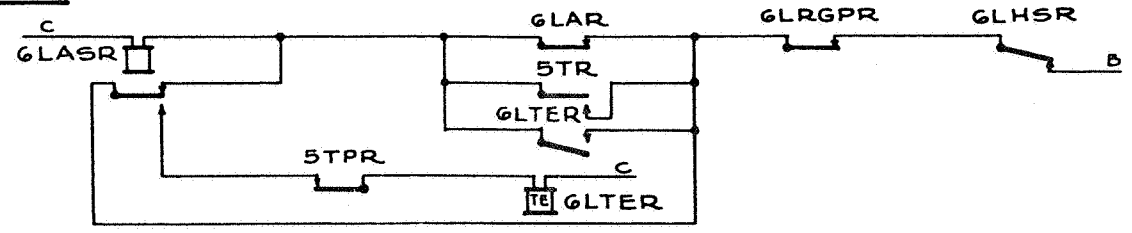


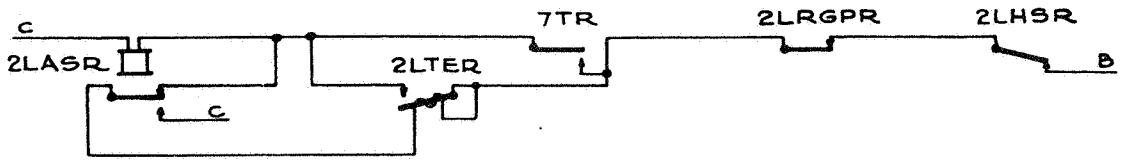
SWITCH LOCKING CIRCUITS



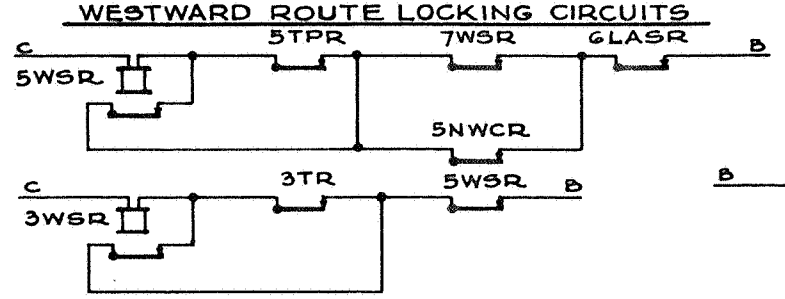


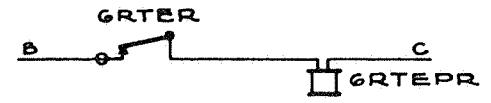


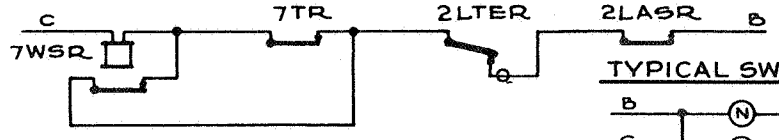




WESTWARD ROUTE LOCKING CIRCUITS

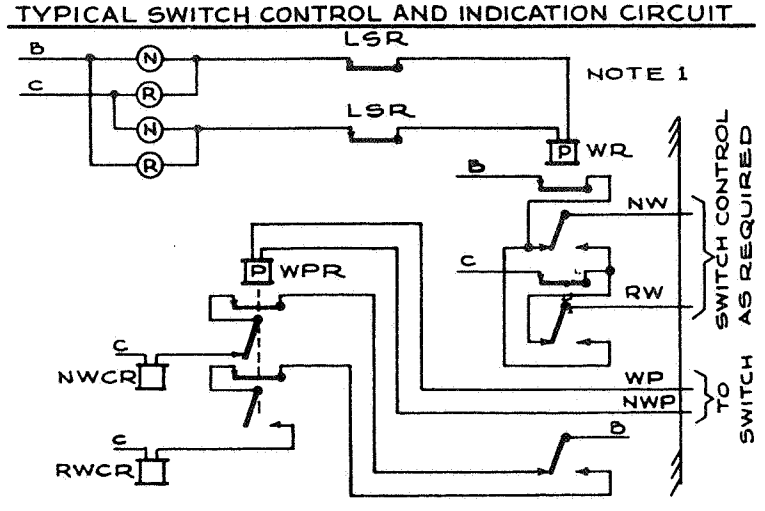






NOTE 1:
EXACT ARRANGEMENT OF SWITCH CONTROL AND INDICATION CIRCUITS WILL VARY WITH TYPE OF SWITCH MACHINE AND CONTROL APPARATUS.

TYPICAL SWITCH CONTROL AND INDICATION CIRCUIT



TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

LOCAL CONTROL—FUNCTIONS INDIVIDUALLY CONTROLLED—NO LEVERS IN TRACK DIAGRAM
SEMI-AUTOMATIC STICK SIGNALS—RESTRICTING SIGNALS CONTROLLED THROUGH FIRST TRACK SECTION ONLY.

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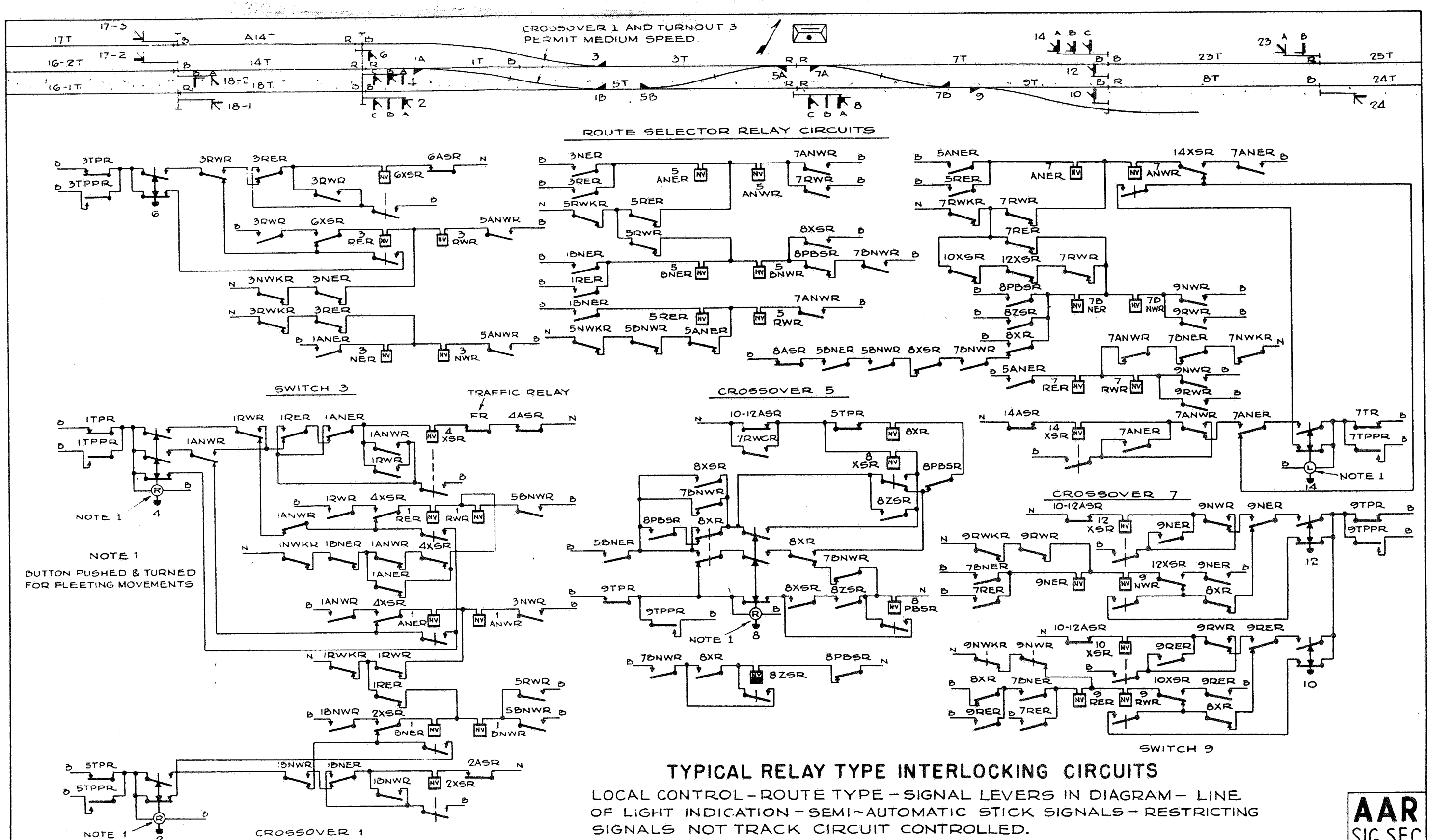
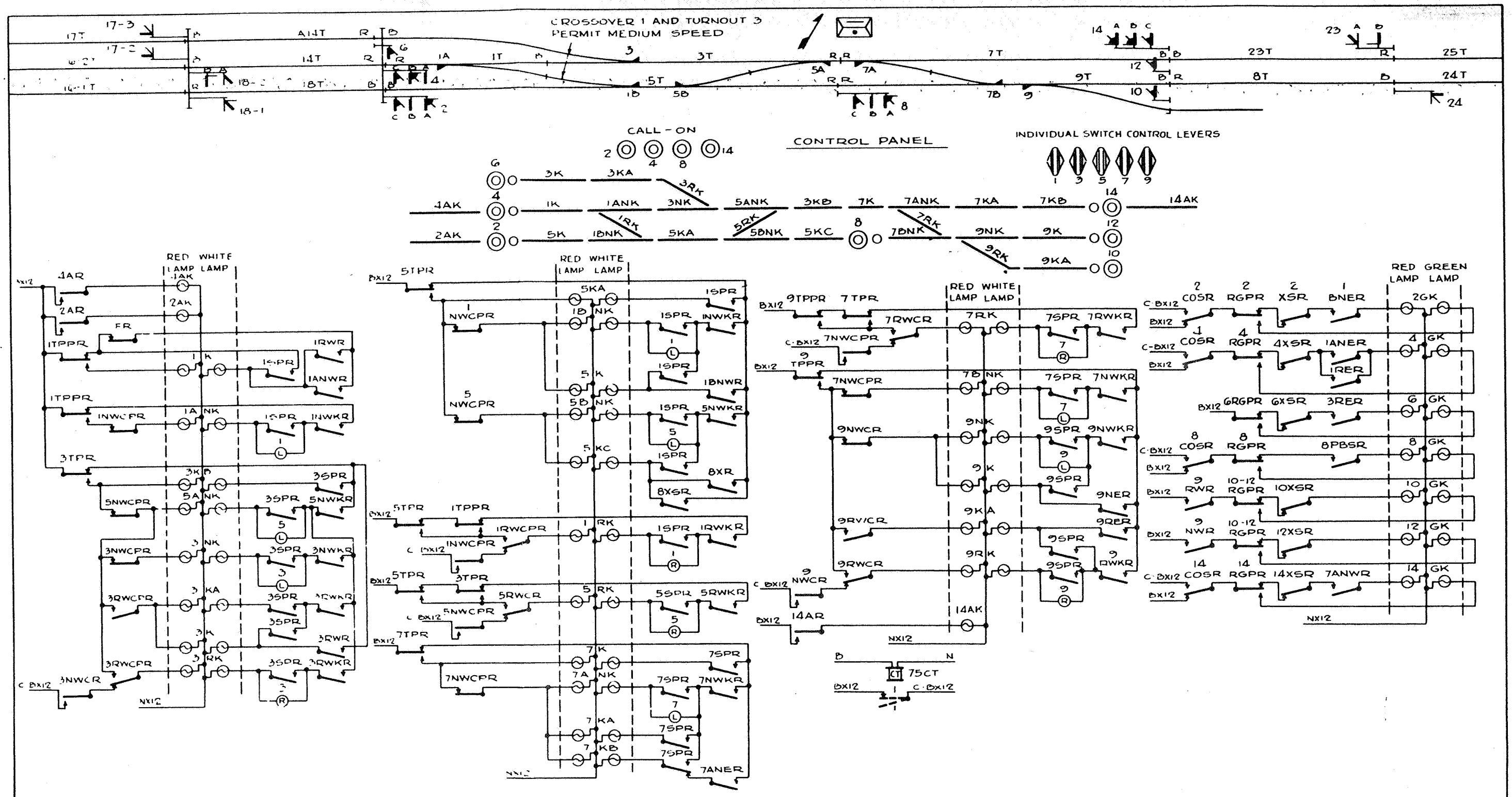


TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

LOCAL CONTROL – ROUTE TYPE – SIGNAL LEVERS IN DIAGRAM – LINE OF LIGHT INDICATION – SEMI-AUTOMATIC STICK SIGNALS – RESTRICTING SIGNALS NOT TRACK CIRCUIT CONTROLLED.

AAR SIG. SEC. 8025A

SEPT. 1950

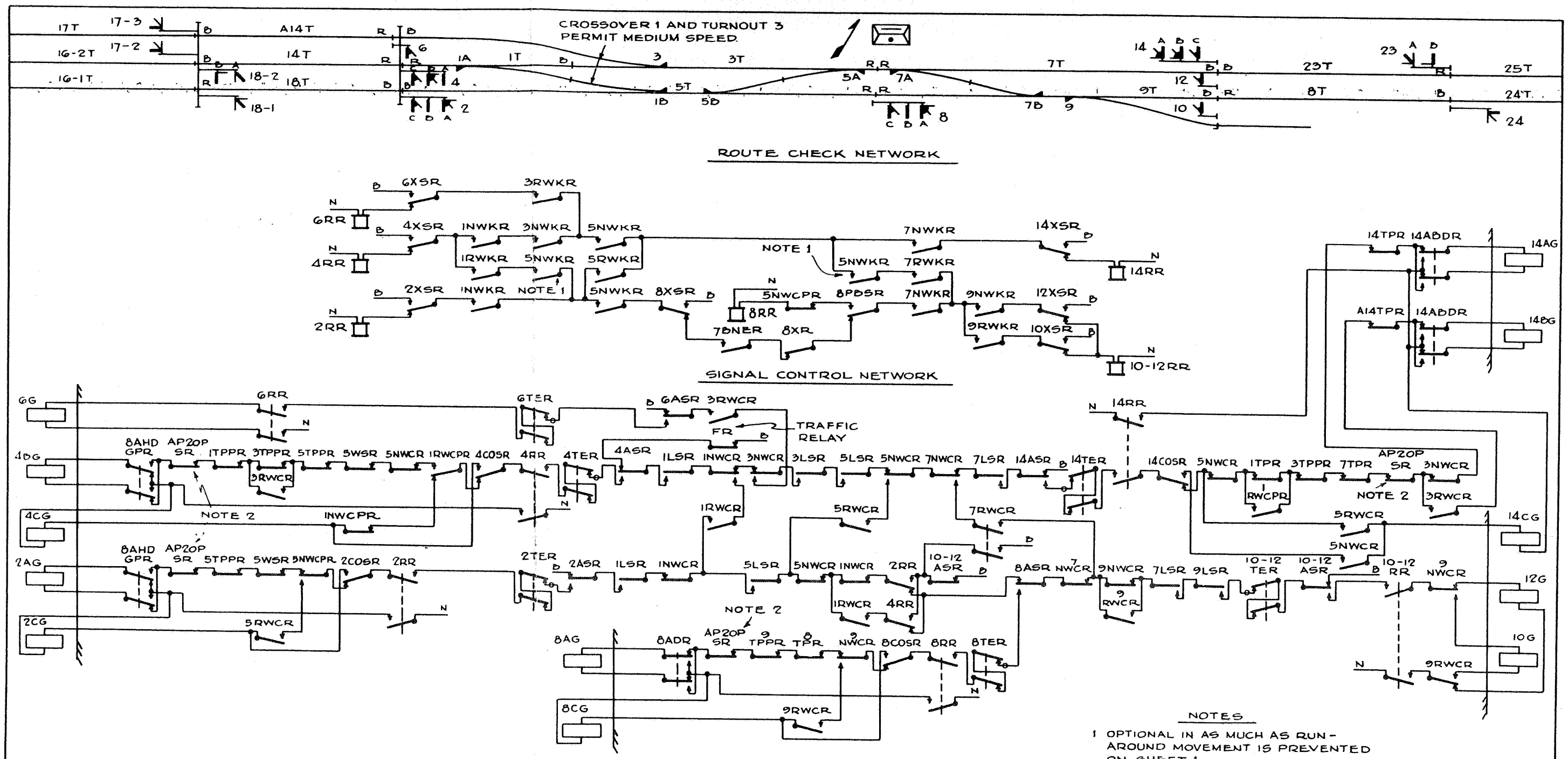


TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

LOCAL CONTROL – ROUTE TYPE – SIGNAL LEVERS IN DIAGRAM – LINE OF LIGHT INDICATION – SEMI-AUTOMATIC STICK SIGNALS — RESTRICTING SIGNALS NOT TRACK CIRCUIT CONTROLLED.

AAR SIG. SEC. 8025A

SEPT. 1950



NOTES

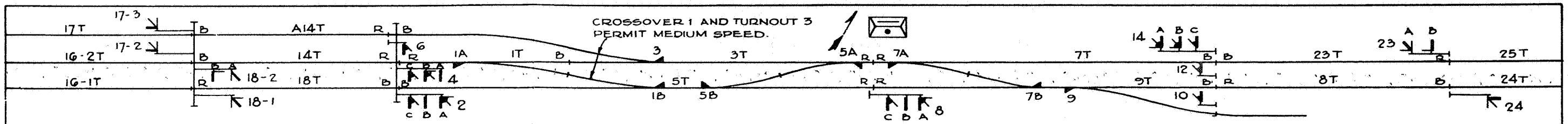
1. OPTIONAL IN AS MUCH AS RUN-AROUND MOVEMENT IS PREVENTED ON SHEET 1.
2. CONTACT AP20PSR REQUIRED FOR ELECTRO-PNEUMATIC INTERLOCKING ONLY.

TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

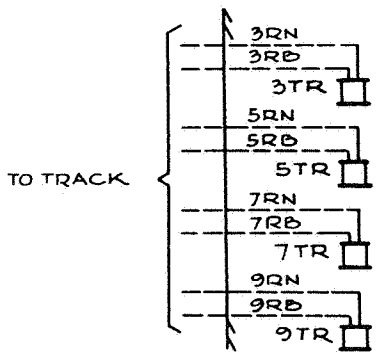
LOCAL CONTROL – ROUTE TYPE – SIGNAL LEVERS IN DIAGRAM – LINE OF LIGHT INDICATION – SEMI-AUTOMATIC STICK SIGNALS – RESTRICTING SIGNALS NOT TRACK CIRCUIT CONTROLLED.

AAR SIG. SEC. 8025A

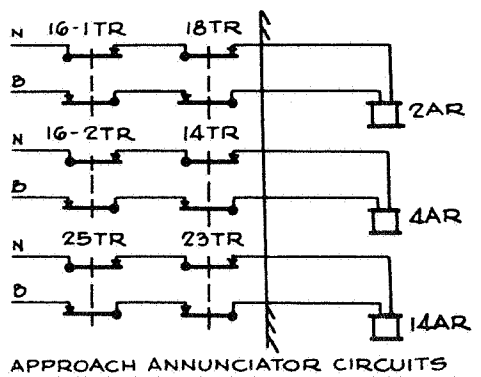
SEPT 1950



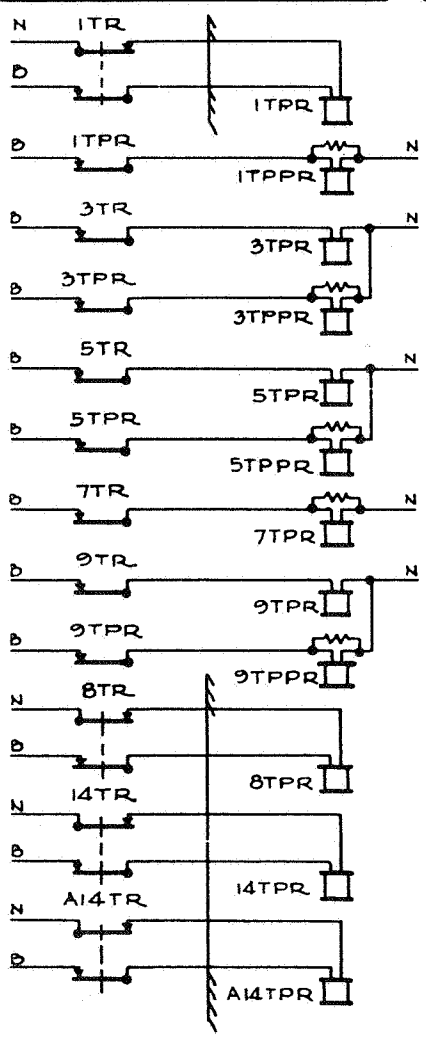
TRACK RELAYS



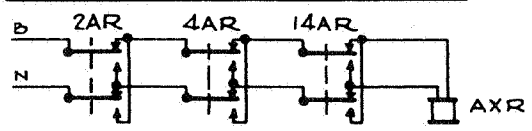
APPROACH CIRCUITS



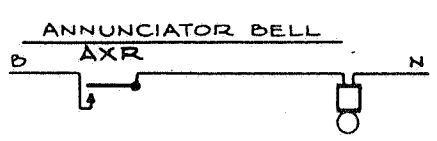
TRACK REPEATING CIRCUITS



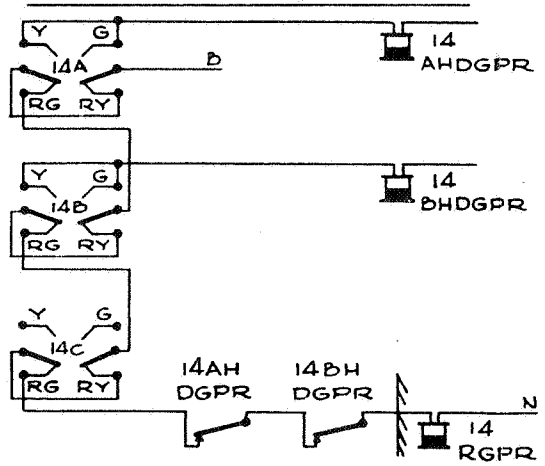
APPROACH ANNUNCIATOR CIRCUITS



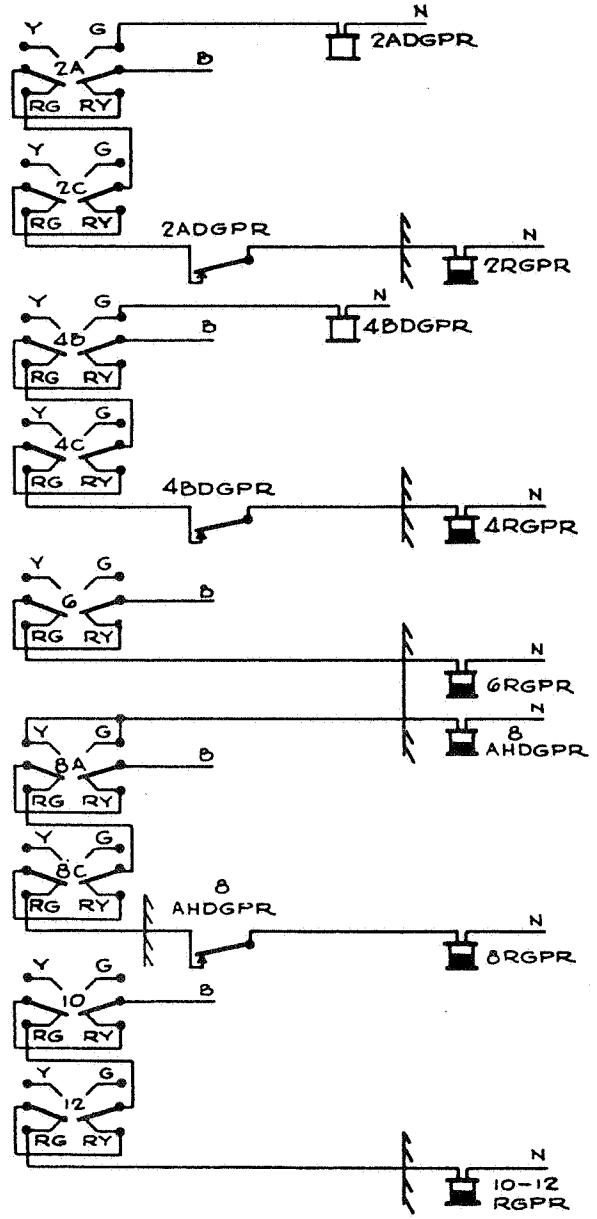
ANNUNCIATOR BELL



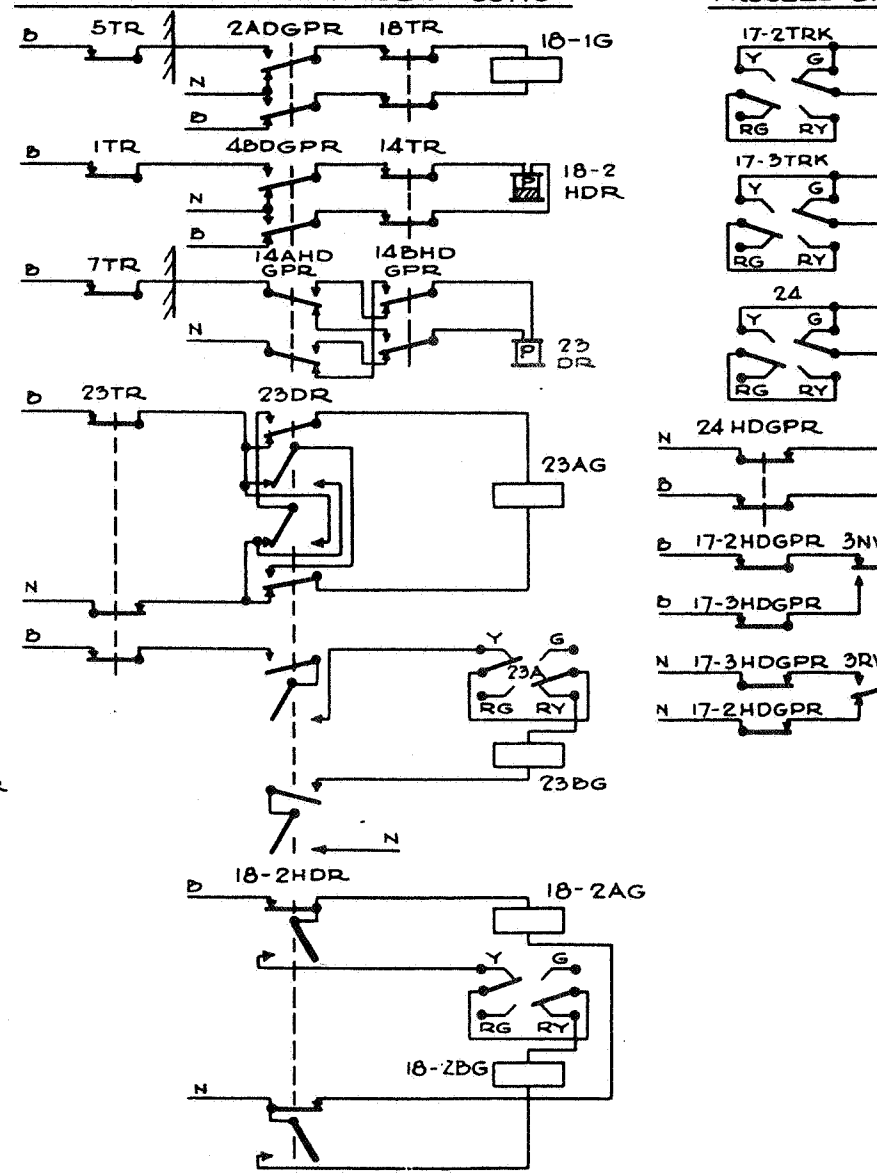
SIGNAL REPEATER CIRCUITS



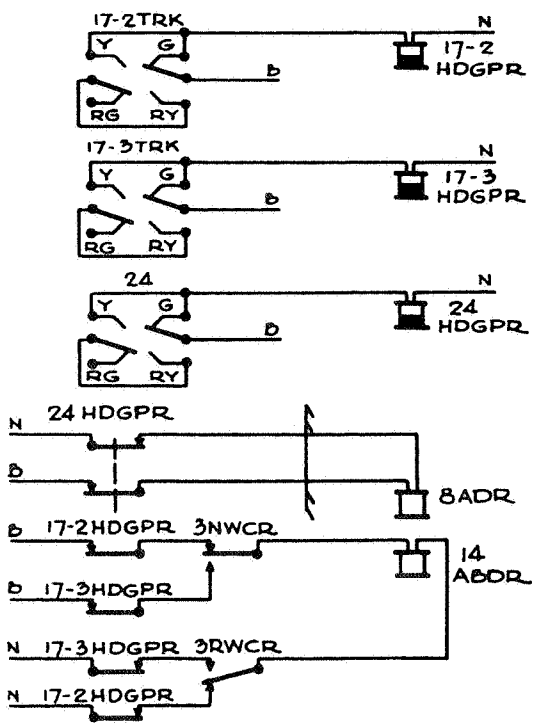
SIGNAL REPEATER CIRCUITS



APPROACH SIGNAL CONTROL CIRCUITS



PROCEED SIGNAL CONTROL CIRCUITS



TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

LOCAL CONTROL– ROUTE TYPE – SIGNAL LEVERS IN DIAGRAM – LINE OF LIGHT INDICATION – SEMI–AUTOMATIC STICK SIGNALS – RESTRICTING SIGNALS NOT TRACK CIRCUIT CONTROLLED

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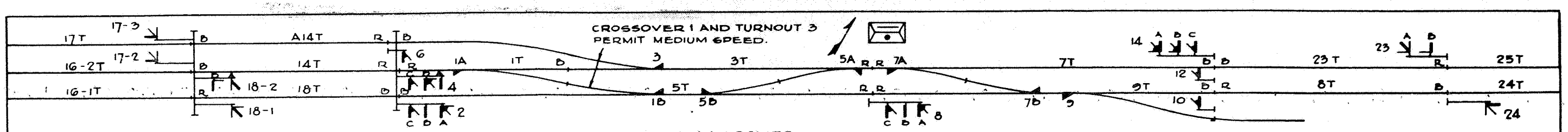
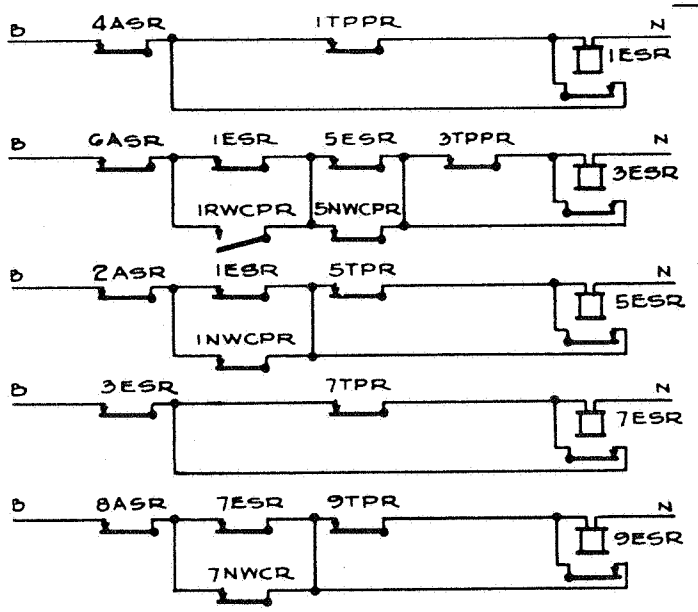
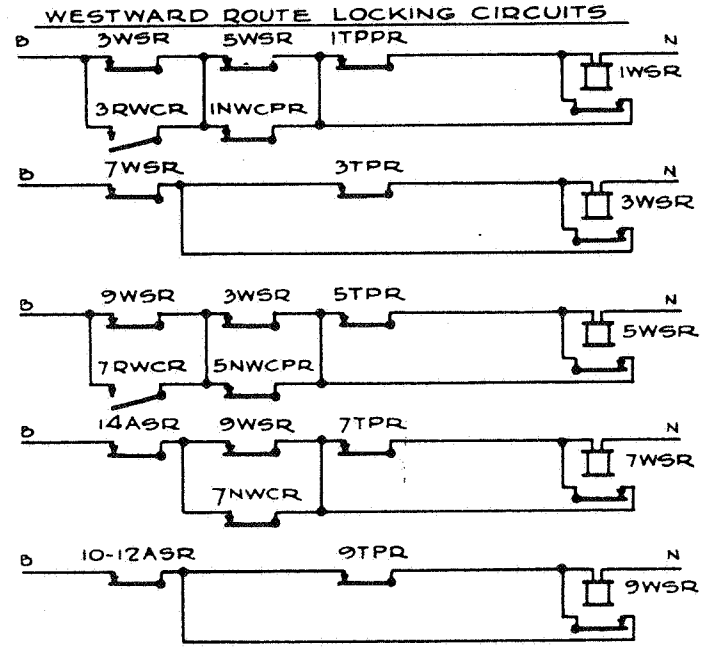


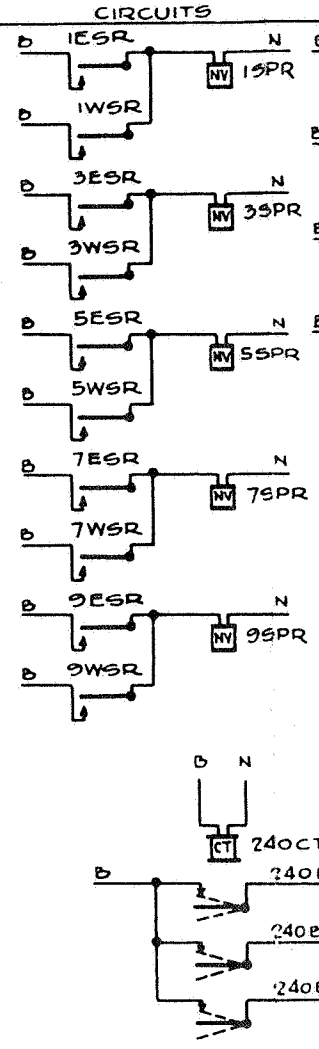
EASTWARD ROUTE LOCKING CIRCUITS.



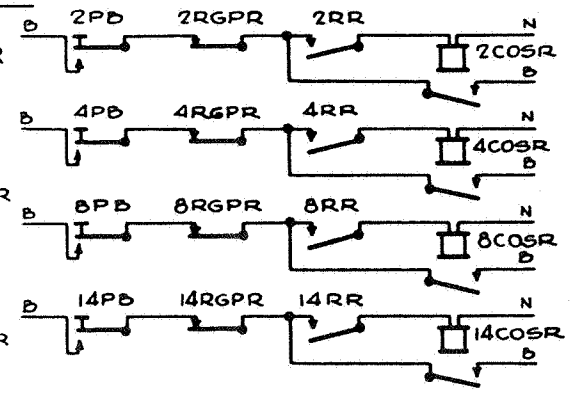
WESTWARD ROUTE LOCKING CIRCUITS



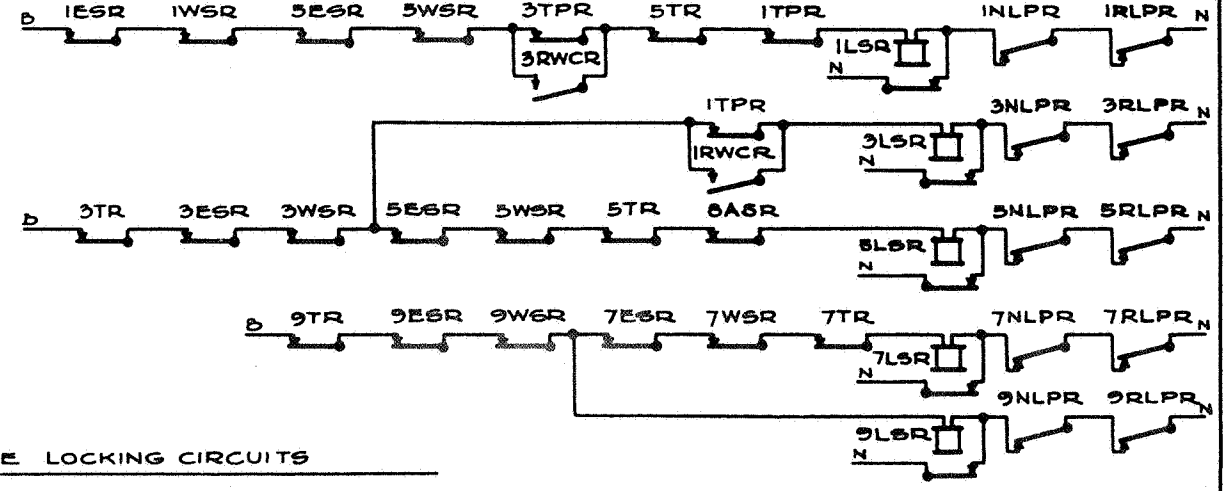
ROUTE INDICATION RELAY CIRCUITS



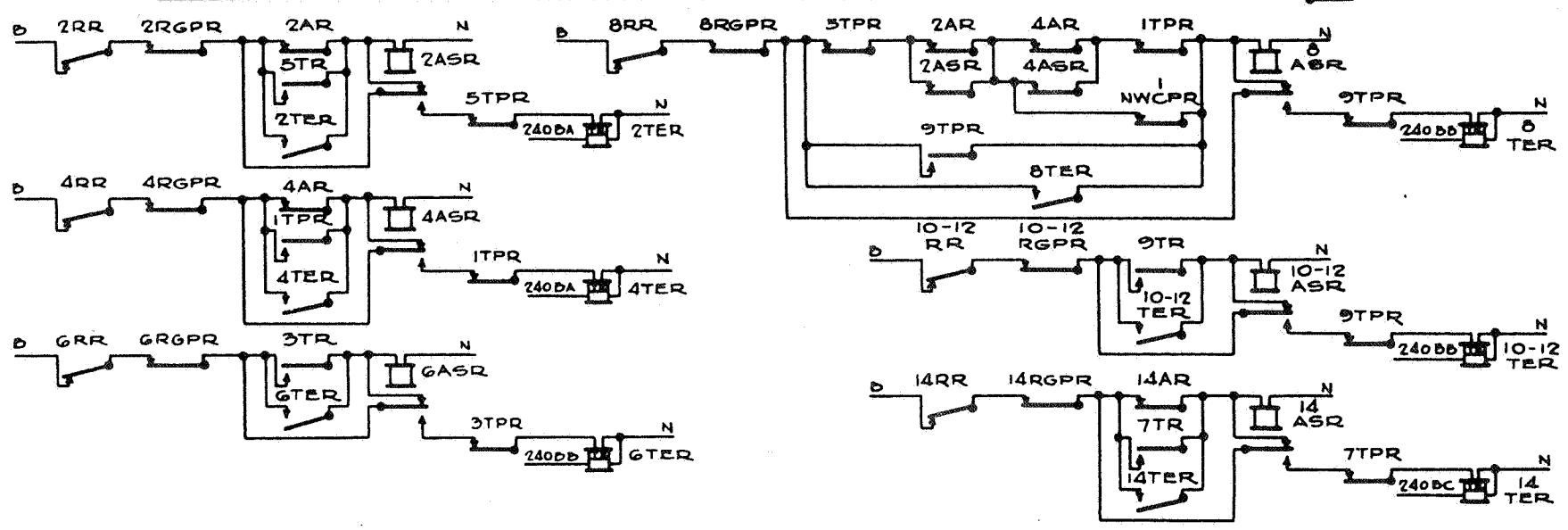
CALL ON RELAY CIRCUITS



SWITCH LOCKING RELAY CIRCUITS



APPROACH AND TIME LOCKING CIRCUITS



TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

LOCAL CONTROL – ROUTE TYPE – SIGNAL LEVERS IN DIAGRAM – LINE OF LIGHT INDICATION – SEMI-AUTOMATIC STICK SIGNALS – RESTRICTING SIGNALS NOT TRACK CIRCUIT CONTROLLED.

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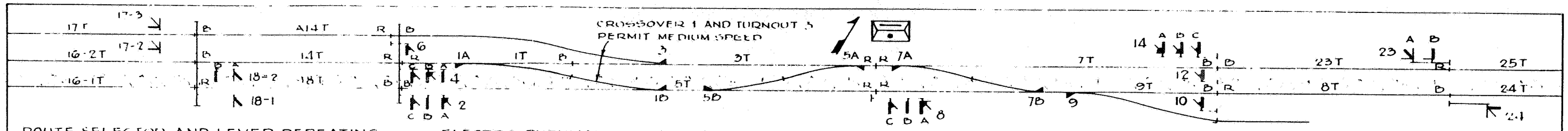
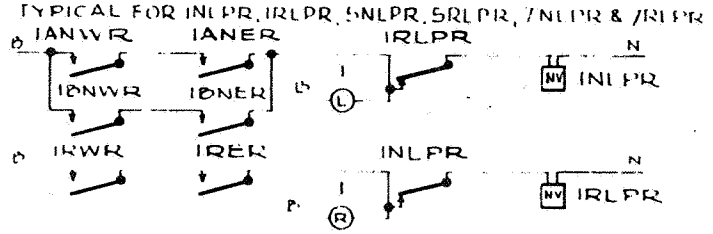
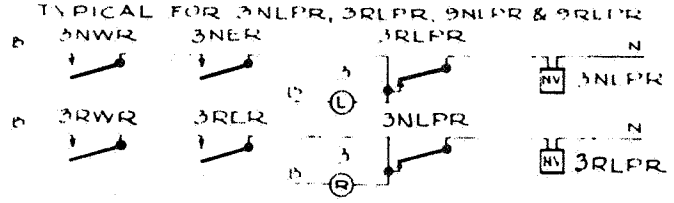


ROUTE SELECTOR AND LEVER REPEATING RELAY CIRCUITS

TYPICAL FOR 1NLPR, 1RLPR, 5NLPR, 5RLPR, 7NLPR & 7RLPR

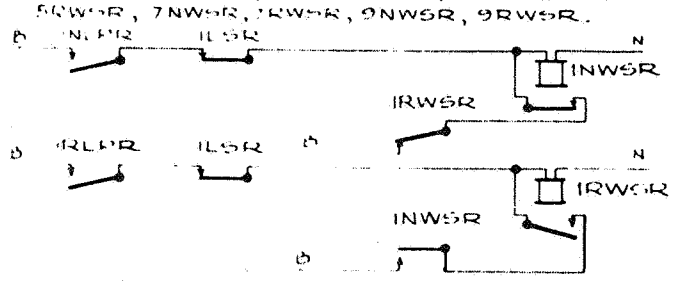


TYPICAL FOR 3NLPR, 3RLPR, 9NLPR & 9RLPR



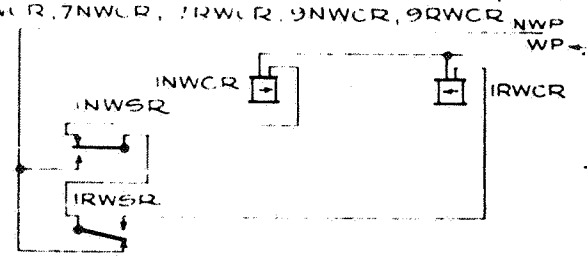
SWITCH CONTROL RELAY CIRCUITS

TYPICAL FOR 1NWSR, 1RWSR, 3NWSR, 3RWSR, 5NWSR, 5RWSR, 7NWSR, 7RWSR, 9NWSR, 9RWSR.

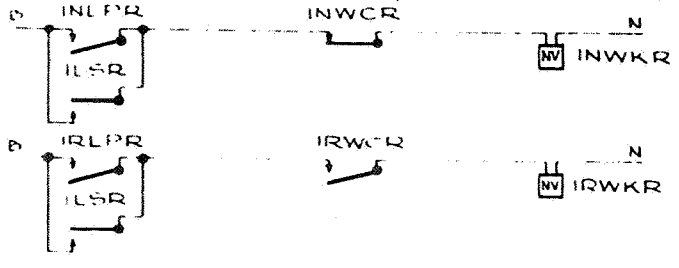


SWITCH INDICATION RELAY CIRCUITS

TYPICAL FOR 1NWCR, 1RWCR, 3NWCR, 3RWCR, 5NWCR, 5RWCR, 7NWCR, 7RWCR, 9NWCR, 9RWCR

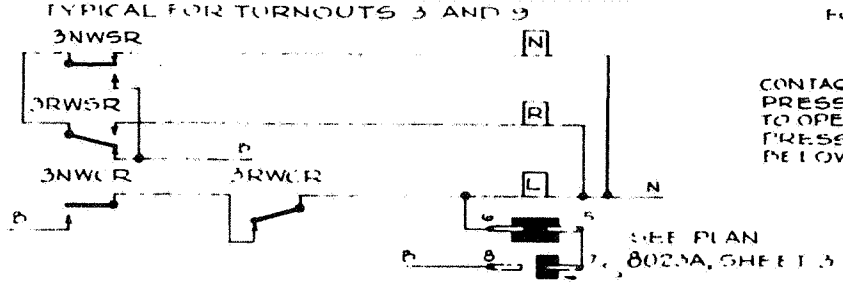


TYPICAL FOR 1NWKR, 1RWKR, 3NWKR, 3RWKR, 5NWKR, 5RWKR, 7NWKR, 7RWKR, 9NWKR & 9RWKR.

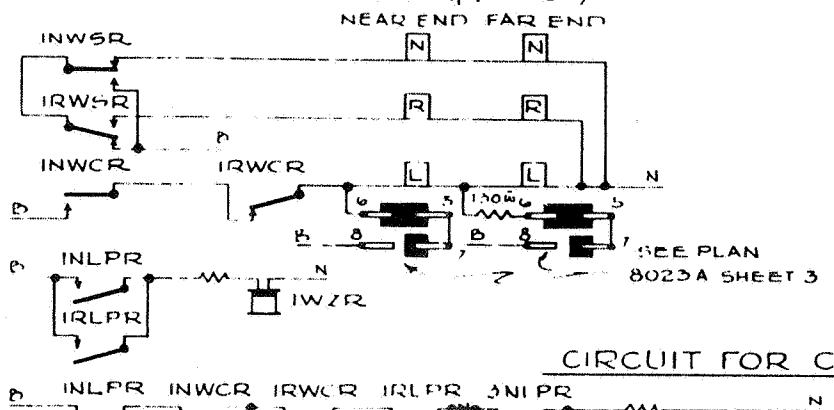


ELECTRO-PNEUMATIC SWITCH CONTROL CIRCUITS

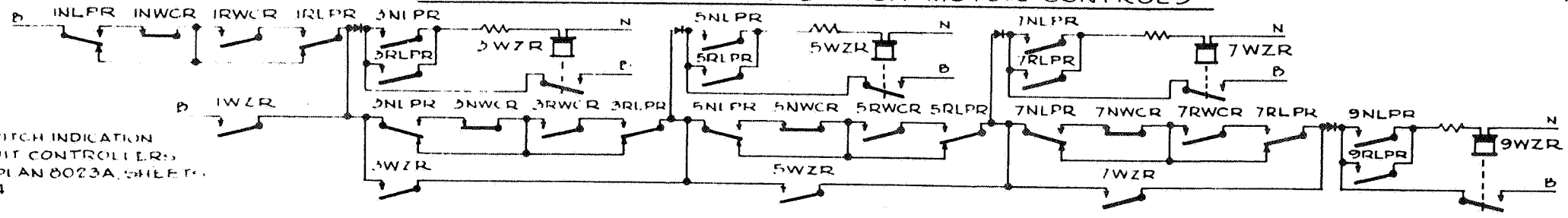
TYPICAL FOR TURNOUTS 3 AND 9



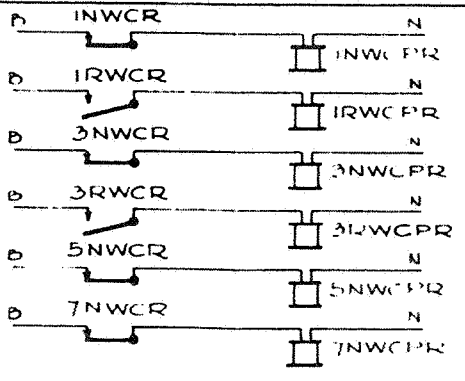
TYPICAL FOR CROSSOVERS 1, 5 AND 7



CIRCUIT FOR CASCADING SWITCH MOTOR CONTROLS

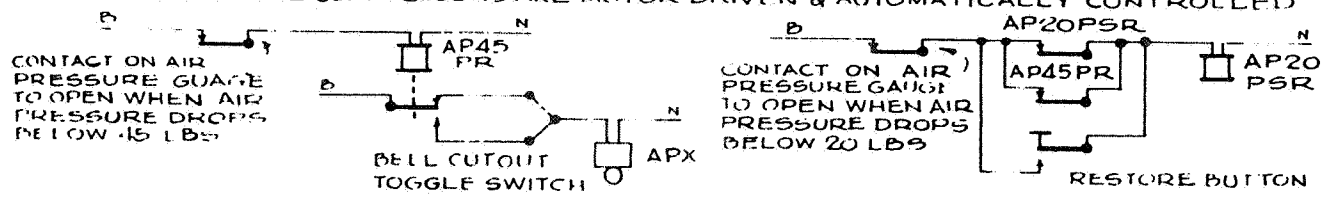


SWITCH INDICATION REPEATING RELAYS

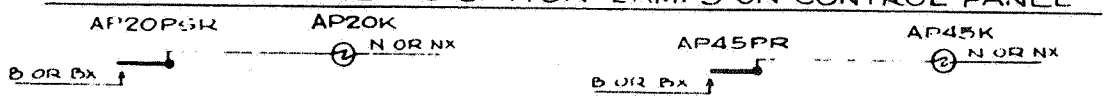


ELECTRO-PNEUMATIC SWITCHES LOW AIR PRESSURE INDICATION CIRCUITS

FOR USE WHERE COMPRESSORS ARE MOTOR DRIVEN & AUTOMATICALLY CONTROLLED

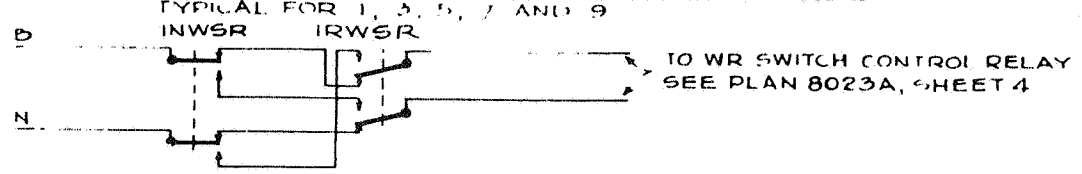


LOW AIR PRESSURE INDICATION LAMPS ON CONTROL PANEL

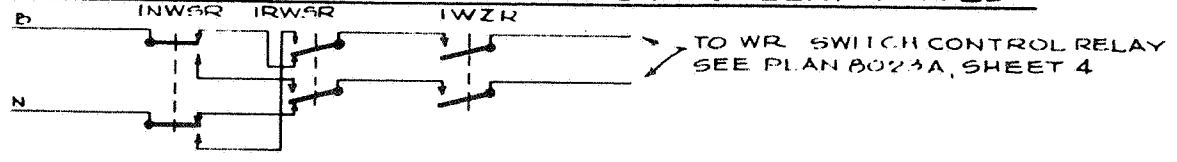


ELECTRIC SWITCH CONTROL CIRCUITS

TYPICAL FOR 1, 3, 5, 7 AND 9



ELECTRIC SWITCH CONTROL CIRCUIT WHERE WZR RELAY IS USED

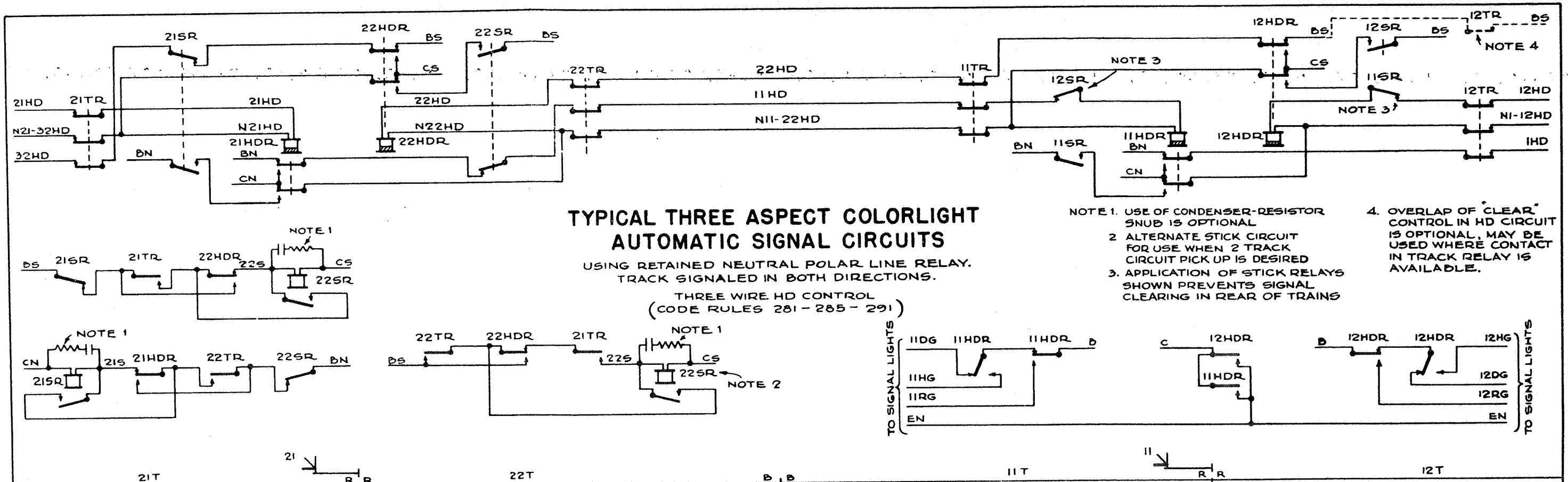


TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

LOCAL CONTROL – ROUTE TYPE – SIGNAL LEVERS IN DIAGRAM – LINE OF LIGHT INDICATION – SEMI-AUTOMATIC STICK SIGNALS – RESTRICTING SIGNALS NOT TRACK CIRCUIT CONTROLLED.

AAR SIG. SEC. 8025A

SEPT. 1950



TYPICAL THREE ASPECT COLORLIGHT AUTOMATIC SIGNAL CIRCUITS

USING RETAINED NEUTRAL POLAR LINE RELAY.
TRACK SIGNALED IN BOTH DIRECTIONS.

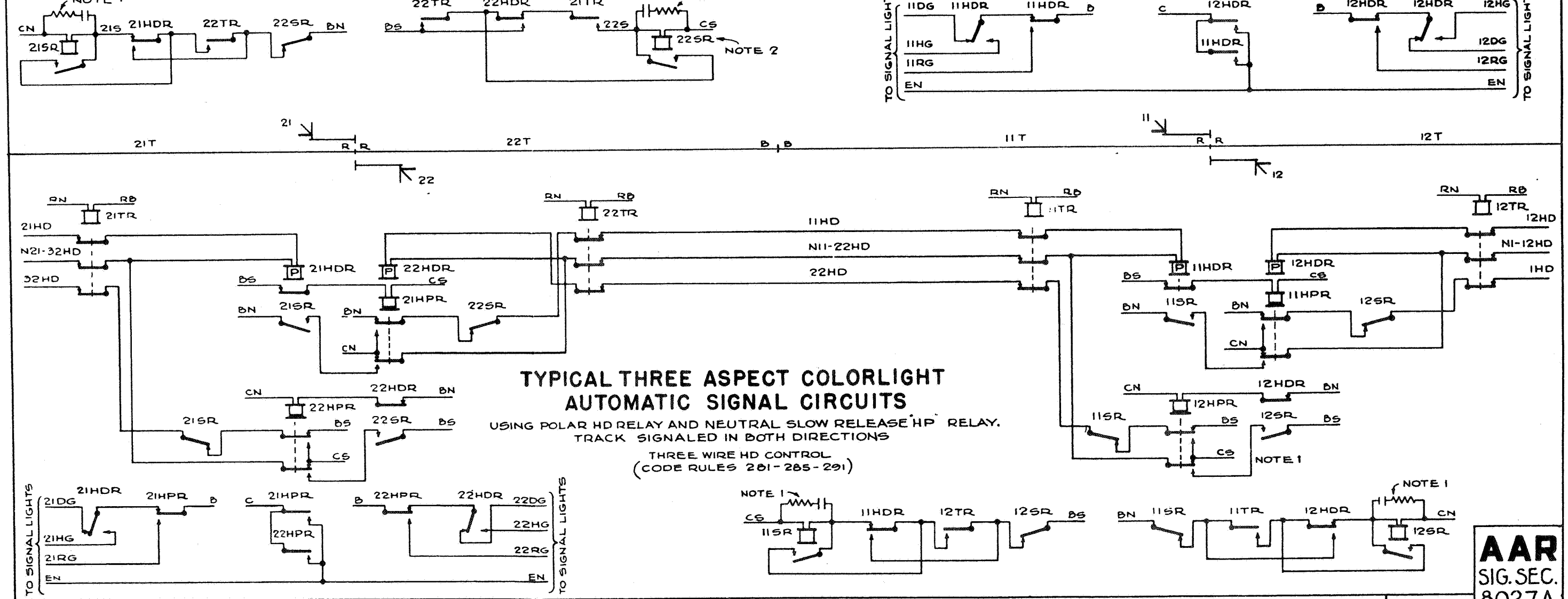
THREE WIRE HD CONTROL
(CODE RULES 281 - 285 - 291)

NOTE 1. USE OF CONDENSER-RESISTOR SNUB IS OPTIONAL

2 ALTERNATE STICK CIRCUIT FOR USE WHEN 2 TRACK CIRCUIT PICK UP IS DESIRED

3. APPLICATION OF STICK RELAYS SHOWN PREVENTS SIGNAL CLEARING IN REAR OF TRAINS

4. OVERLAP OF "CLEAR" CONTROL IN HD CIRCUIT IS OPTIONAL, MAY BE USED WHERE CONTACT IN TRACK RELAY IS AVAILABLE.



TYPICAL THREE ASPECT COLORLIGHT AUTOMATIC SIGNAL CIRCUITS

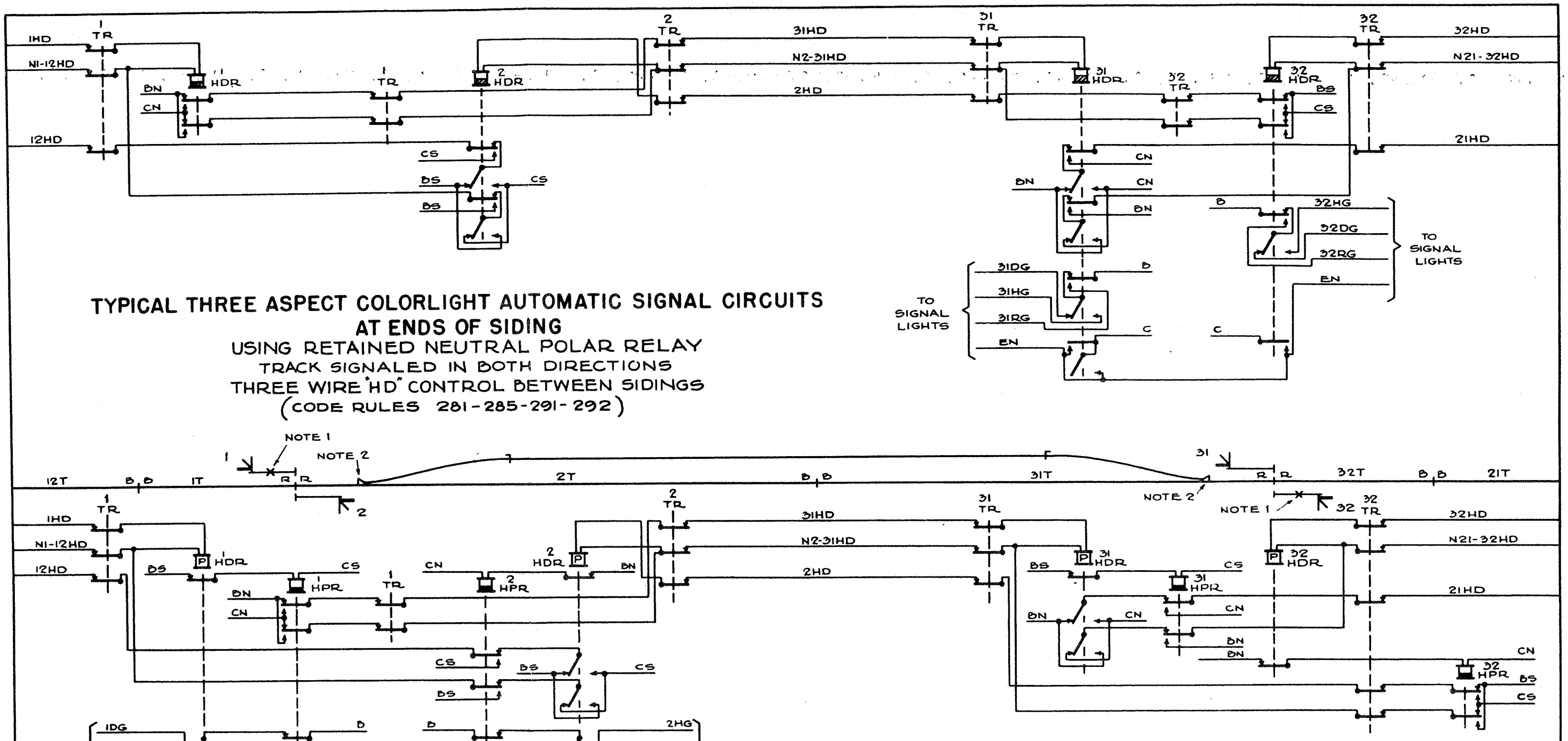
USING POLAR HD RELAY AND NEUTRAL SLOW RELEASE "HP" RELAY.
TRACK SIGNALED IN BOTH DIRECTIONS

THREE WIRE HD CONTROL
(CODE RULES 281 - 285 - 291)

AAR SIG. SEC. 8027A

SEPT. 1948

SHEET 1



TYPICAL THREE ASPECT COLORLIGHT AUTOMATIC SIGNAL CIRCUITS AT ENDS OF SIDING

USING RETAINED NEUTRAL POLAR RELAY
TRACK SIGNALED IN BOTH DIRECTIONS
THREE WIRE "HD" CONTROL BETWEEN SIDINGS
(CODE RULES 281-285-291-292)

NOTE 1. SIGNAL DISPLAYS RULE 292 AS THE MOST RESTRICTIVE INDICATION. CIRCUITS PROVIDE DOUBLE APPROACH FOR OPPOSING AND FOLLOWING MOVEMENTS.

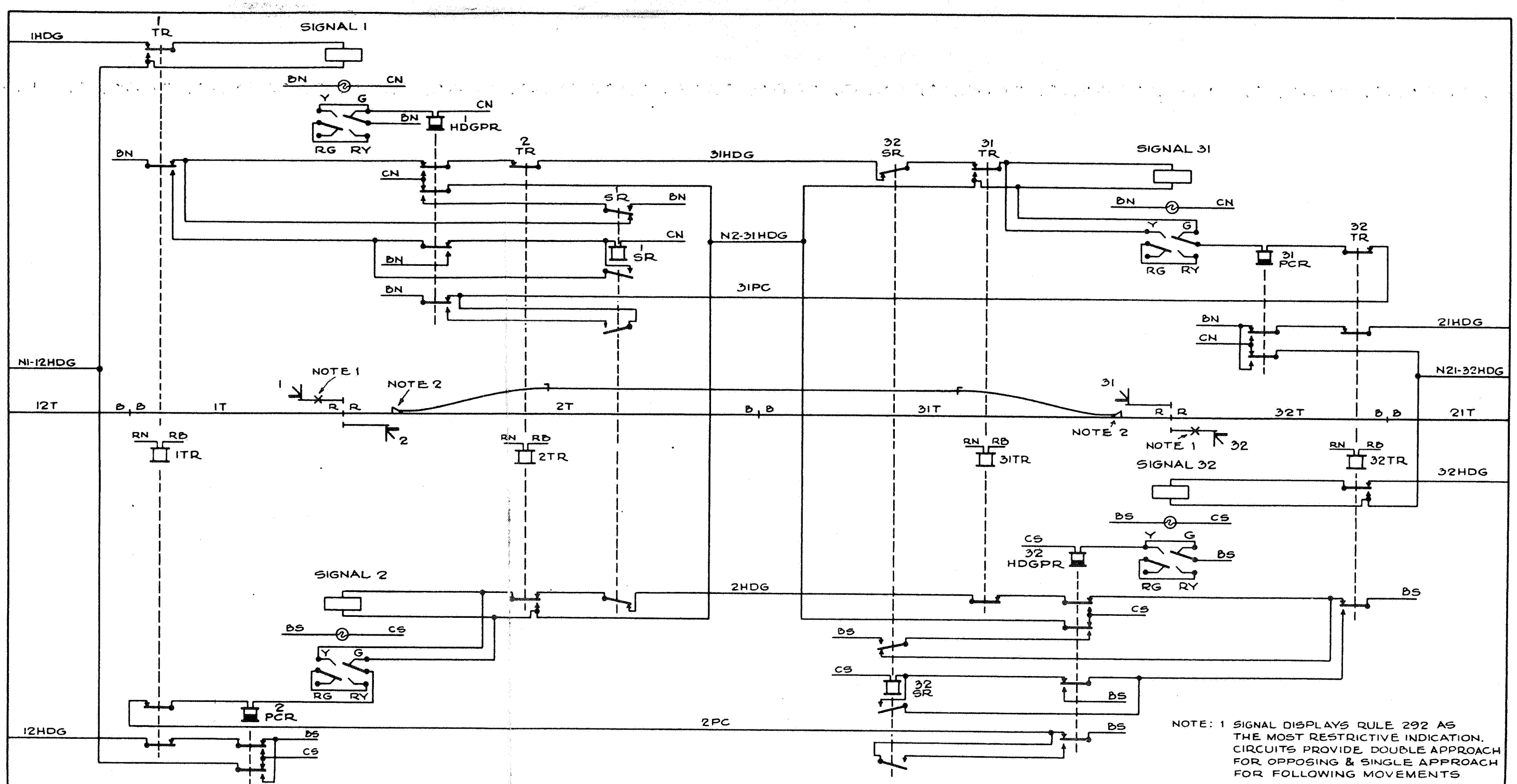
2. DETAILS OF SWITCH PROTECTION NOT SHOWN.

TYPICAL THREE ASPECT COLORLIGHT AUTOMATIC SIGNAL CIRCUITS AT ENDS OF SIDING

USING POLAR "HD" RELAY & NEUTRAL SLOW RELEASE "HP" RELAY
TRACK SIGNALED IN BOTH DIRECTIONS
THREE WIRE "HD" CONTROL BETWEEN SIDINGS
(CODE RULES 281-285-291-292)

AAR SIG. SEC 8027A

SEPT. 1949



NOTE: 1 SIGNAL DISPLAYS RULE 292 AS THE MOST RESTRICTIVE INDICATION. CIRCUITS PROVIDE DOUBLE APPROACH FOR OPPOSING & SINGLE APPROACH FOR FOLLOWING MOVEMENTS

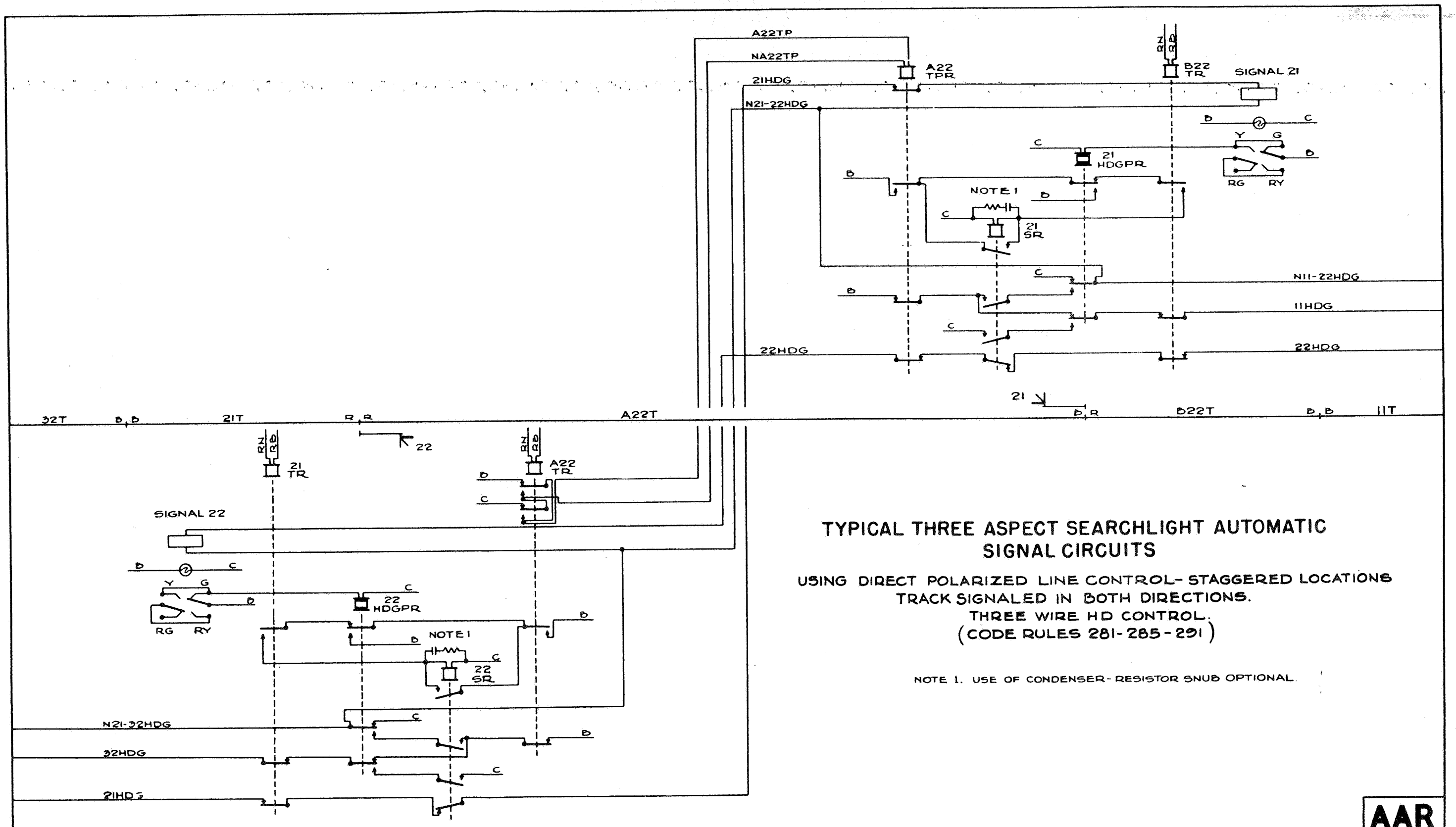
2. DETAILS OF SWITCH PROTECTION NOT SHOWN.

TYPICAL THREE ASPECT SEARCHLIGHT AUTOMATIC SIGNAL CIRCUITS AT ENDS OF SIDING

USING DIRECT POLARIZED LINE CONTROL
TRACK SIGNALED IN BOTH DIRECTIONS
THREE WIRE "HD" CONTROL BETWEEN SIDINGS
(CODE RULES 281-285-291-292)

SEPT. 1949

AAR SIG.SEC. 8027A



TYPICAL THREE ASPECT SEARCHLIGHT AUTOMATIC SIGNAL CIRCUITS

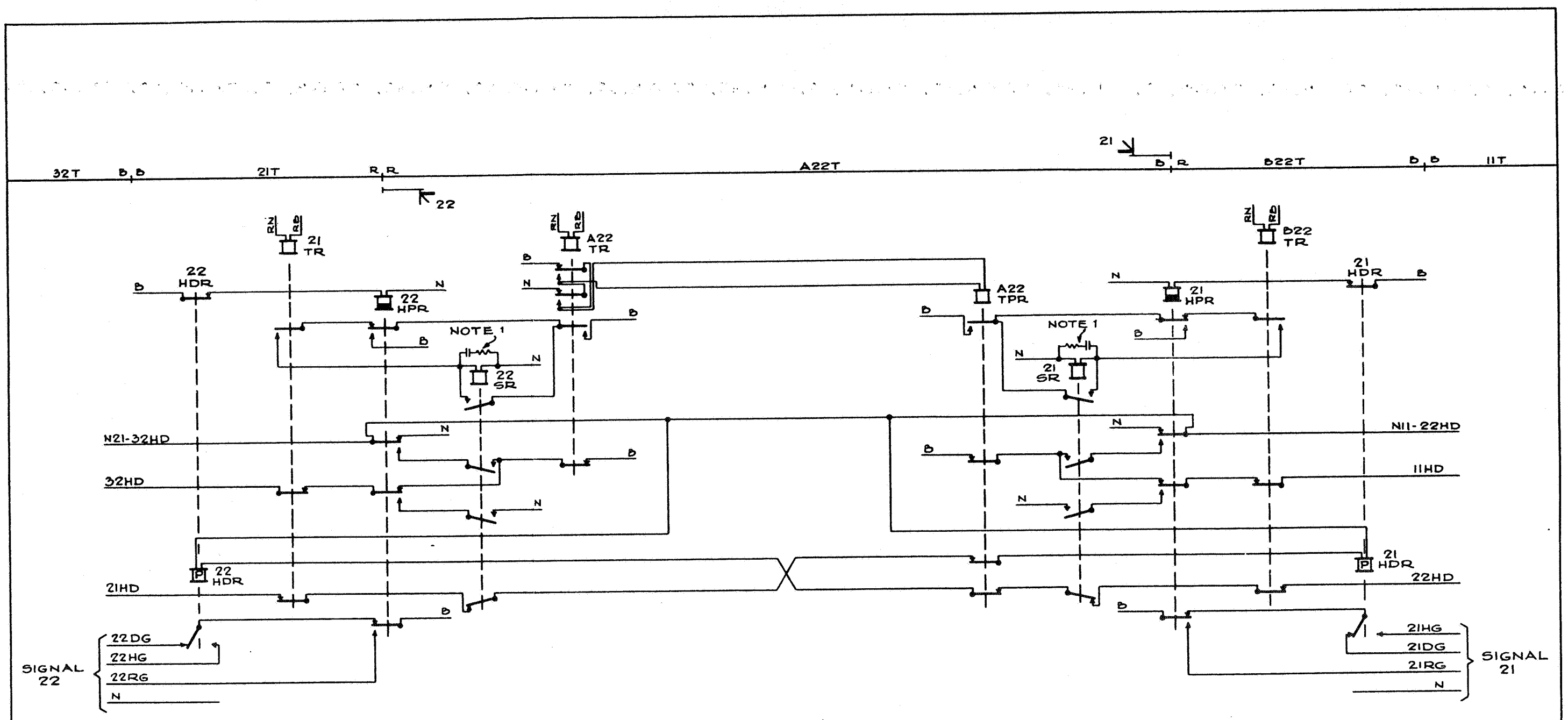
USING DIRECT POLARIZED LINE CONTROL- STAGGERED LOCATIONS
TRACK SIGNALED IN BOTH DIRECTIONS.
THREE WIRE HD CONTROL.
(CODE RULES 281-285-291)

NOTE 1. USE OF CONDENSER-RESISTOR SNUB OPTIONAL.

AAR SIG.SEC. 8027A

SEPT. 1949

SHEET 4



NOTE 1

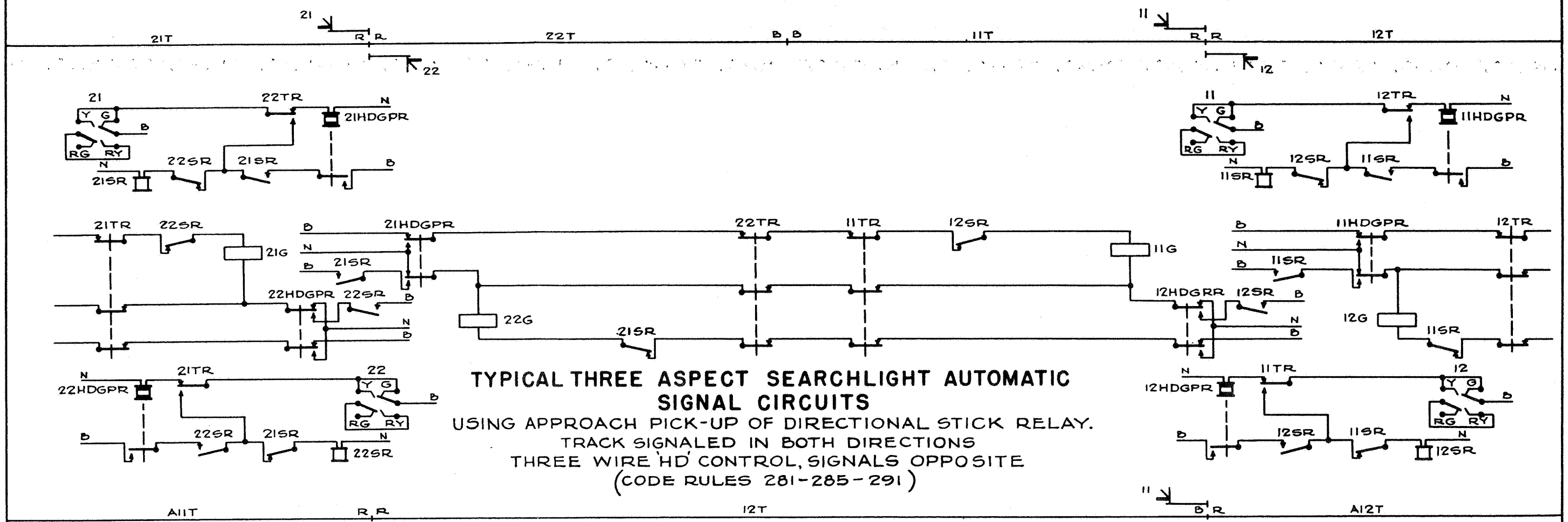
USE OF CONDENSER-RESISTOR SNUB OPTIONAL.

TYPICAL THREE ASPECT COLORLIGHT AUTOMATIC SIGNAL CIRCUITS

USING DIRECT POLARIZED LINE CONTROL – STAGGERED LOCATIONS
TRACK SIGNALED IN BOTH DIRECTIONS
THREE WIRE 'HD' CONTROL
(CODE RULES 281-285-291)

AAR SIG.SEC. 8027A

SEPT 1950



TYPICAL THREE ASPECT SEARCHLIGHT AUTOMATIC SIGNAL CIRCUITS

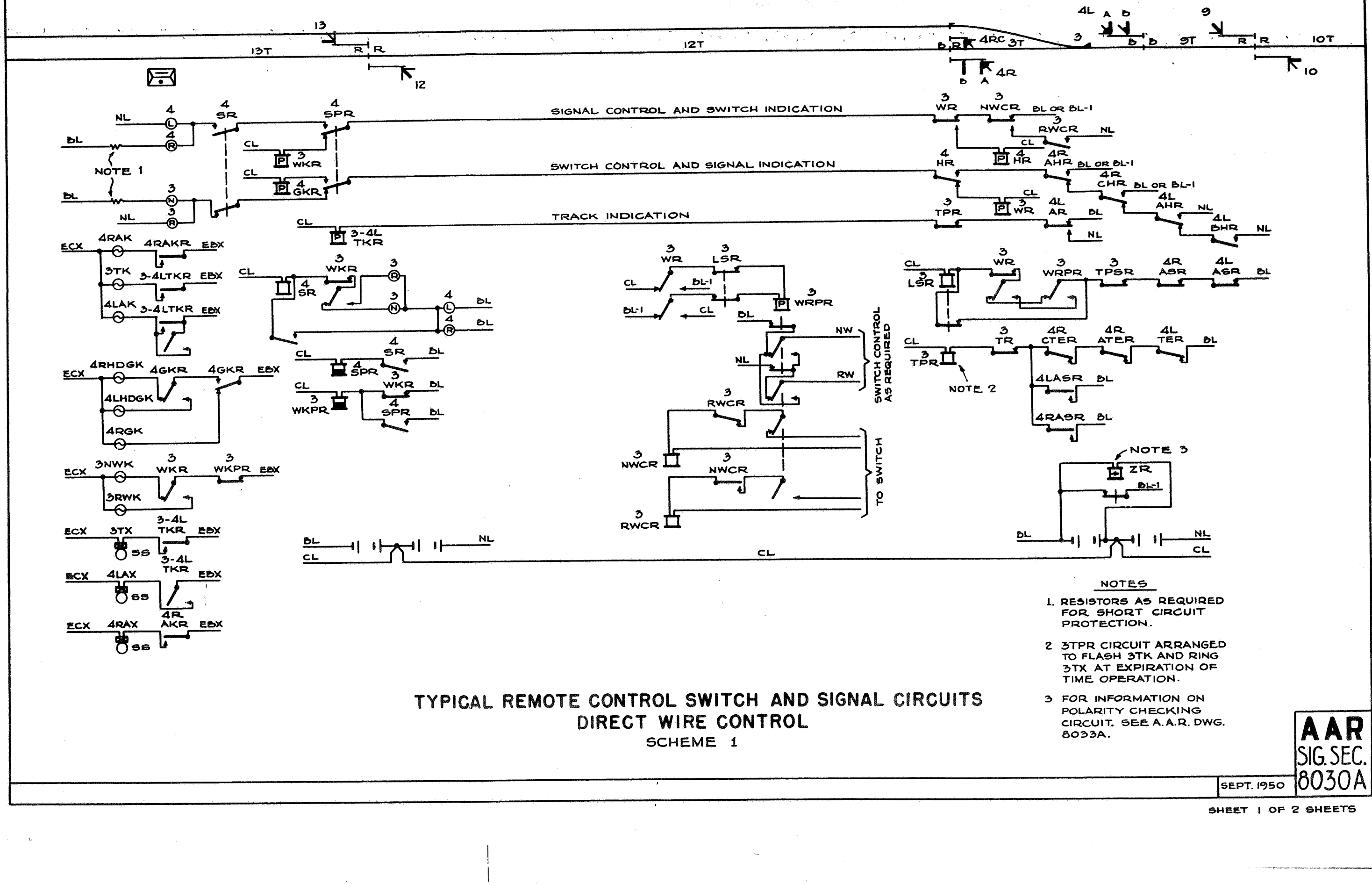
USING APPROACH PICK-UP OF DIRECTIONAL STICK RELAY.
TRACK SIGNALED IN BOTH DIRECTIONS
THREE WIRE 'HD' CONTROL, SIGNALS OPPOSITE
(CODE RULES 281-285-291)

TYPICAL THREE ASPECT SEARCHLIGHT AUTOMATIC SIGNAL CIRCUITS

USING APPROACH PICK-UP OF DIRECTIONAL STICK RELAY
TRACK SIGNALED IN BOTH DIRECTIONS
THREE WIRE 'HD' CONTROL, SIGNALS STAGGERED
(CODE RULES 281-285-291)

SEPT. 1950

AAR SIG. SEC. 8027A



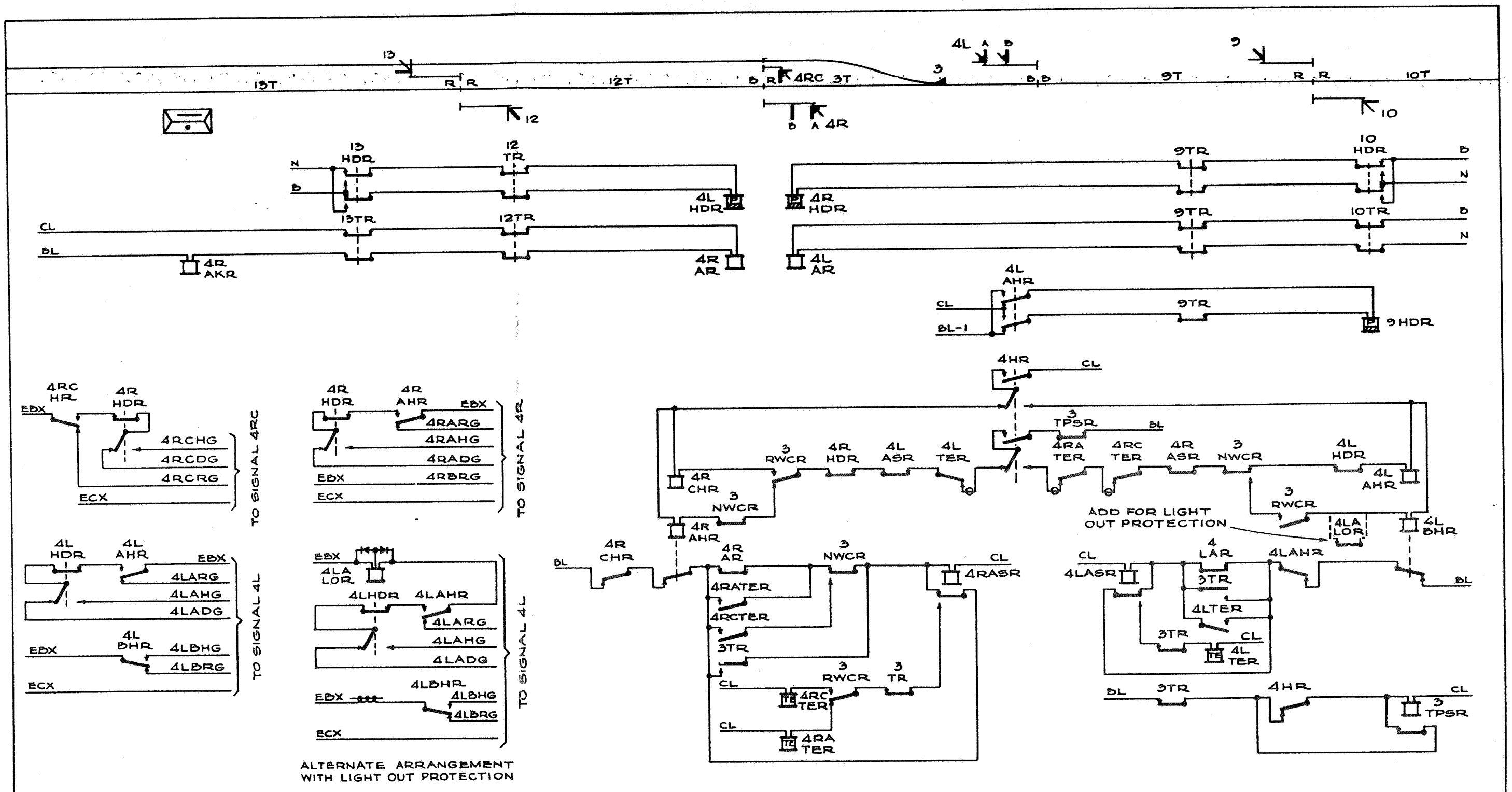
NOTES

1. RESISTORS AS REQUIRED FOR SHORT CIRCUIT PROTECTION.
2. 3TPR CIRCUIT ARRANGED TO FLASH 3TK AND RING 3TX AT EXPIRATION OF TIME OPERATION.
3. FOR INFORMATION ON POLARITY CHECKING CIRCUIT. SEE A.A.R. DWG. 8033A.

TYPICAL REMOTE CONTROL SWITCH AND SIGNAL CIRCUITS
DIRECT WIRE CONTROL
SCHEME 1

AAR SIG. SEC. 8030A

SEPT. 1950



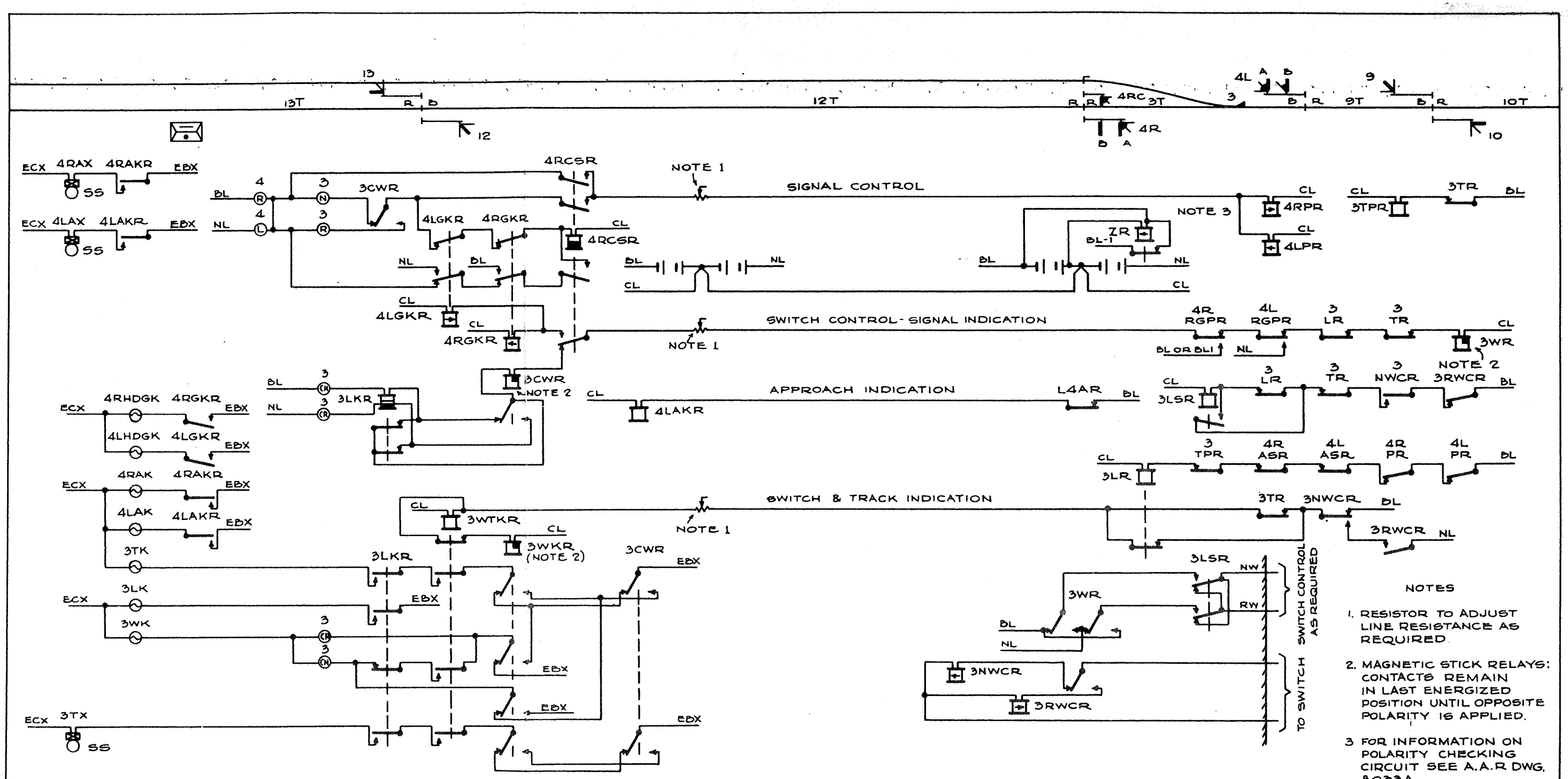
TYPICAL REMOTE CONTROL SWITCH AND SIGNAL CIRCUITS DIRECT WIRE CONTROL.

SCHEME 1

AAR SIG. SEC. 8030A

SEPT. 1950

SHEET 2 OF 2 SHEETS



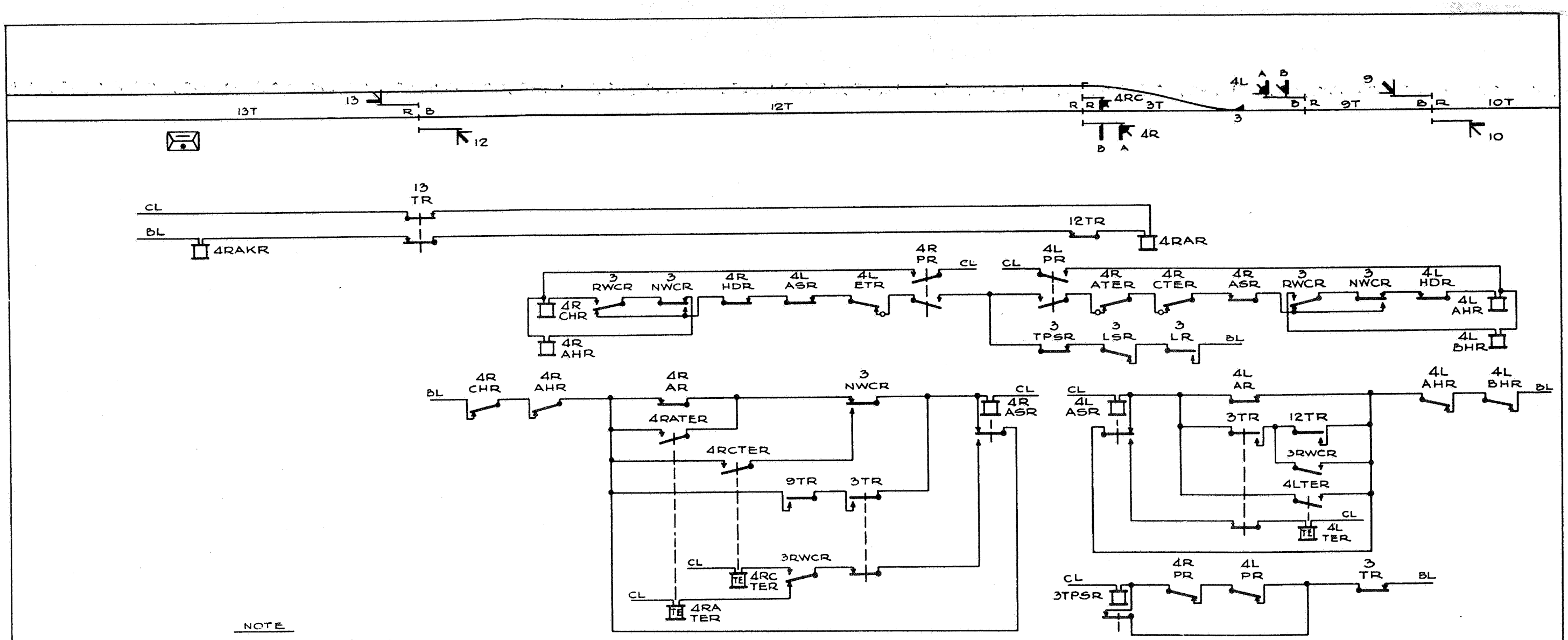
NOTES

1. RESISTOR TO ADJUST LINE RESISTANCE AS REQUIRED.
2. MAGNETIC STICK RELAYS: CONTACTS REMAIN IN LAST ENERGIZED POSITION UNTIL OPPOSITE POLARITY IS APPLIED.
3. FOR INFORMATION ON POLARITY CHECKING CIRCUIT SEE A.A.R DWG. 8033A.

TYPICAL REMOTE CONTROL SWITCH AND SIGNAL CIRCUITS
DIRECT WIRE CONTROL
SCHEME 2

AAR SIG.SEC. 8031 A

SEPT. 1950



NOTE

CIRCUITS FOR 4LAR, 4LHDR, 4RHDR AND SIGNAL LIGHTING SHOWN ON SHEET 2, OF A.A.R. SIG SEC. DWG. 8030A.

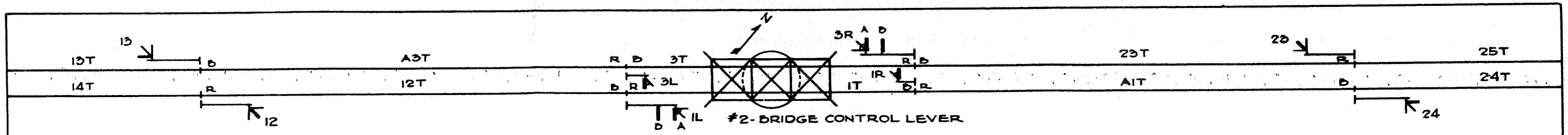
TYPICAL REMOTE CONTROL SWITCH AND SIGNAL CIRCUITS DIRECT WIRE CONTROL

SCHEME 2

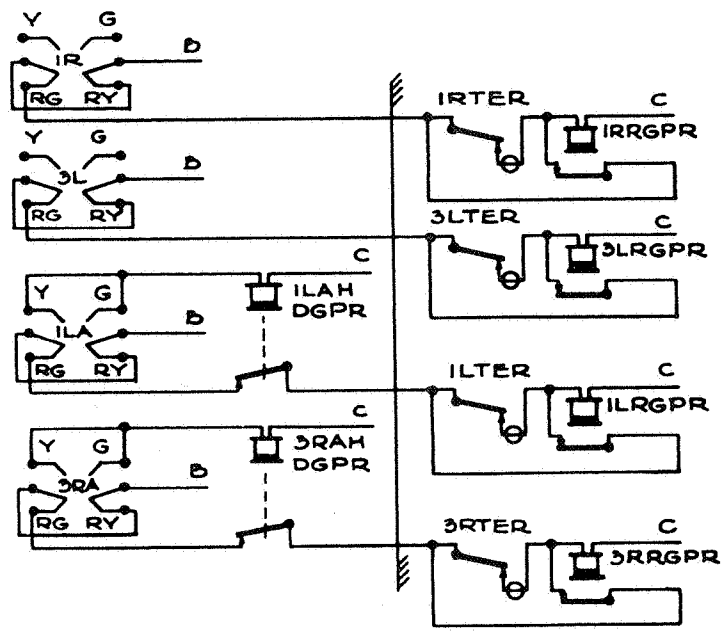
AAR SIG.SEC. 8031A

SEPT. 1930

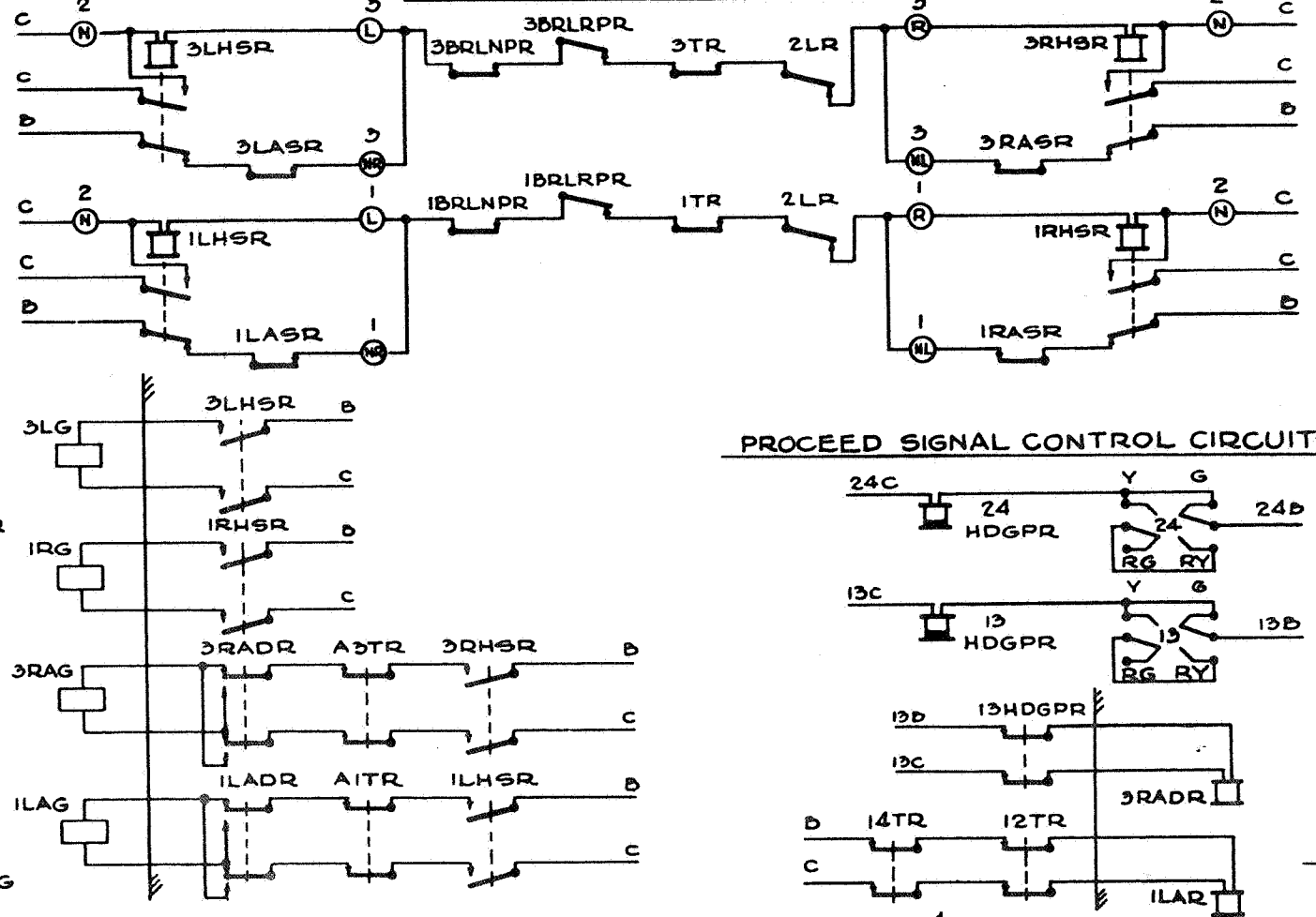
SHEET 2 OF 2 SHEETS.



SIGNAL REPEATER CIRCUITS

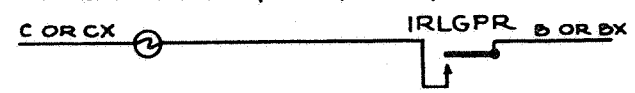


SIGNAL CONTROL CIRCUITS



SIGNAL CLEAR INDICATION LAMP CIRCUITS

TYPICAL FOR ILHK, IRHK, 3LHK, AND 3RHK.



TRACK INDICATION LAMP CIRCUITS

TYPICAL FOR ILAK, A3TK, AITK, AND 3RAK

TYPICAL FOR ITK, AND 3TK

RAIL LOCK INDICATION LAMP CIRCUITS

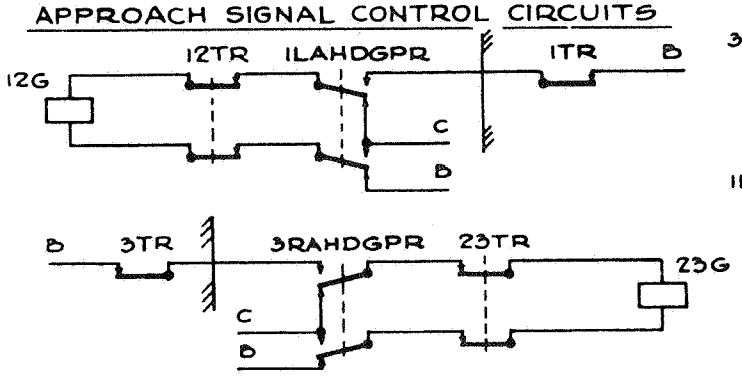
TYPICAL FOR IBRLE, AND 3BRLE

WHEN LIGHTED, INDICATES THAT SIGNALS CANNOT BE DISPLAYED FOR RAIL TRAFFIC

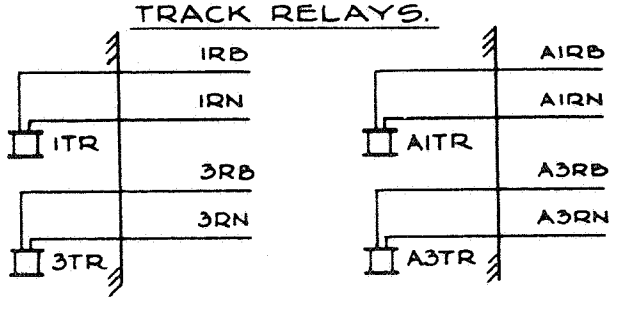
TYPICAL FOR IEBRLE, IWBRLE, 3EBRLE, 3WBRLE

LIGHTED DURING TRANSIT OF RAIL LOCKS.

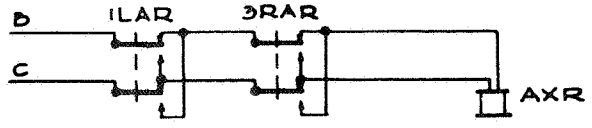
APPROACH SIGNAL CONTROL CIRCUITS



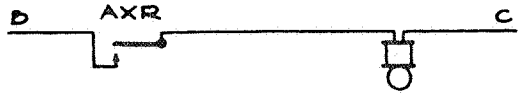
TRACK RELAYS.



APPROACH ANNUNCIATOR CIRCUIT



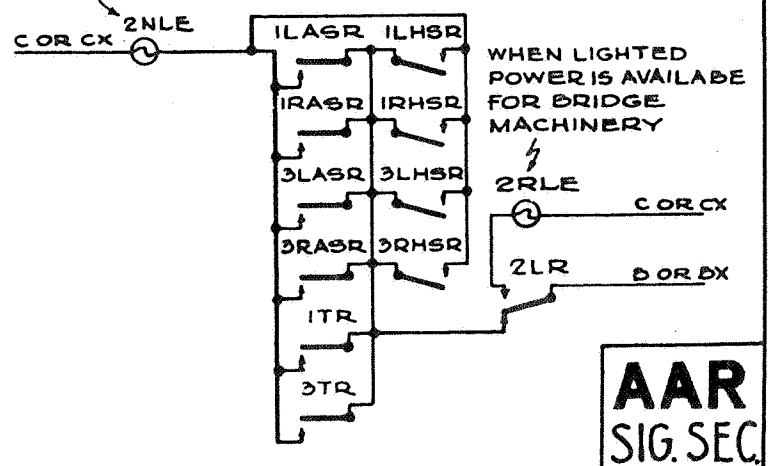
ANNUNCIATOR BELL



PROCEED SIGNAL CONTROL CIRCUITS

BRIDGE CONTROL INDICATION LAMP CIRCUITS

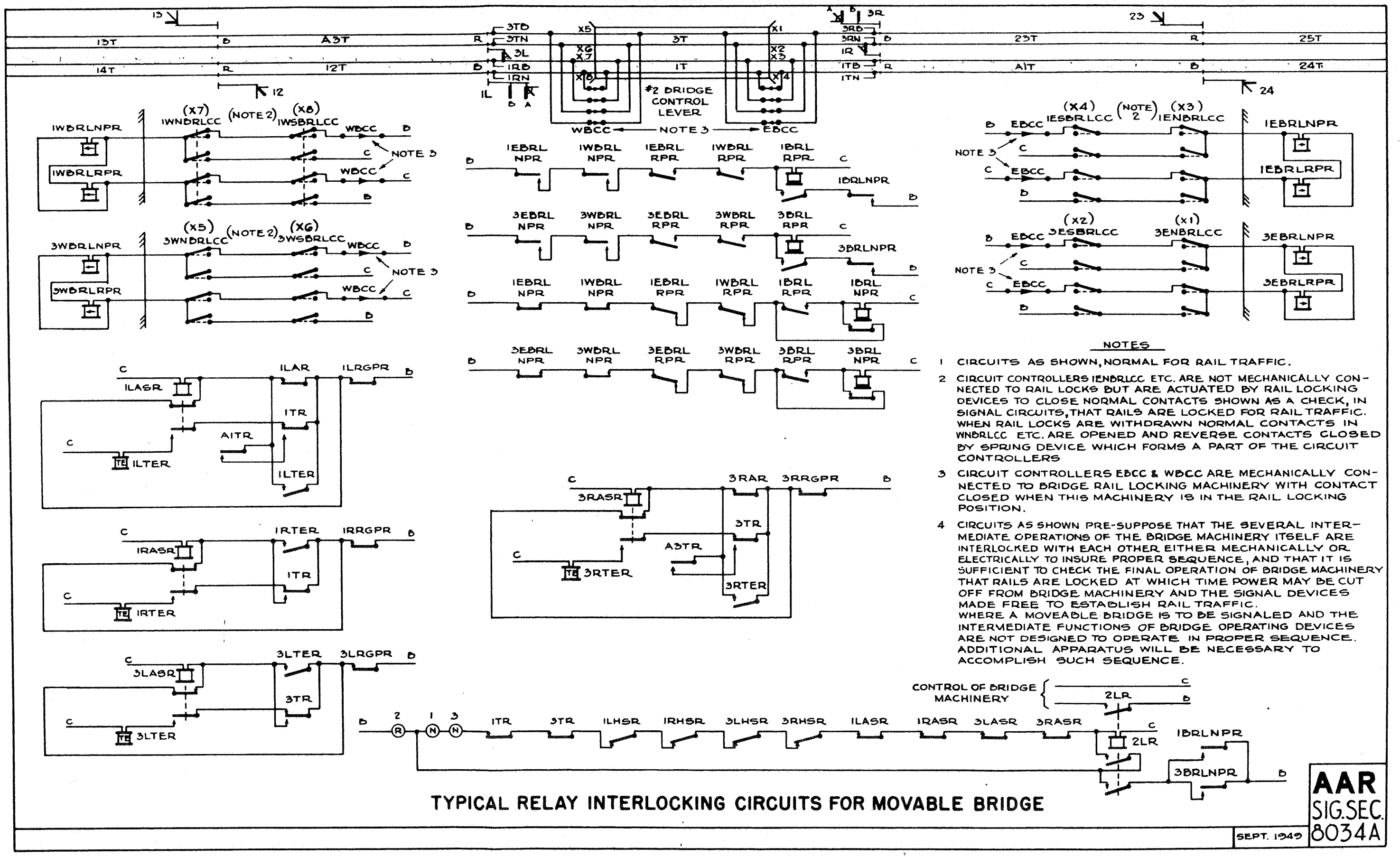
WHEN LIGHTED, INDICATES LEVER 2 WILL NOT RELEASE BRIDGE MACHINERY



TYPICAL RELAY INTERLOCKING CIRCUITS FOR MOVABLE BRIDGE

AAR SIG. SEC. 8034A

SEPT 1949



NOTES

1 CIRCUITS AS SHOWN, NORMAL FOR RAIL TRAFFIC.

2 CIRCUIT CONTROLLERS IENDRLCC ETC. ARE NOT MECHANICALLY CONNECTED TO RAIL LOCKS BUT ARE ACTUATED BY RAIL LOCKING DEVICES TO CLOSE NORMAL CONTACTS SHOWN AS A CHECK, IN SIGNAL CIRCUITS, THAT RAILS ARE LOCKED FOR RAIL TRAFFIC. WHEN RAIL LOCKS ARE WITHDRAWN NORMAL CONTACTS IN WNDRLCC ETC. ARE OPENED AND REVERSE CONTACTS CLOSED BY SPRING DEVICE WHICH FORMS A PART OF THE CIRCUIT CONTROLLERS

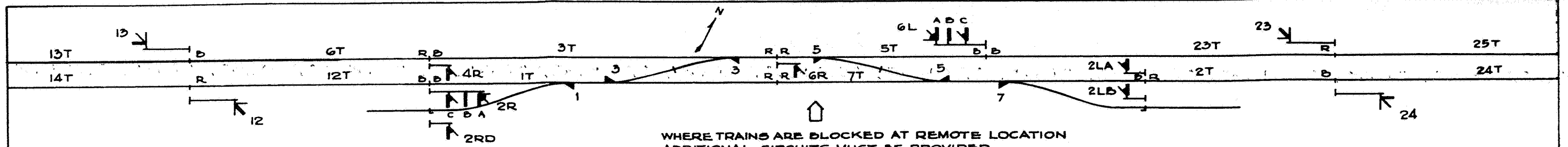
3 CIRCUIT CONTROLLERS EBCC & WBCC ARE MECHANICALLY CONNECTED TO BRIDGE RAIL LOCKING MACHINERY WITH CONTACT CLOSED WHEN THIS MACHINERY IS IN THE RAIL LOCKING POSITION.

4 CIRCUITS AS SHOWN PRE-SUPPOSE THAT THE SEVERAL INTERMEDIATE OPERATIONS OF THE BRIDGE MACHINERY ITSELF ARE INTERLOCKED WITH EACH OTHER EITHER MECHANICALLY OR ELECTRICALLY TO INSURE PROPER SEQUENCE, AND THAT IT IS SUFFICIENT TO CHECK THE FINAL OPERATION OF BRIDGE MACHINERY THAT RAILS ARE LOCKED AT WHICH TIME POWER MAY BE CUT OFF FROM BRIDGE MACHINERY AND THE SIGNAL DEVICES MADE FREE TO ESTABLISH RAIL TRAFFIC.
WHERE A MOVEABLE BRIDGE IS TO BE SIGNALED AND THE INTERMEDIATE FUNCTIONS OF BRIDGE OPERATING DEVICES ARE NOT DESIGNED TO OPERATE IN PROPER SEQUENCE. ADDITIONAL APPARATUS WILL BE NECESSARY TO ACCOMPLISH SUCH SEQUENCE.

TYPICAL RELAY INTERLOCKING CIRCUITS FOR MOVABLE BRIDGE

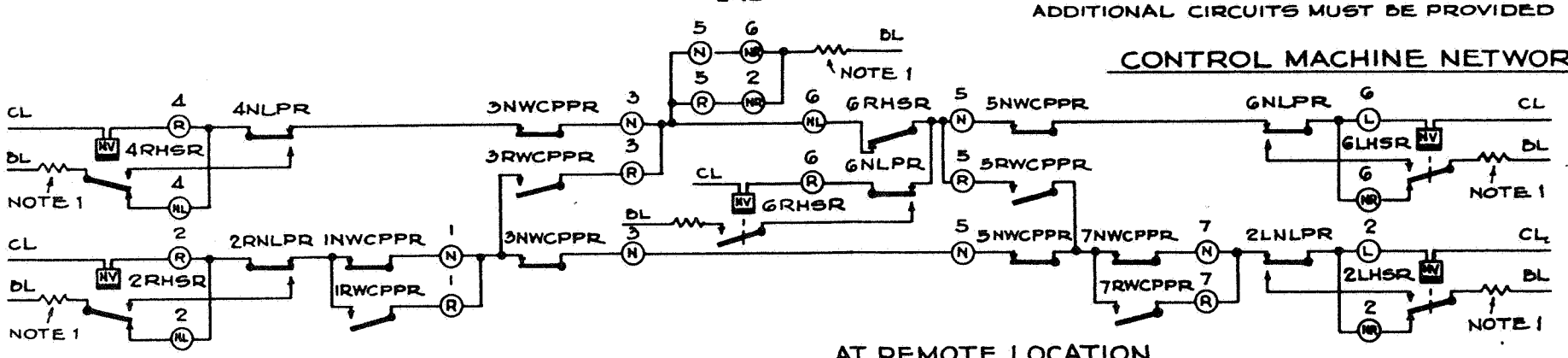
AAR SIG.SEC. 8034A

SEPT. 1949

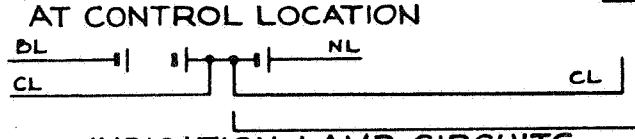


WHERE TRAINS ARE BLOCKED AT REMOTE LOCATION ADDITIONAL CIRCUITS MUST BE PROVIDED

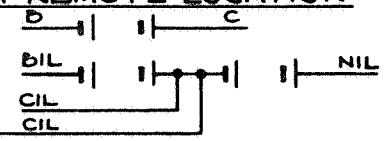
CONTROL MACHINE NETWORK



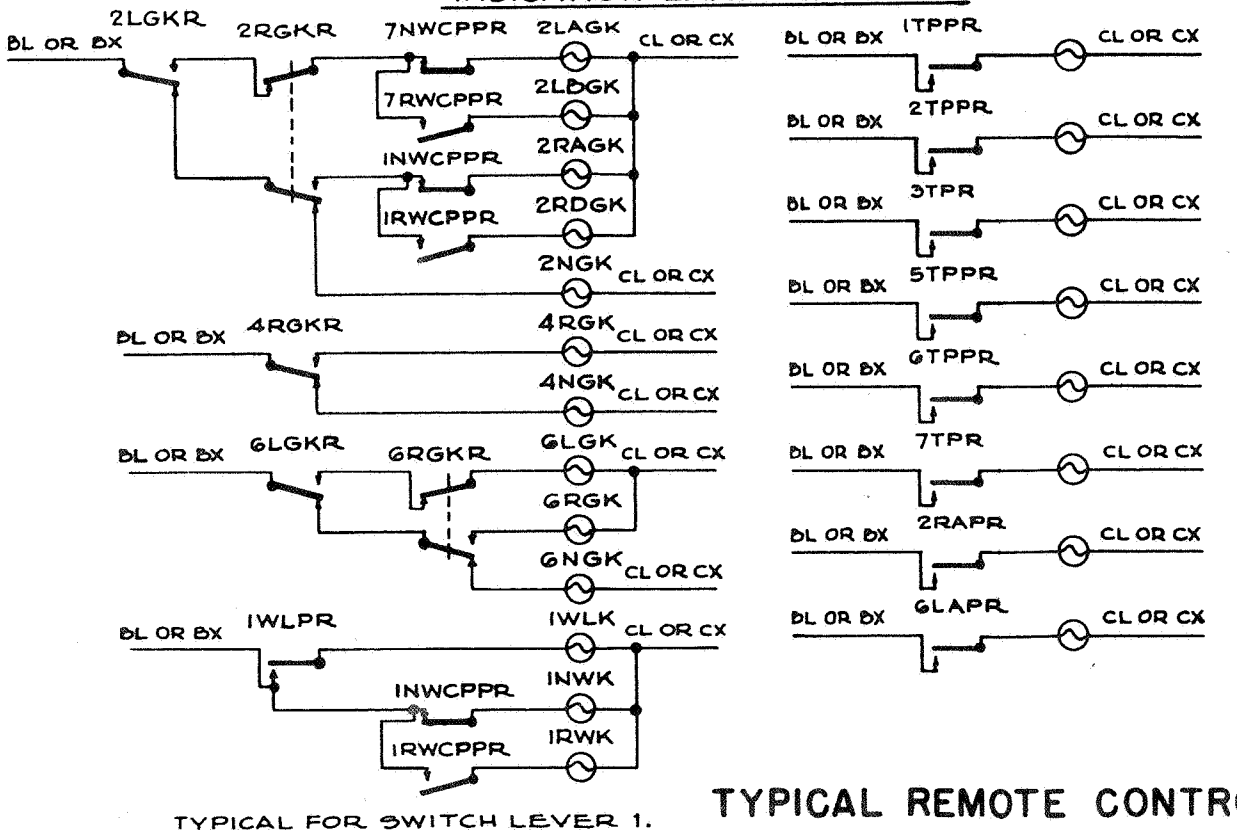
AT CONTROL LOCATION



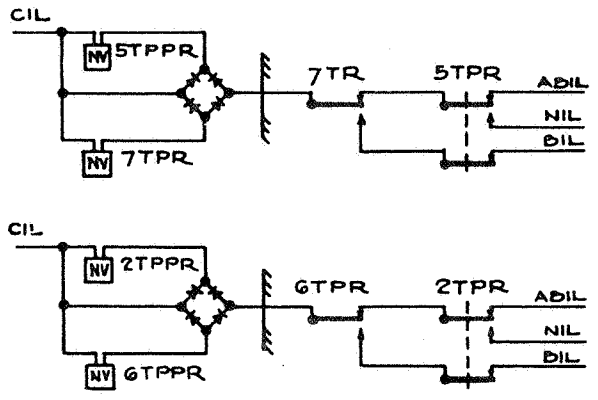
AT REMOTE LOCATION

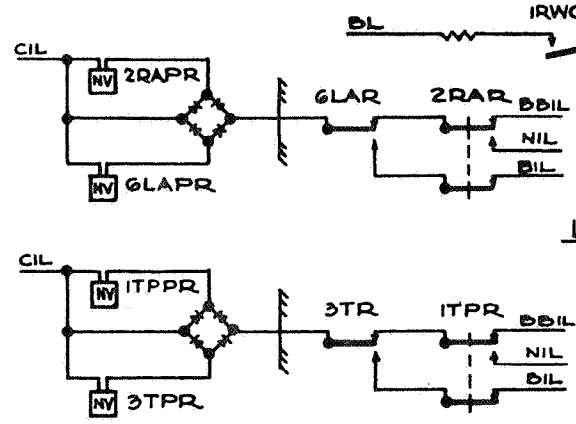


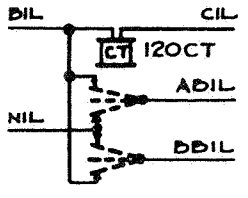
INDICATION LAMP CIRCUITS



TYPICAL FOR SWITCH LEVER 1. CIRCUITS FOR SWITCH LEVERS 3, 5, AND 7 TO BE SIMILAR



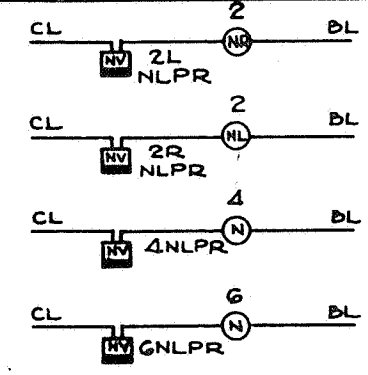




CIRCUITS FOR 3NWCPR, 3RWCPR, 5NWCPR, 5RWCPR, 7 NWCPR, AND 7RWCPR TO BE SIMILAR.

TYPICAL FOR SWITCH LEVER 1. CIRCUITS FOR SWITCH LEVERS 3, 5, AND 7 TO BE SIMILAR

LEVER REPEATING CIRCUITS



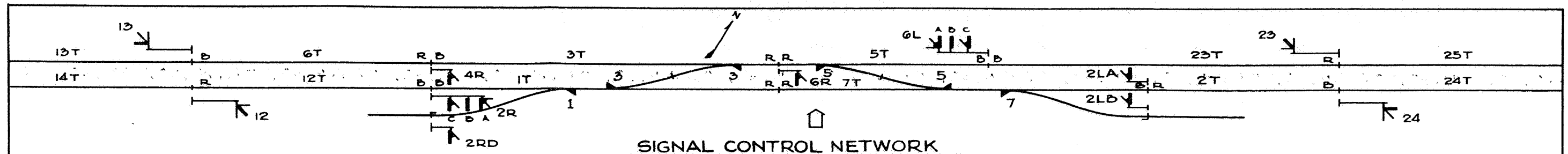
NOTE:-
1. RESISTORS REQUIRED FOR SHORT CIRCUIT PROTECTION.
2. FOR APPROACH, APPROACH SIGNAL CONTROL PROCEED SIGNAL CONTROL, SIGNAL REPEATER, TRACK REPEATING, AND SWITCH INDICATION CIRCUITS, SEE A.A.R. SIG. SEC. DRAWING 8010A.

TYPICAL REMOTE CONTROL RELAY TYPE INTERLOCKING CIRCUITS

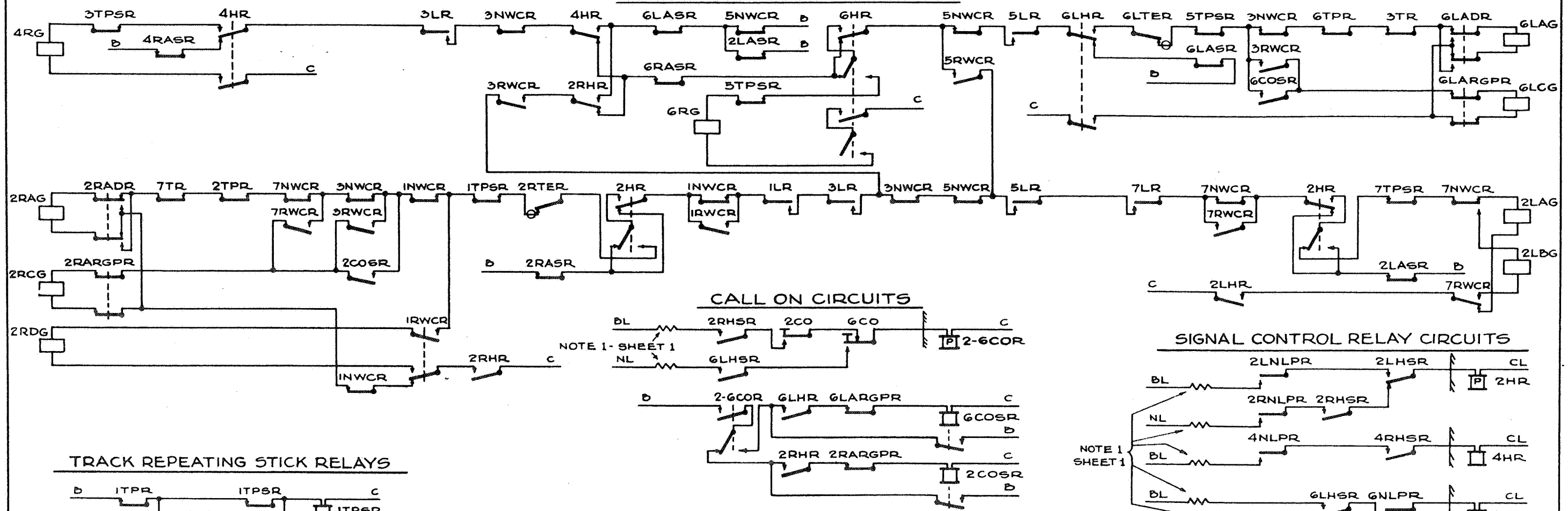
DIRECT WIRE CONTROL

SEPT. 1949

AAR SIG. SEC. 8036A



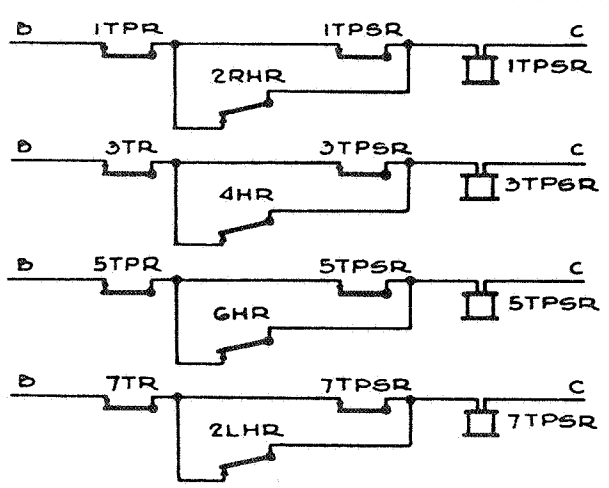
SIGNAL CONTROL NETWORK



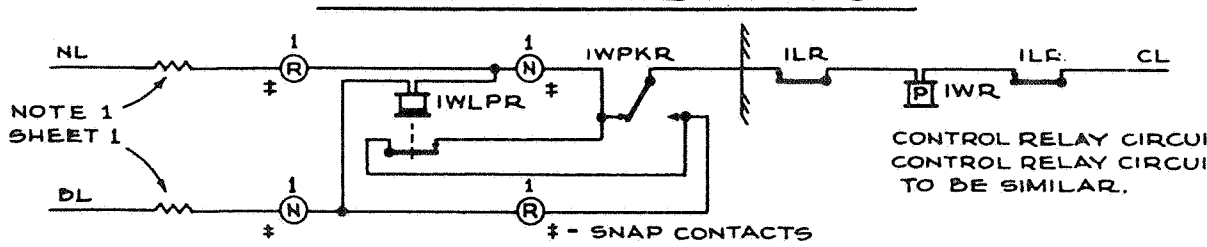
CALL ON CIRCUITS

SIGNAL CONTROL RELAY CIRCUITS

TRACK REPEATING STICK RELAYS



SWITCH CONTROL CIRCUITS



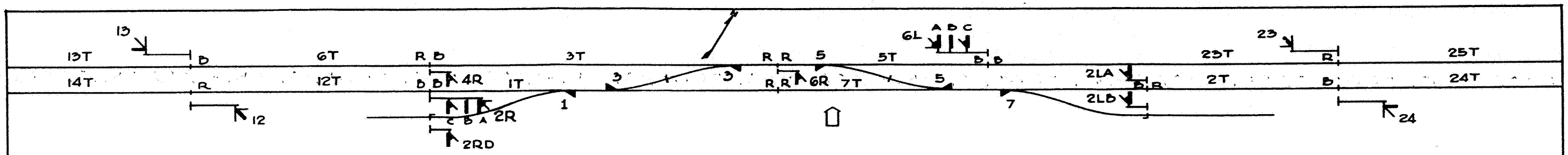
CONTROL RELAY CIRCUITS FOR SWITCH Nº 1.
CONTROL RELAY CIRCUITS FOR SWITCHES 3, 5, & 7 TO BE SIMILAR.

TYPICAL REMOTE CONTROL RELAY TYPE INTERLOCKING CIRCUITS

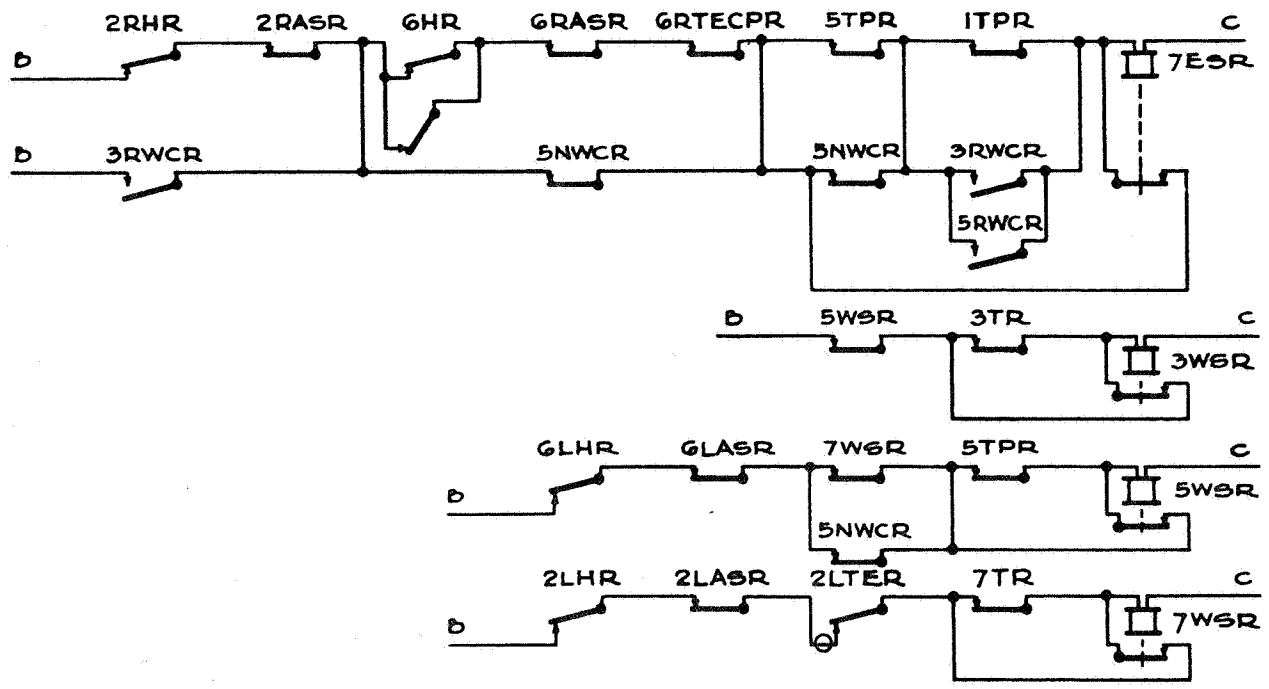
DIRECT WIRE CONTROL

AAR SIG.SEC 8036A

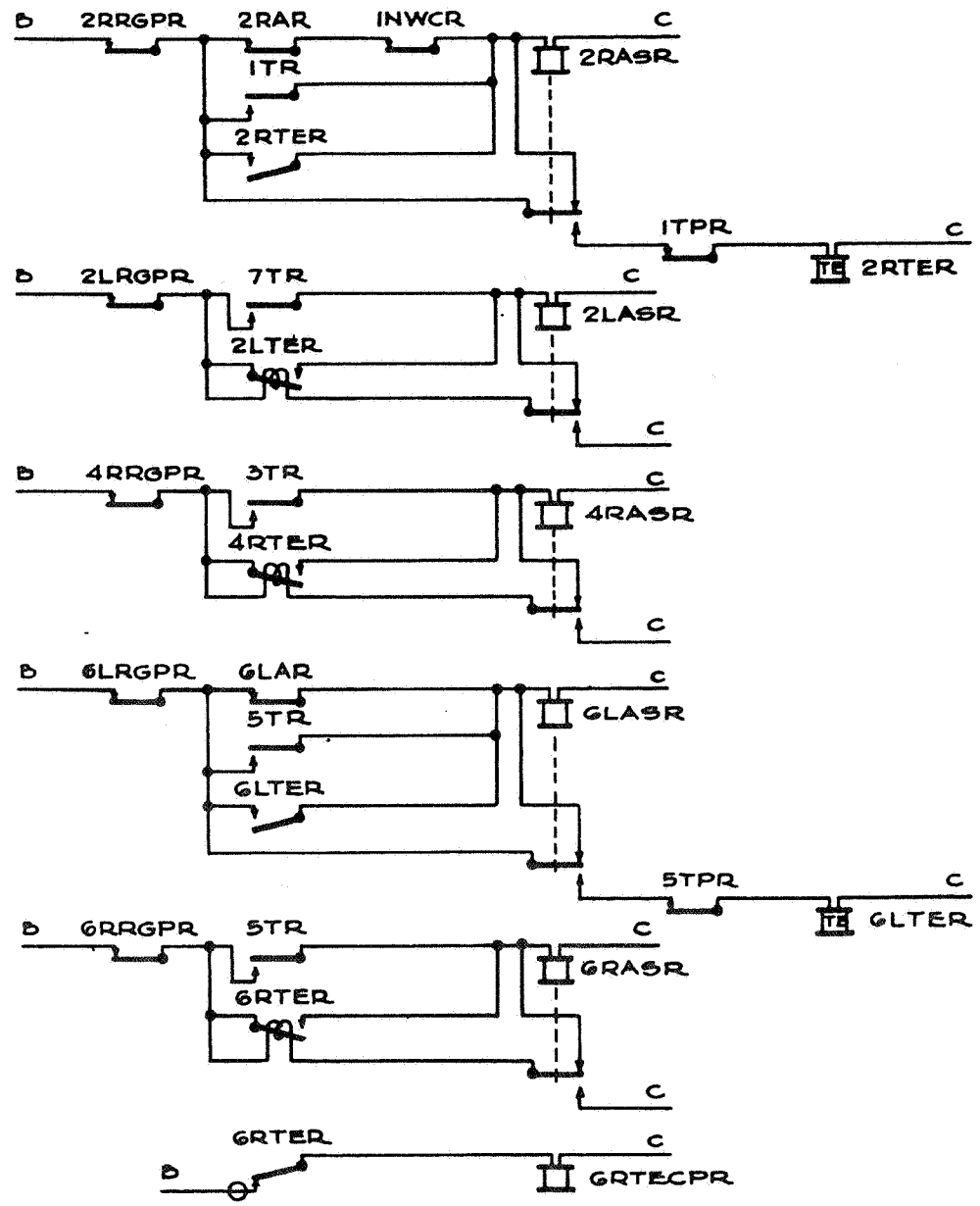
SEPT. 1949



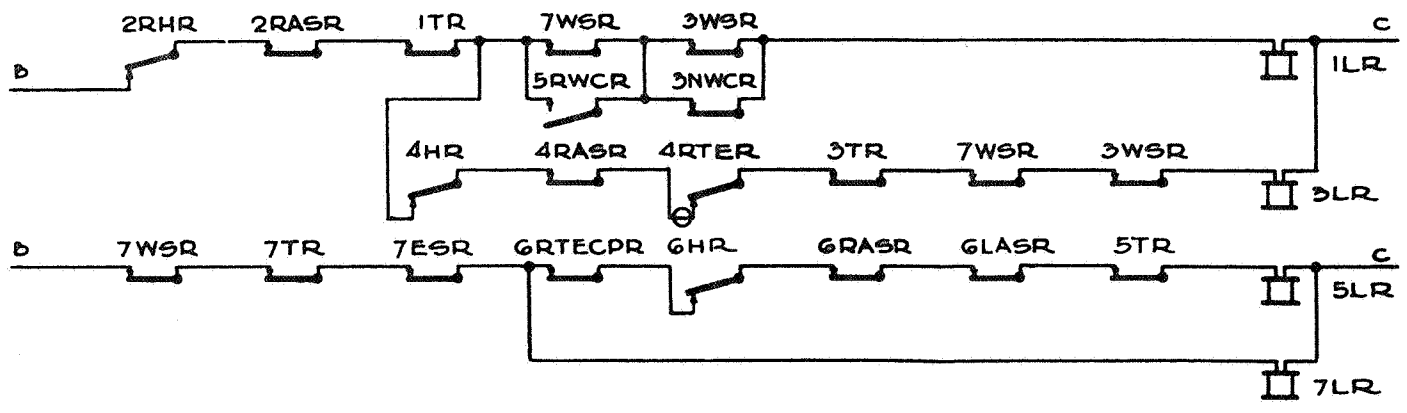
ROUTE LOCKING CIRCUITS



APPROACH AND TIME LOCKING CIRCUITS



SWITCH LOCKING CIRCUITS

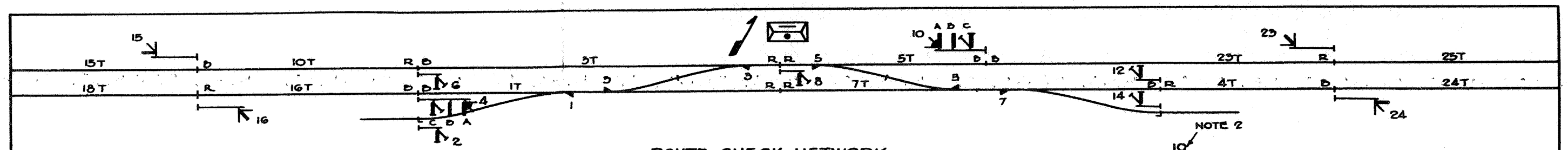


TYPICAL REMOTE CONTROL RELAY TYPE INTERLOCKING CIRCUITS

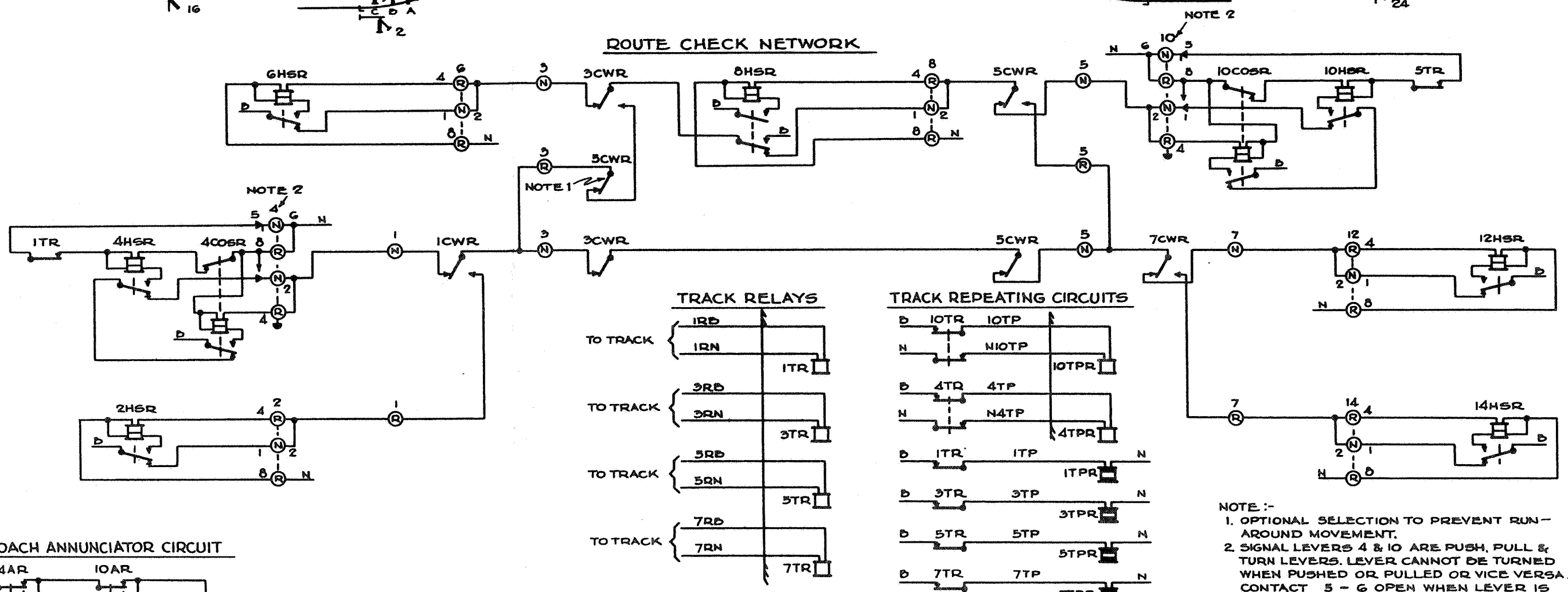
DIRECT WIRE CONTROL

SEPT. 1949

AAR SIG. SEC 8036A



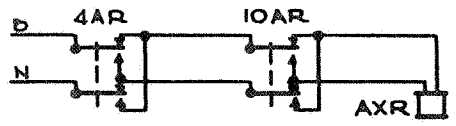
ROUTE CHECK NETWORK



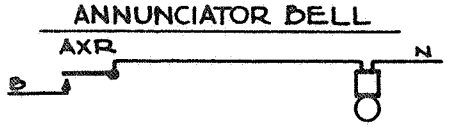
TRACK RELAYS

TRACK REPEATING CIRCUITS

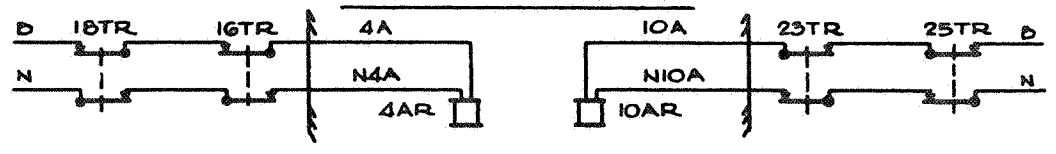
APPROACH ANNUNCIATOR CIRCUIT



ANNUNCIATOR BELL



APPROACH CIRCUITS



NOTE :-

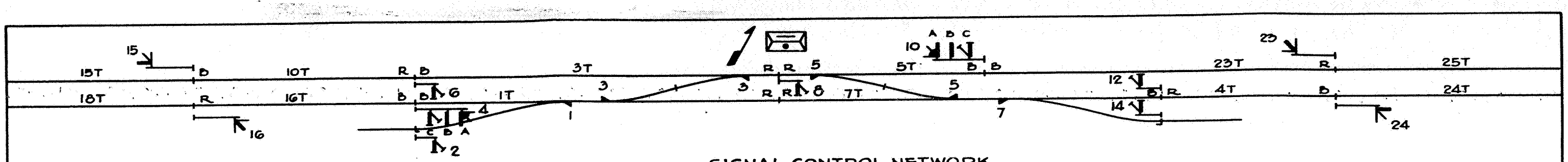
1. OPTIONAL SELECTION TO PREVENT RUN-AROUND MOVEMENT.
2. SIGNAL LEVERS 4 & 10 ARE PUSH, PULL & TURN LEVERS. LEVER CANNOT BE TURNED WHEN PUSHED OR PULLED OR VICE VERSA.
   CONTACT 5 - 6 OPEN WHEN LEVER IS PULLED OR TURNED.
   CONTACTS 2-4 & 6-8 CLOSED WHEN LEVER IS TURNED.
   CONTACT 2-8 CLOSED WHEN LEVER IS PUSHED.
   CONTACT 1 - 2 OPEN WHEN LEVER IS PUSHED, PULLED OR TURNED
3. MAGNETIC STICK RELAY CONTACTS REMAIN IN LAST ENERGIZED POSITION UNTIL OPPOSITE POLARITY IS APPLIED.

TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

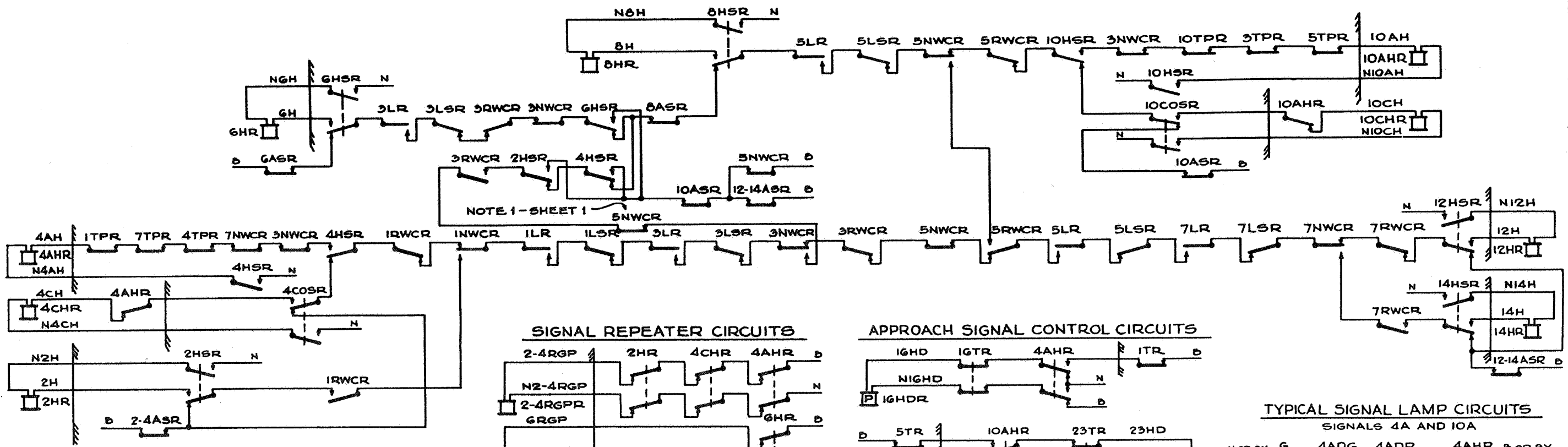
LOCAL CONTROL - FUNCTIONS INDIVIDUALLY CONTROLLED - SIGNAL LEVERS IN TRACK DIAGRAM.

AAR SIG. SEC 8043 A

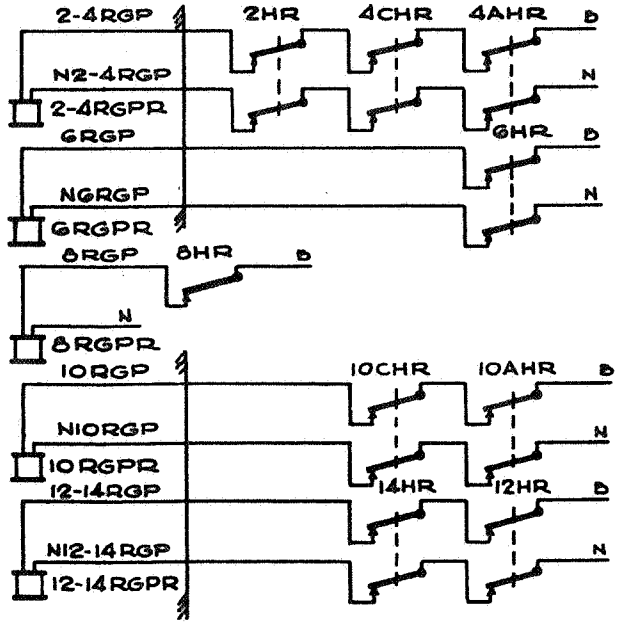
SEPT. 1950



SIGNAL CONTROL NETWORK

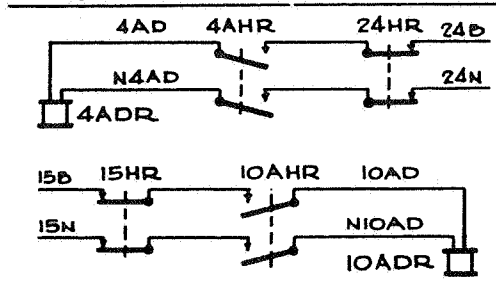


SIGNAL REPEATER CIRCUITS



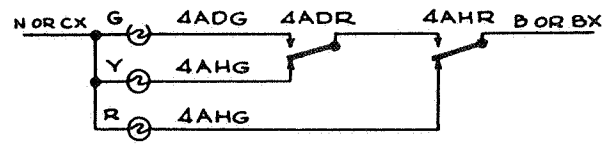
APPROACH SIGNAL CONTROL CIRCUITS

PROCEED SIGNAL CONTROL CIRCUITS



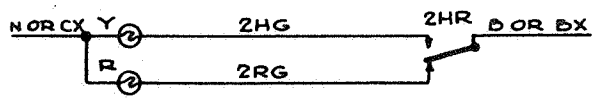
TYPICAL SIGNAL LAMP CIRCUITS

SIGNALS 4A AND 10A



TYPICAL SIGNAL LAMP CIRCUITS

SIGNALS 2-4C, 6, 8, 10C, 12 AND 14

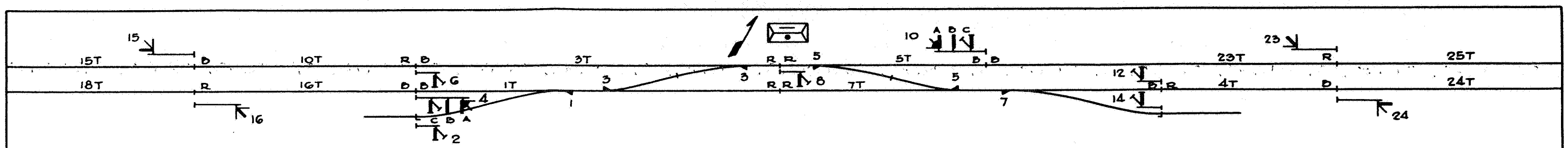


TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

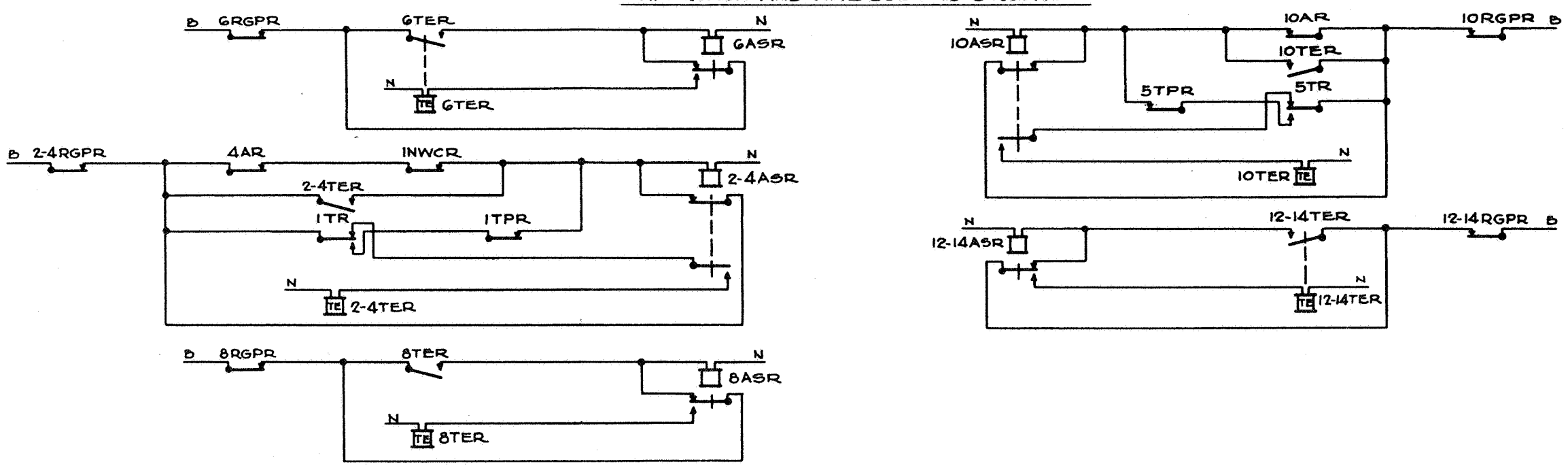
LOCAL CONTROL - FUNCTIONS INDIVIDUALLY CONTROLLED - SIGNAL LEVERS IN TRACK DIAGRAM

SEPT. 1950

AAR SIG.SEC 8043 A

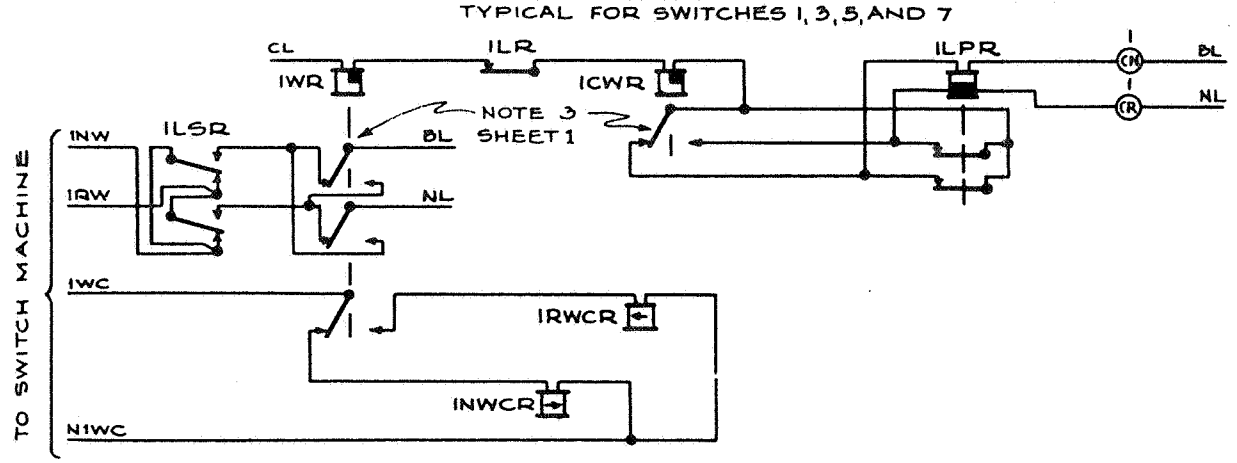


APPROACH AND TIME LOCKING CIRCUITS

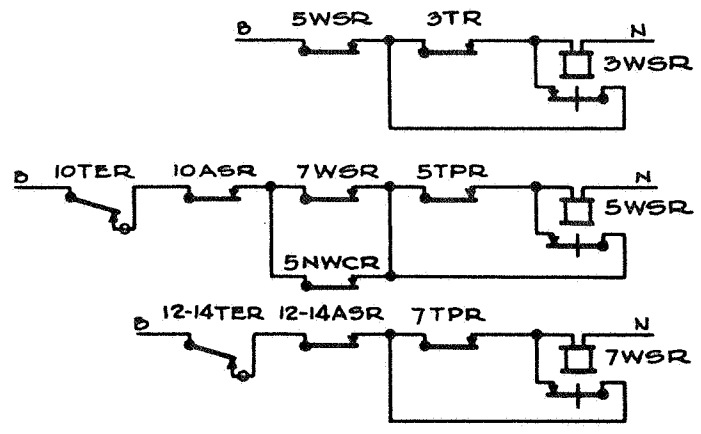


SWITCH CONTROL AND INDICATION CIRCUITS

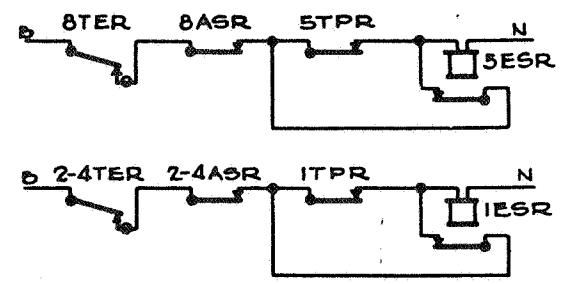
TYPICAL FOR SWITCHES 1, 3, 5, AND 7



WESTWARD ROUTE LOCKING CIRCUITS



EASTWARD ROUTE LOCKING CIRCUITS

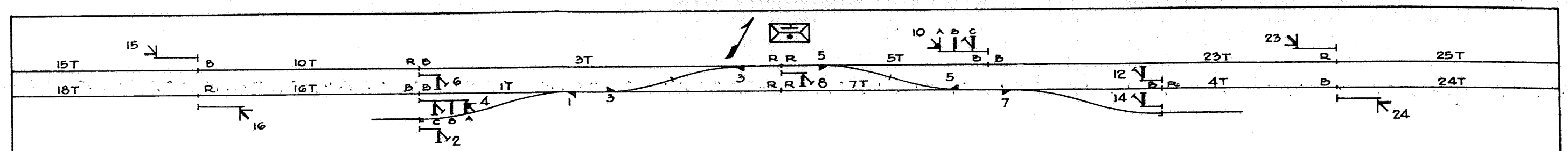


TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

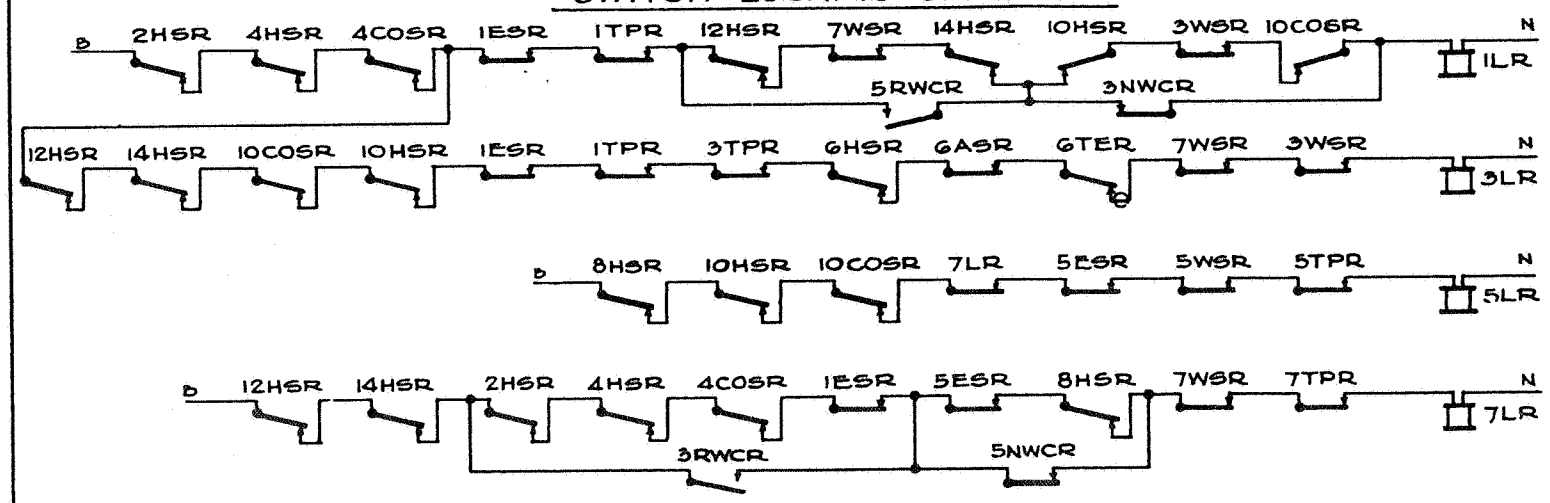
LOCAL CONTROL – FUNCTIONS INDIVIDUALLY CONTROLLED – SIGNAL LEVERS IN TRACK DIAGRAM.

AAR SIG. SEC 8043A

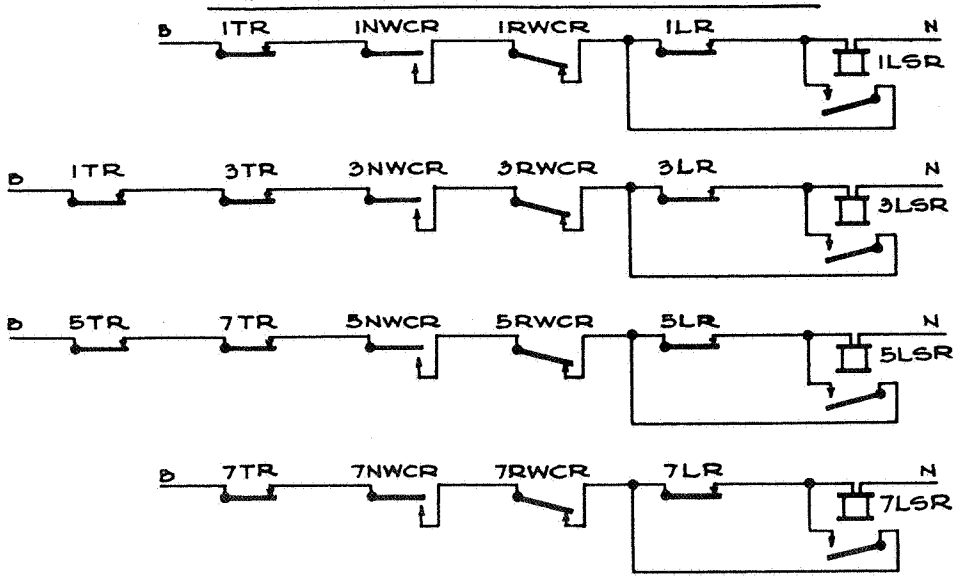
SEPT. 1950



SWITCH LOCKING CIRCUITS



SWITCH LOCK STICK CIRCUITS

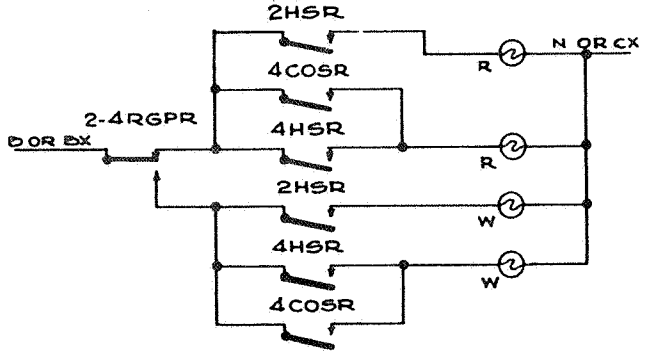


TRACK DIAGRAM LAMP CIRCUITS

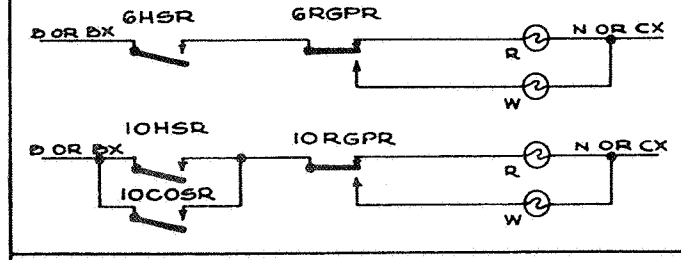
TYPICAL FOR 1TK, 3TK, 4TK, 5TK, 7TK, 10TK, 4AK, 10AK.

SIGNAL LEVER LAMP CIRCUITS

TYPICAL FOR 2HK, 4HK, 12HK, 14HK.

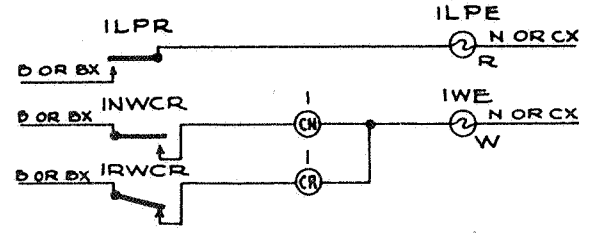


TYPICAL FOR 6HK, 8HK



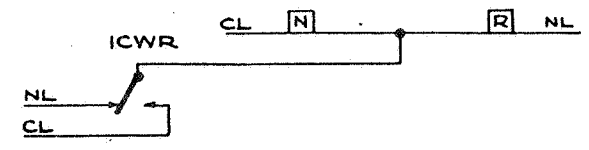
SWITCH LEVER LAMP CIRCUITS

TYPICAL FOR SWITCHES 1, 3, 5, 7

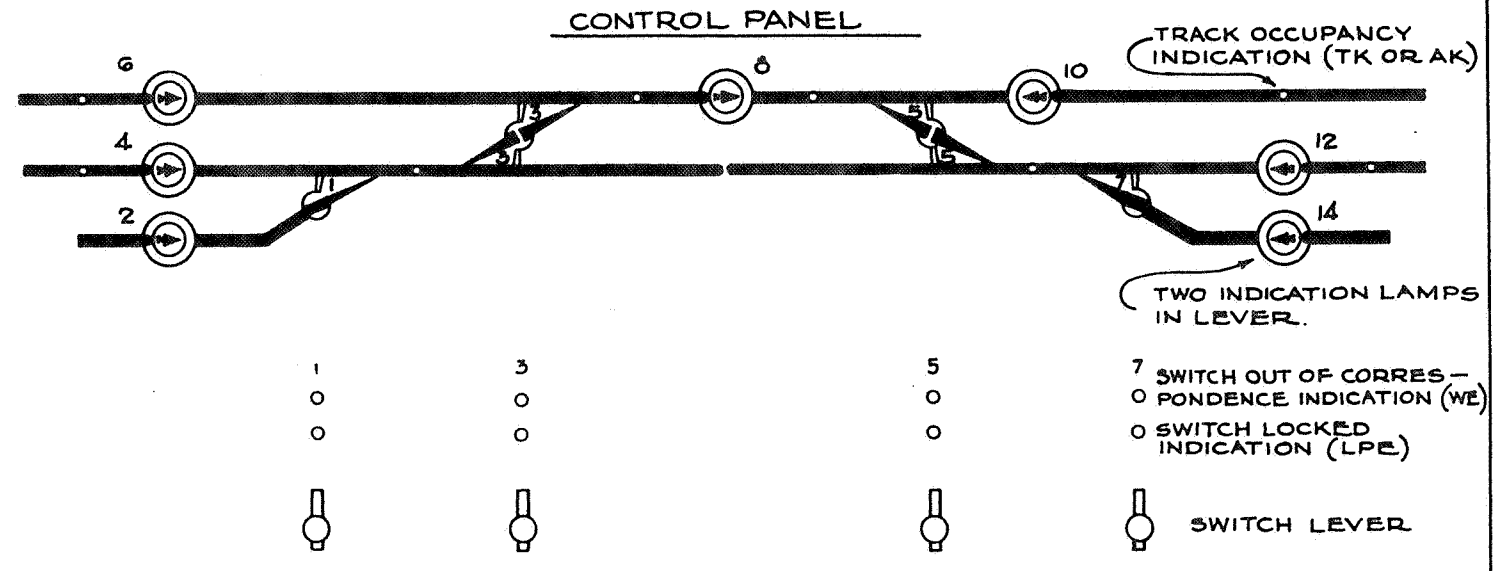


POINT INDICATORS

TYPICAL FOR SWITCHES 1, 3, 5, 7



CONTROL PANEL

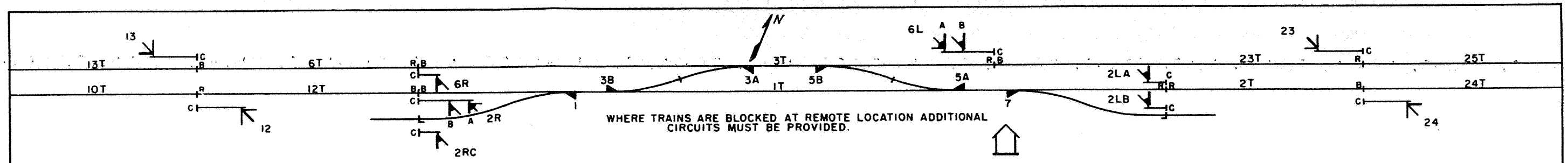


TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

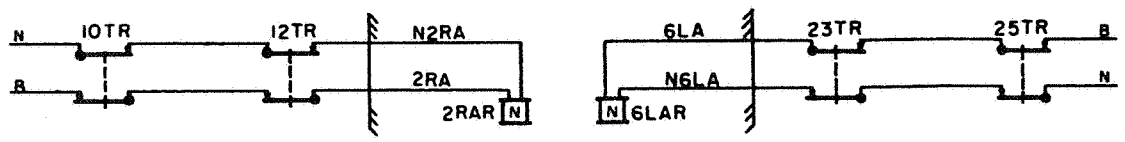
LOCAL CONTROL - FUNCTIONS INDIVIDUALLY CONTROLLED - SIGNAL LEVERS IN TRACK DIAGRAM

AAR SIG. SEC. 8043A

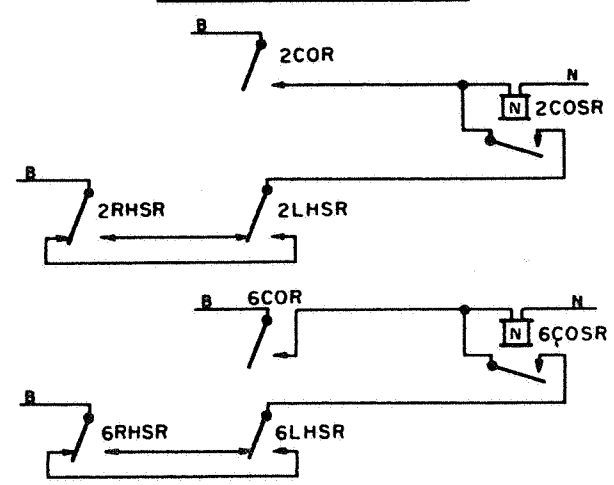
SEPT. 1950



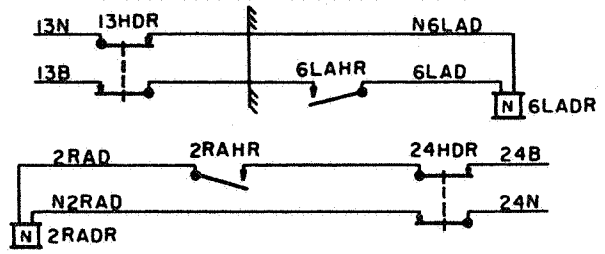
APPROACH CIRCUITS



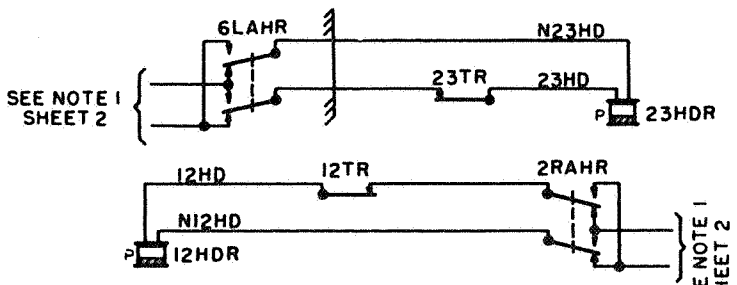
CALL ON RELAY CIRCUITS



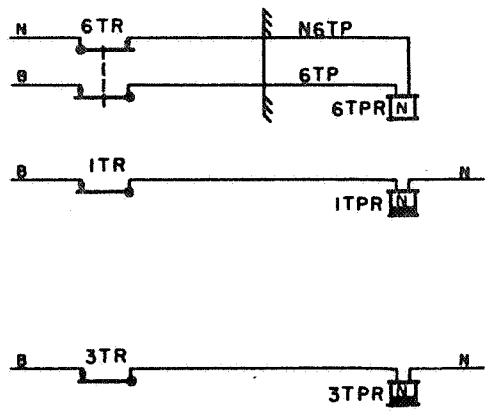
PROCEED SIGNAL CONTROL CIRCUITS



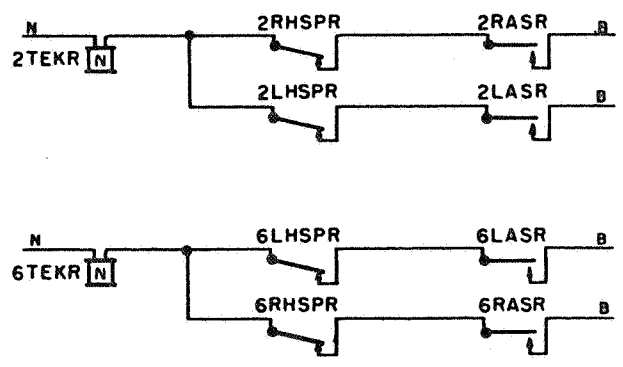
APPROACH SIGNAL CONTROL CIRCUITS



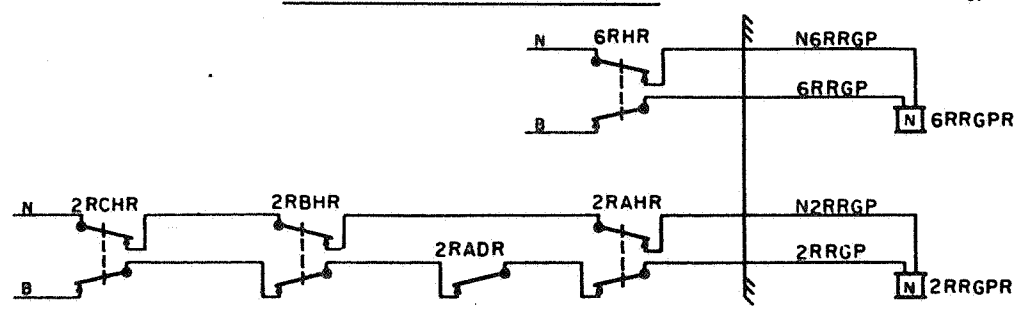
TRACK REPEATING CIRCUITS



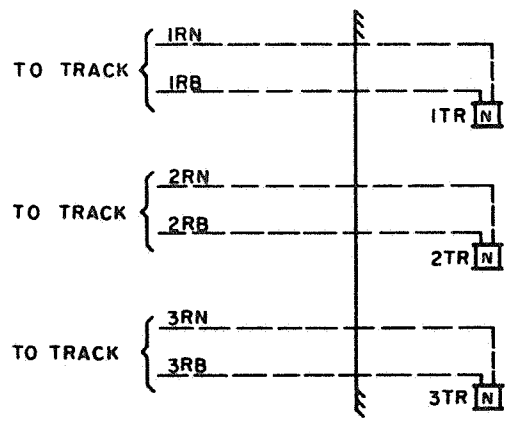
TIME INDICATION RELAY CIRCUITS



SIGNAL REPEATING CIRCUITS



TRACK RELAYS

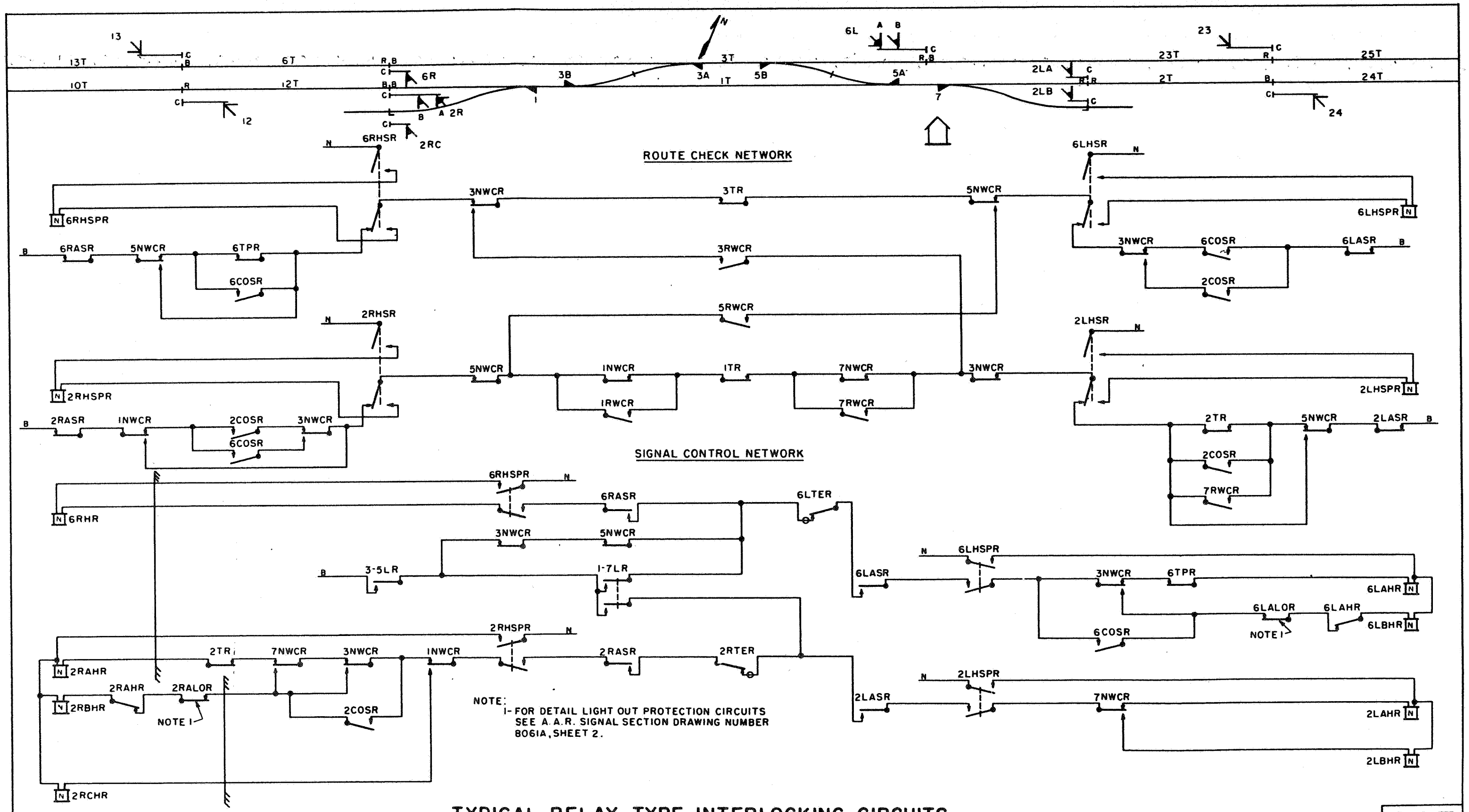


TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

CODED REMOTE CONTROL - FUNCTIONS INDIVIDUALLY CONTROLLED
SEMI-AUTOMATIC STICK SIGNALS - RESTRICTING SIGNALS CONTROLLED THROUGH FIRST TRACK SECTION ONLY.

AAR SIG.SEC. 8055A

SEPT. 1951

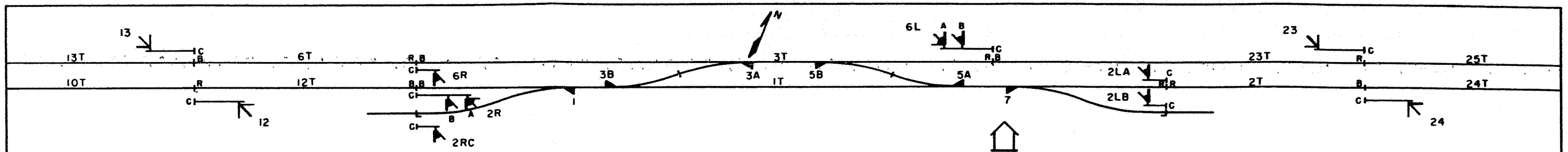


TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

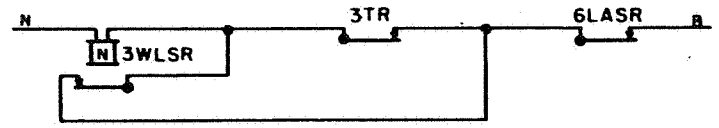
CODED REMOTE CONTROL - FUNCTIONS INDIVIDUALLY CONTROLLED
SEMI-AUTOMATIC STICK SIGNALS - RESTRICTING SIGNALS CONTROLLED THROUGH FIRST TRACK SECTION ONLY.

AAR SIG. SEC. 8055A

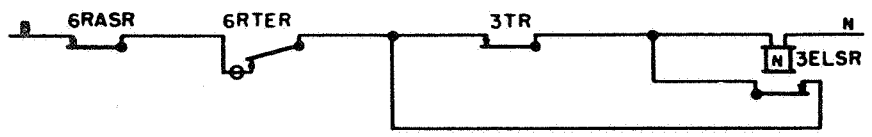
SEPT. 1951



WESTWARD ROUTE LOCKING RELAY CIRCUIT

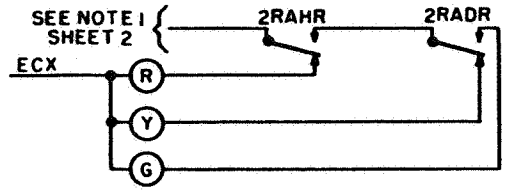


EASTWARD ROUTE LOCKING RELAY CIRCUIT

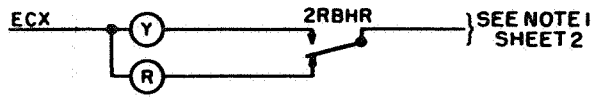


TYPICAL SIGNAL LAMP CIRCUITS

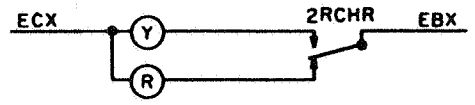
SIGNALS 2RA AND 6LA



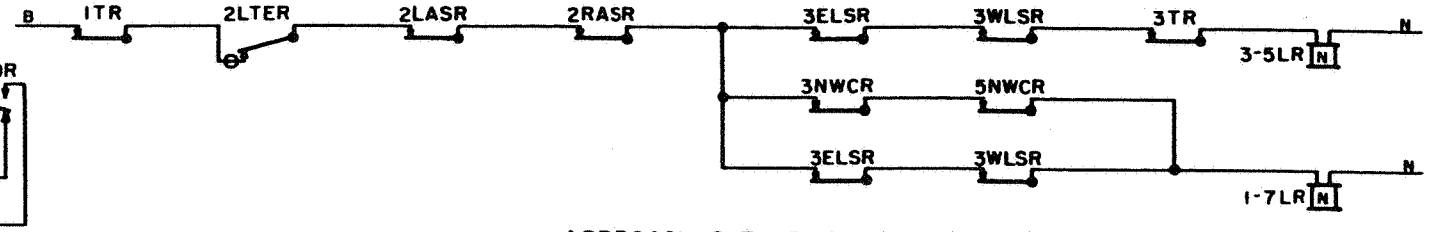
SIGNALS 2RB AND 6LB



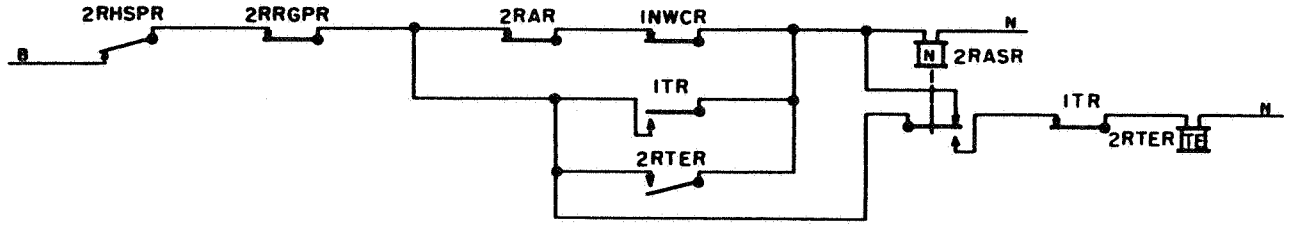
SIGNALS 2RC, 2LA, 2LB AND 6R

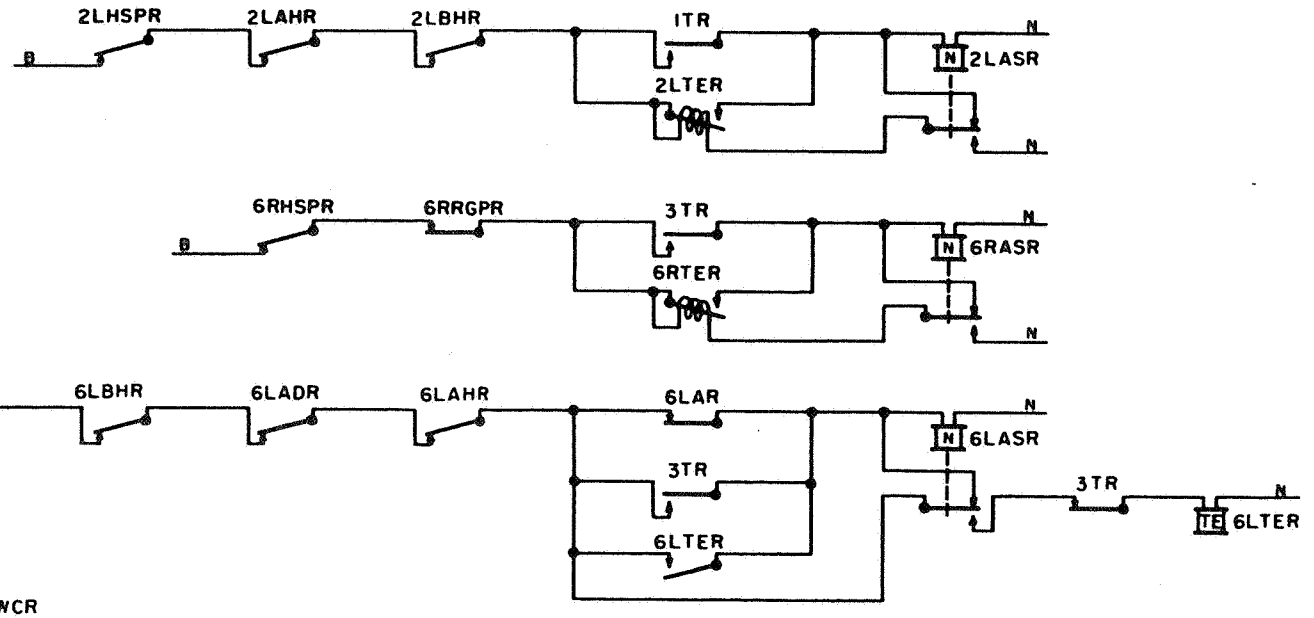


SWITCH LOCKING RELAY CIRCUITS



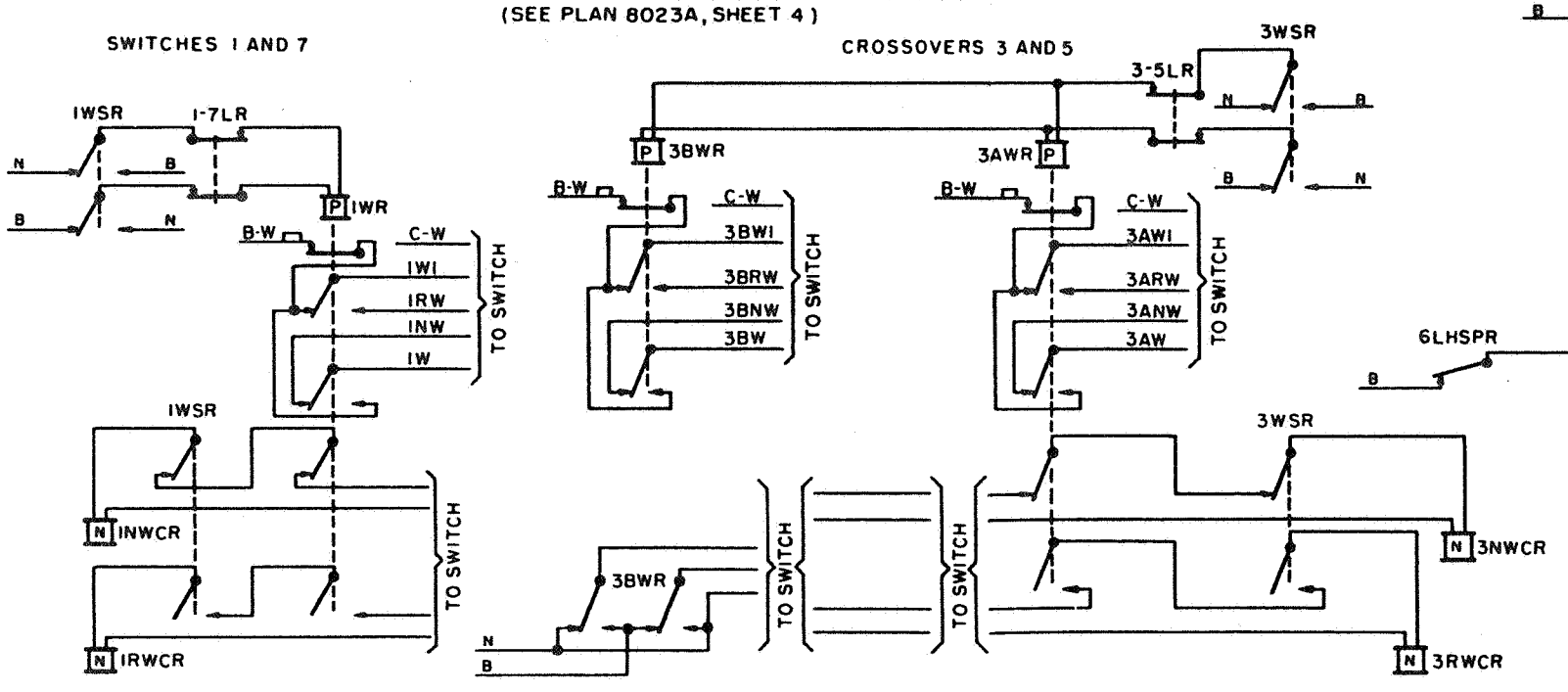
APPROACH & TIME LOCKING CIRCUITS





TYPICAL SWITCH CONTROL & INDICATION CIRCUITS

(SEE PLAN 8023A, SHEET 4)



TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

CODED REMOTE CONTROL – FUNCTIONS INDIVIDUALLY CONTROLLED

SEMI-AUTOMATIC STICK SIGNALS – RESTRICTING SIGNALS CONTROLLED THROUGH FIRST TRACK SECTION ONLY.

SEPT. 1951

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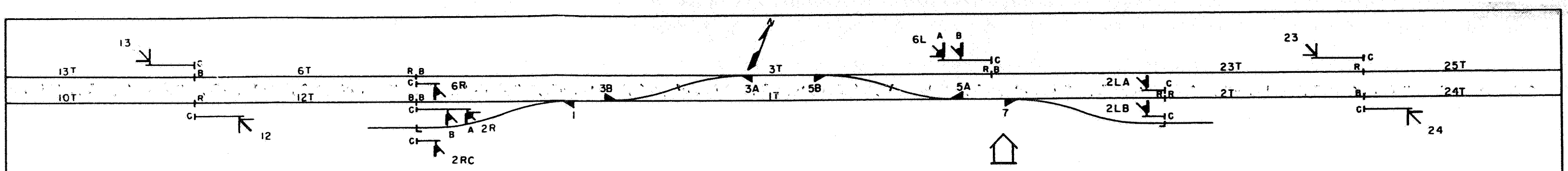
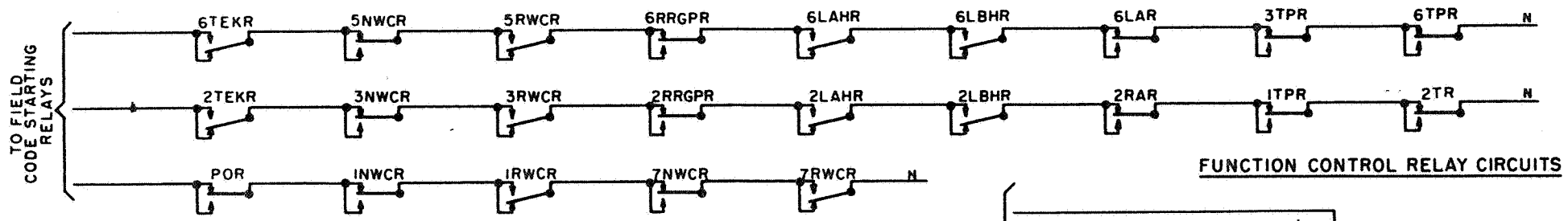
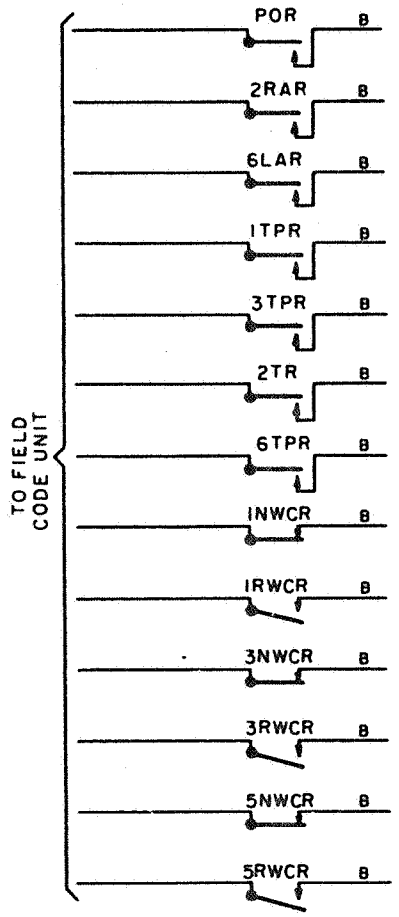
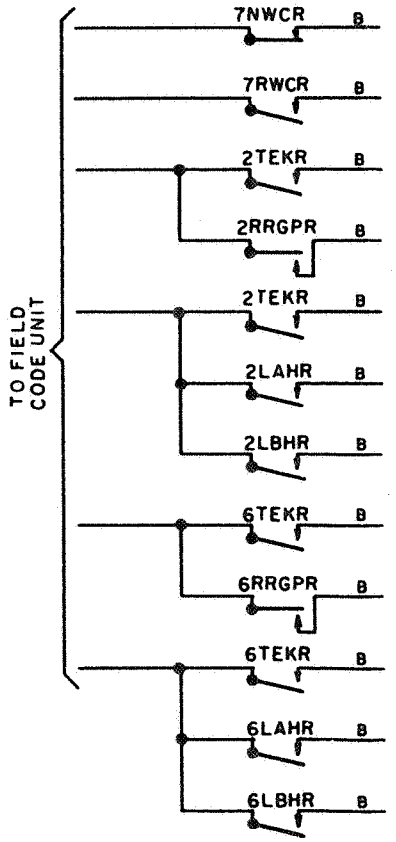


INDICATION CODE STARTING CIRCUITS

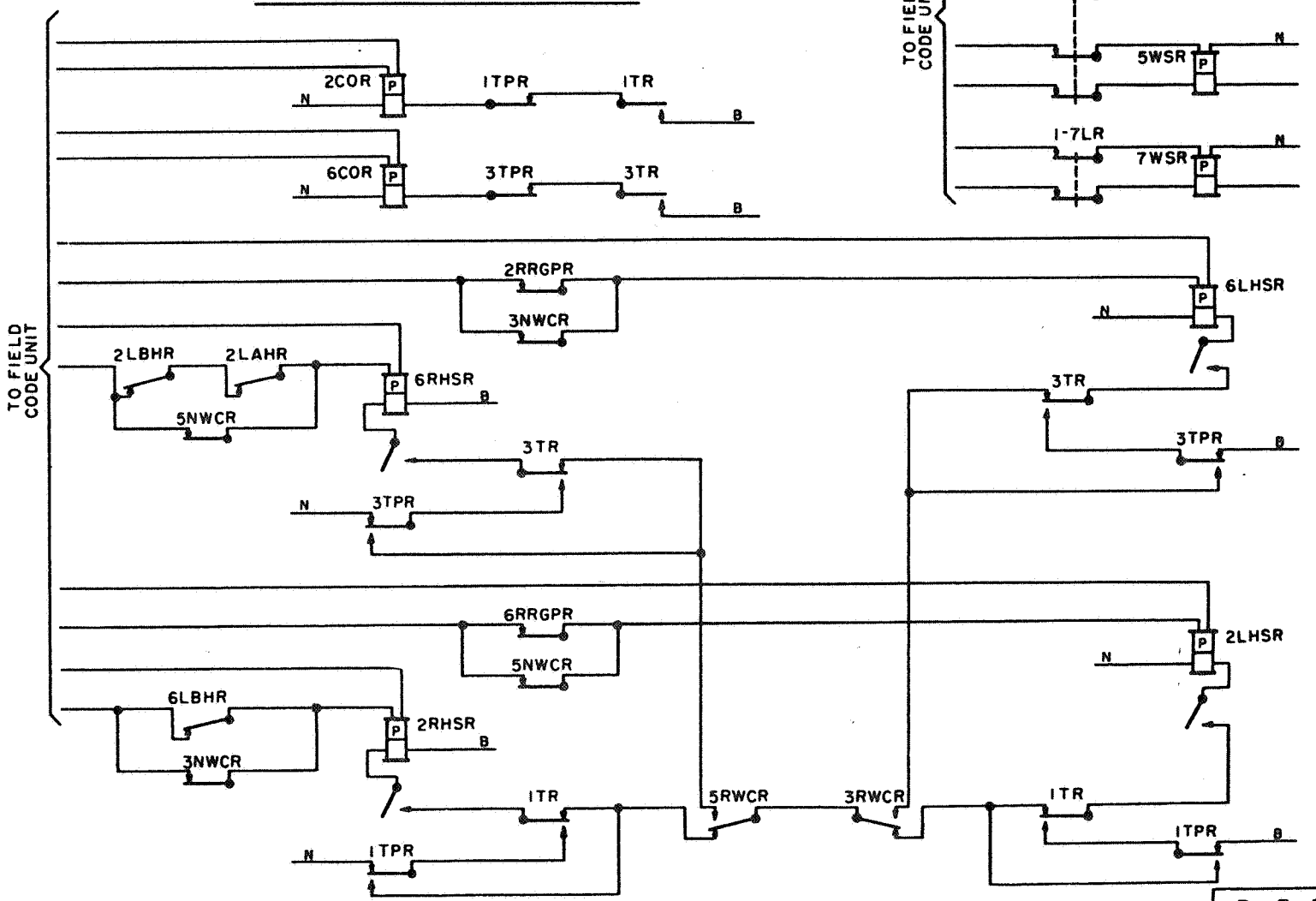


INDICATION CIRCUITS





FUNCTION CONTROL RELAY CIRCUITS



TO FIELD CODE UNIT

TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

CODED REMOTE CONTROL - FUNCTIONS INDIVIDUALLY CONTROLLED
SEMI-AUTOMATIC STICK SIGNALS - RESTRICTING SIGNALS CONTROLLED THROUGH FIRST TRACK SECTION ONLY.

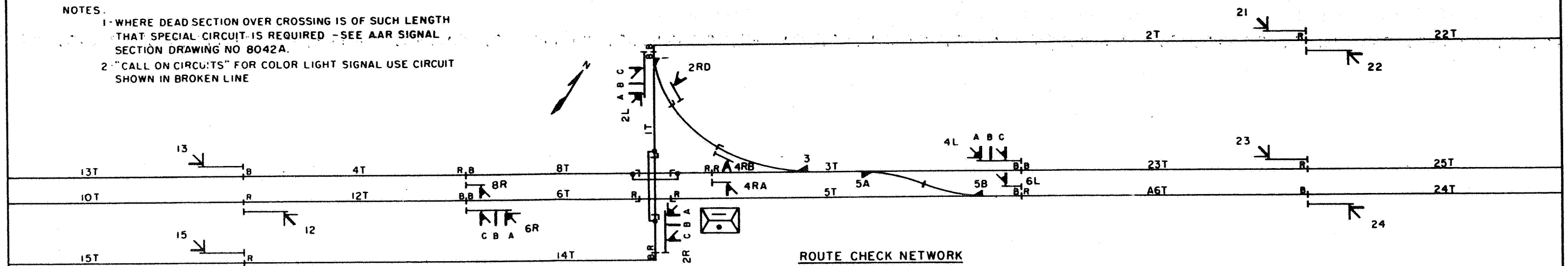
AAR
SIG.SEC.
8055A

SEPT. 1951

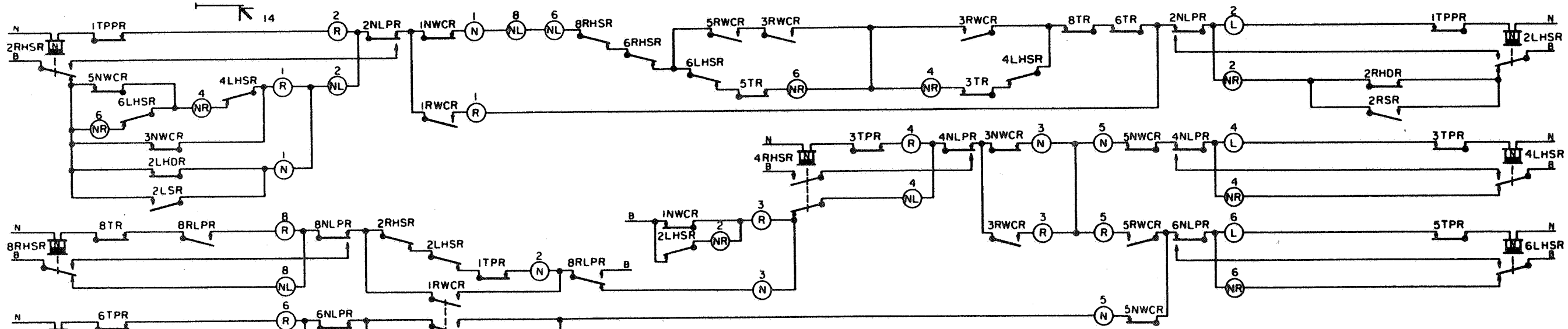
NOTES.

1 - WHERE DEAD SECTION OVER CROSSING IS OF SUCH LENGTH THAT SPECIAL CIRCUIT IS REQUIRED - SEE AAR SIGNAL SECTION DRAWING NO 8042A.

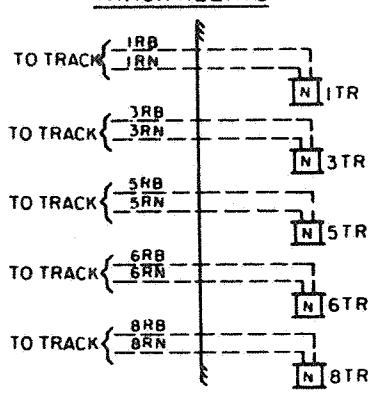
2 "CALL ON CIRCUITS" FOR COLOR LIGHT SIGNAL USE CIRCUIT SHOWN IN BROKEN LINE



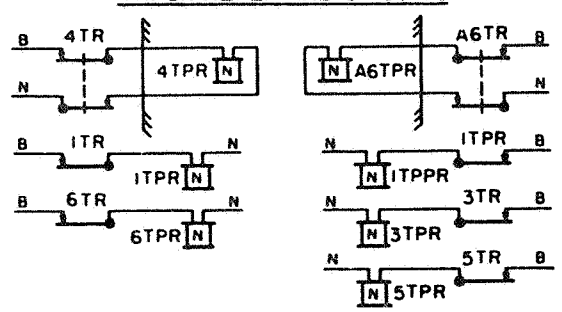
ROUTE CHECK NETWORK



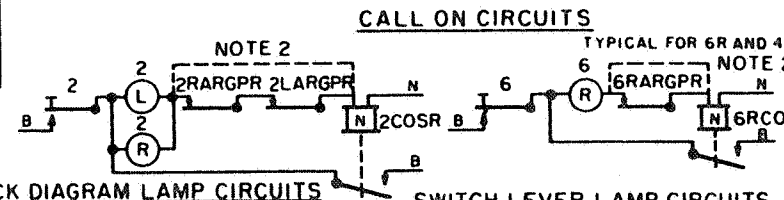
TRACK RELAYS



TRACK REPEATING CIRCUITS

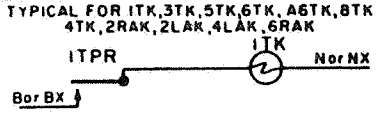


CALL ON CIRCUITS



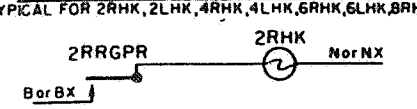
TRACK DIAGRAM LAMP CIRCUITS

TYPICAL FOR 1TK, 3TK, 5TK, 6TK, A6TK, 8TK 4TK, 2RAK, 2LAK, 4LAK, 6RAK



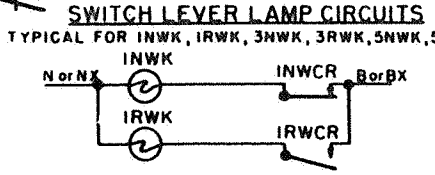
SIGNAL LEVER LAMP CIRCUITS

TYPICAL FOR 2RHK, 2LHK, 4RHK, 4LHK, 6RHK, 6LHK, 8RHK



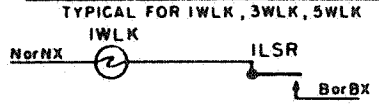
SWITCH LEVER LAMP CIRCUITS

TYPICAL FOR 1NWK, 1RWK, 3NWK, 3RWK, 5NWK, 5RWK

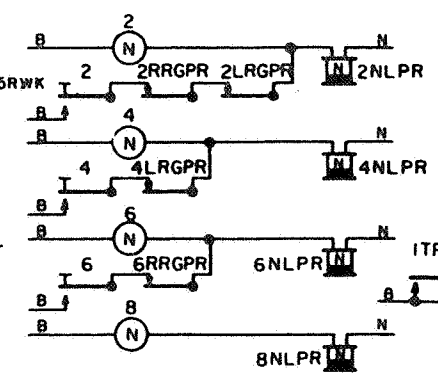


SWITCH LOCKED LAMP CIRCUITS

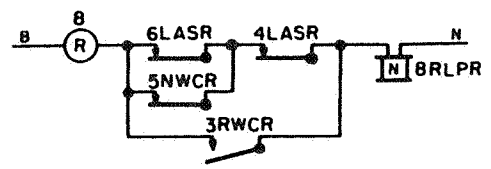
TYPICAL FOR 1WLK, 3WLK, 5WLK



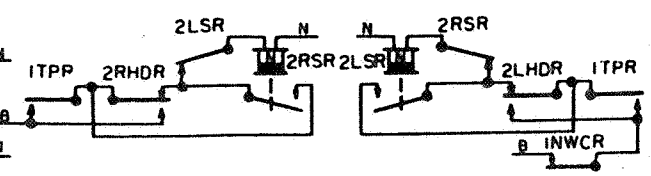
LEVER NORMAL REPEATING CIRCUITS



SIGNAL LEVER REPEATING CIRCUIT



STICK RELAY CIRCUITS



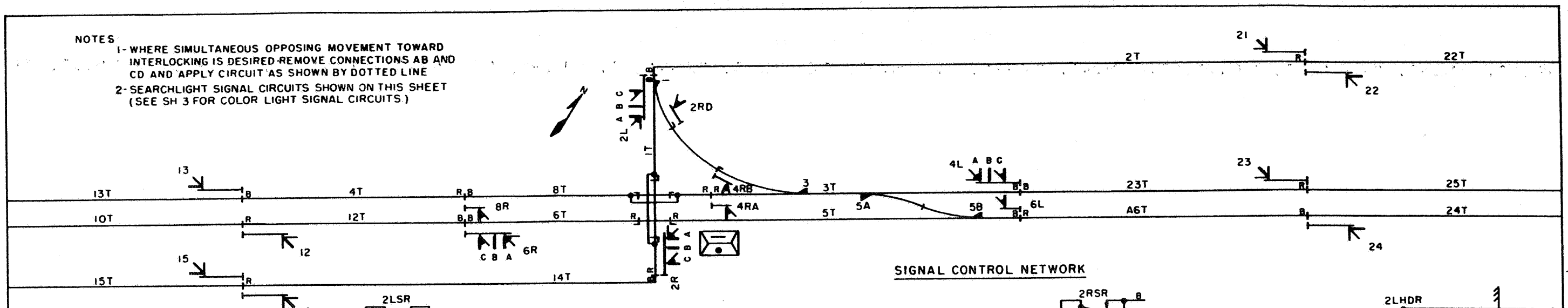
TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

RAILROAD CROSSING - LOCAL CONTROL

AAR SIG. SEC. 8056A

SEPT 1951

NOTES
1- WHERE SIMULTANEOUS OPPOSING MOVEMENT TOWARD INTERLOCKING IS DESIRED REMOVE CONNECTIONS AB AND CD AND APPLY CIRCUIT AS SHOWN BY DOTTED LINE
2- SEARCHLIGHT SIGNAL CIRCUITS SHOWN ON THIS SHEET (SEE SH 3 FOR COLOR LIGHT SIGNAL CIRCUITS.)



TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

RAILROAD CROSSING - LOCAL CONTROL

AAR SIG. SEC. 8056 A

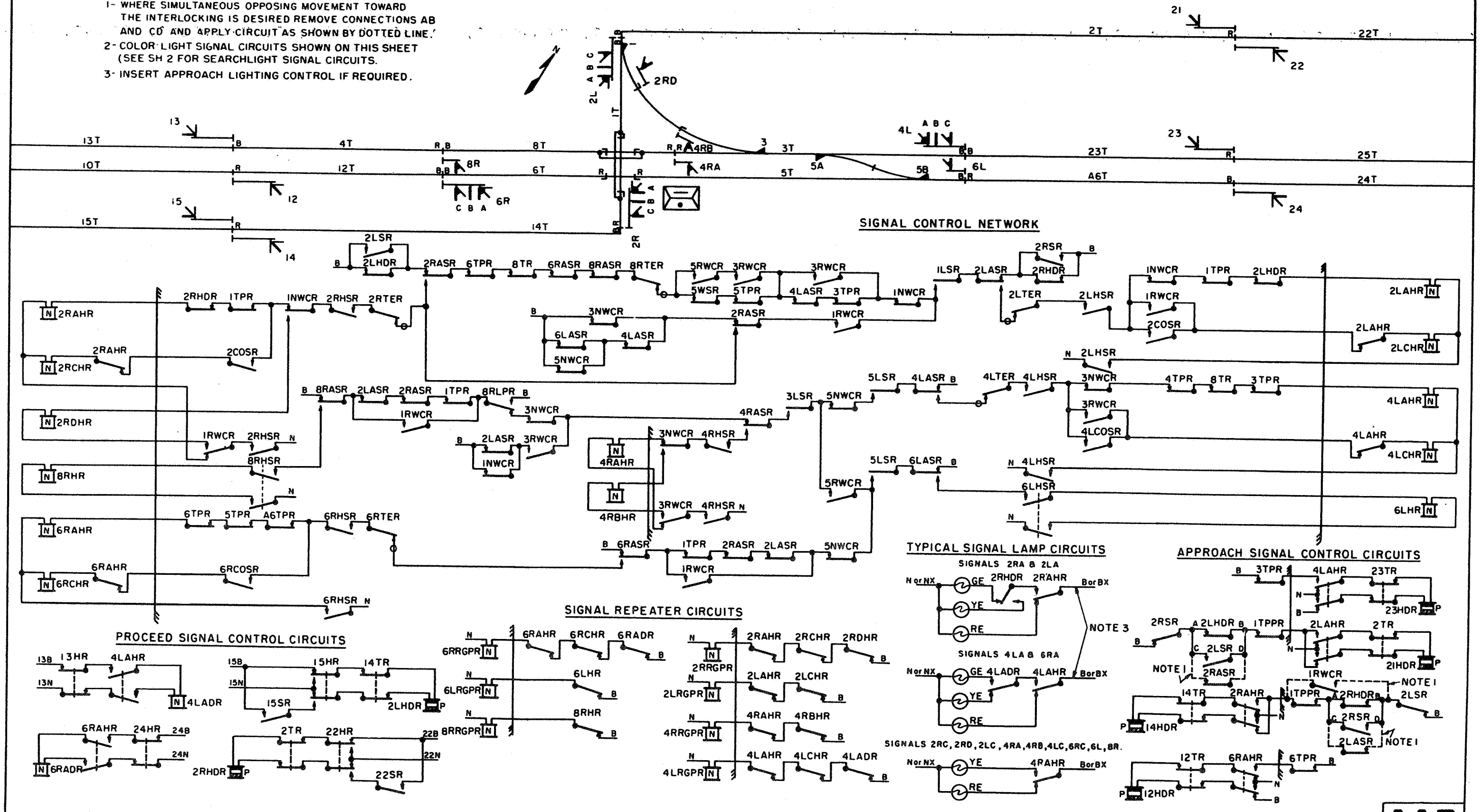
SEPT. 1951

NOTES.

1- WHERE SIMULTANEOUS OPPOSING MOVEMENT TOWARD THE INTERLOCKING IS DESIRED REMOVE CONNECTIONS AB AND CD AND APPLY CIRCUIT AS SHOWN BY DOTTED LINE.

2- COLOR LIGHT SIGNAL CIRCUITS SHOWN ON THIS SHEET (SEE SH 2 FOR SEARCHLIGHT SIGNAL CIRCUITS.

3- INSERT APPROACH LIGHTING CONTROL IF REQUIRED.



SIGNAL CONTROL NETWORK

PROCEED SIGNAL CONTROL CIRCUITS

SIGNAL REPEATER CIRCUITS

TYPICAL SIGNAL LAMP CIRCUITS

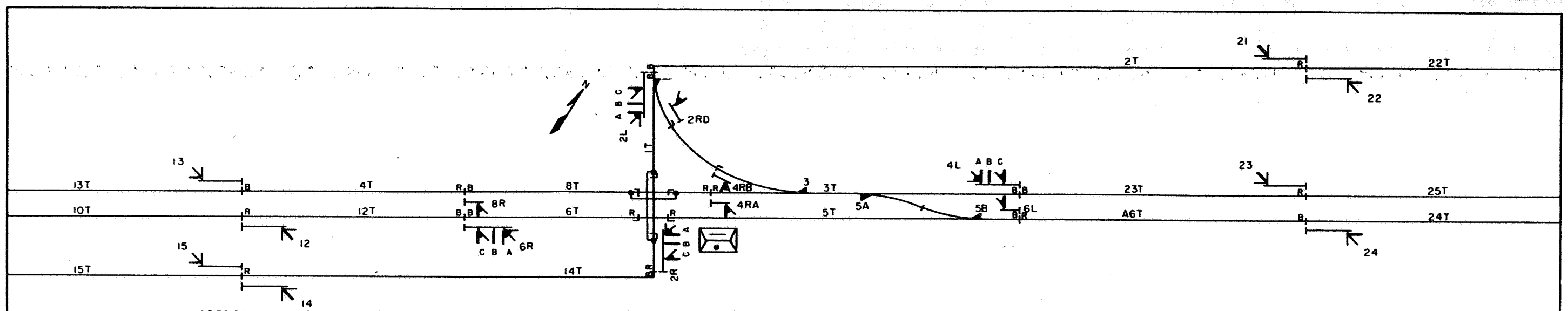
APPROACH SIGNAL CONTROL CIRCUITS

TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

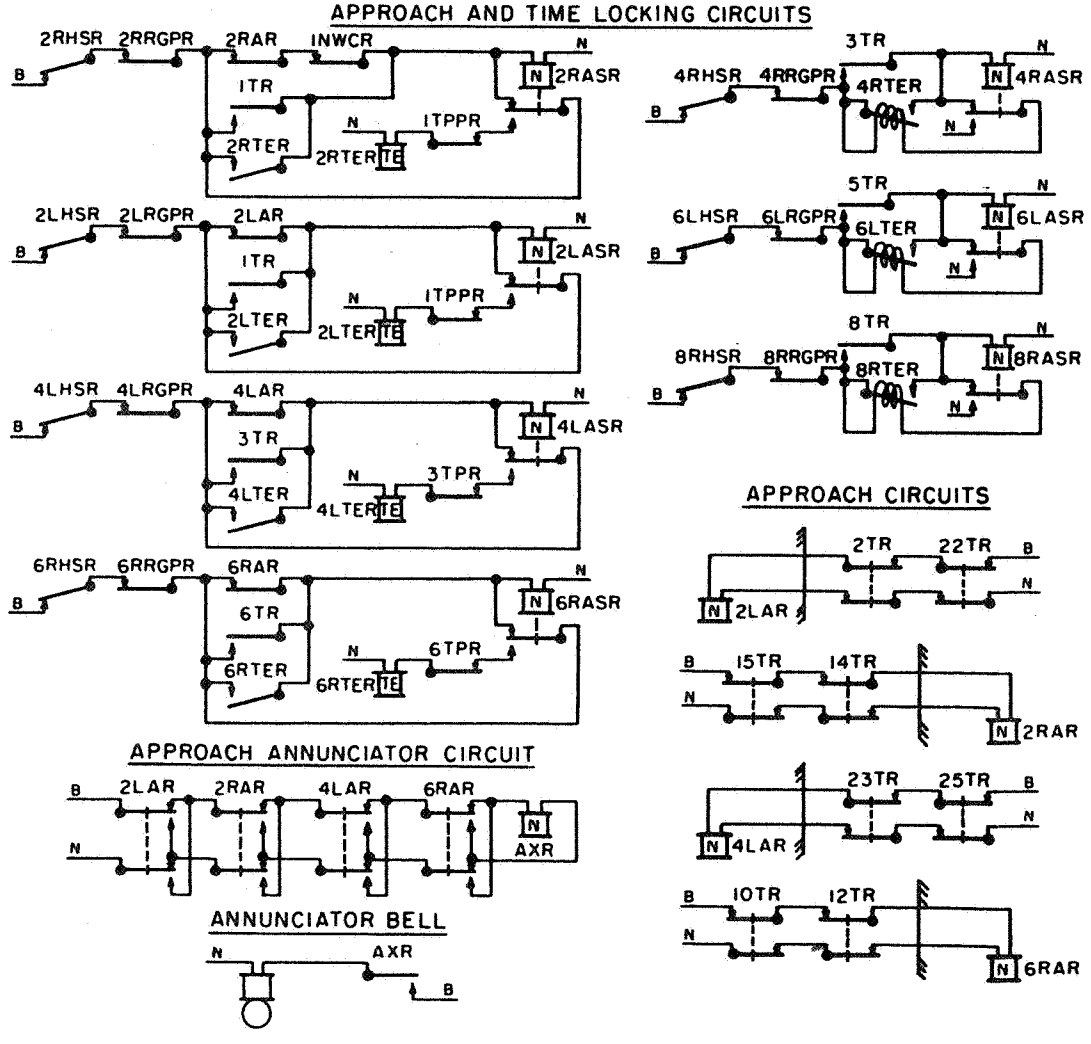
RAILROAD CROSSING - LOCAL CONTROL.

AAR SIG.SEC. 8056A

SEPT. 1951



APPROACH AND TIME LOCKING CIRCUITS

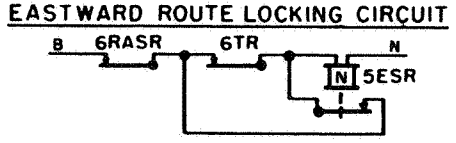


APPROACH ANNUNCIATOR CIRCUIT

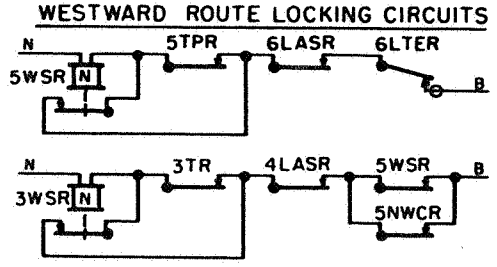
ANNUNCIATOR BELL

APPROACH CIRCUITS

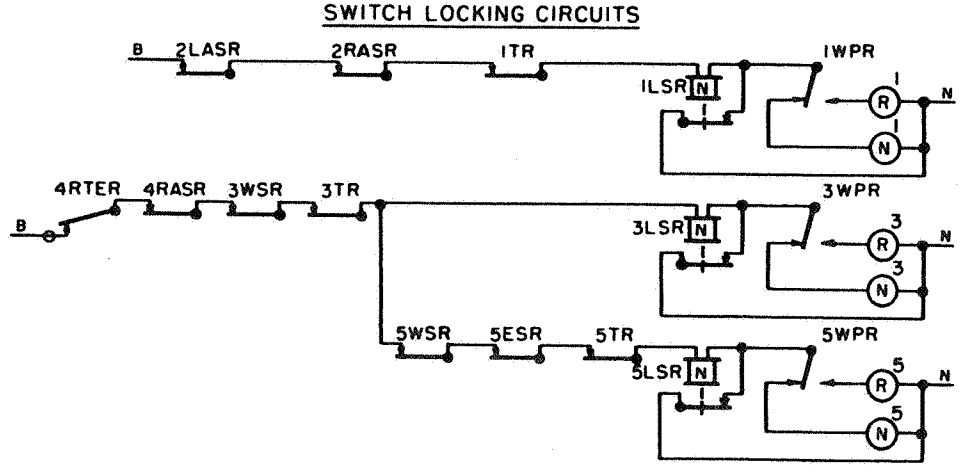
EASTWARD ROUTE LOCKING CIRCUIT



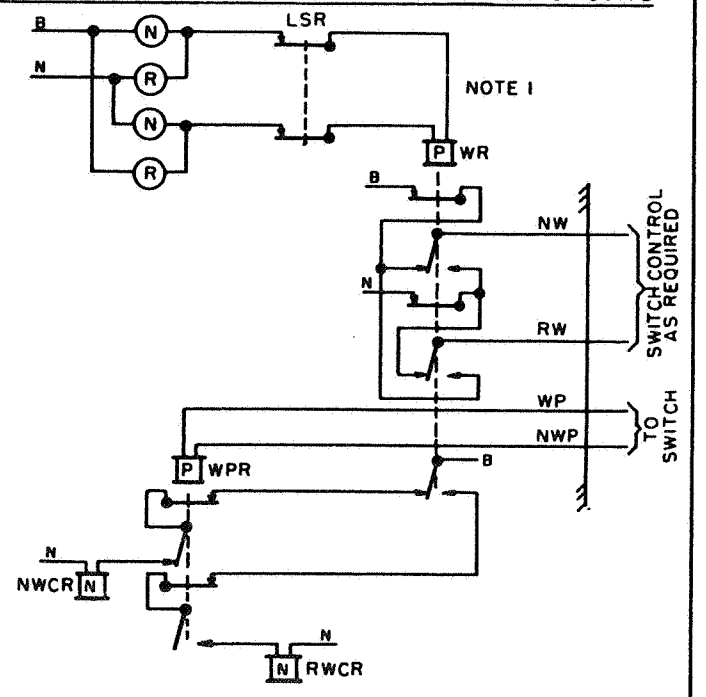
WESTWARD ROUTE LOCKING CIRCUITS



SWITCH LOCKING CIRCUITS



TYPICAL SWITCH CONTROL AND INDICATION CIRCUITS



NOTE.

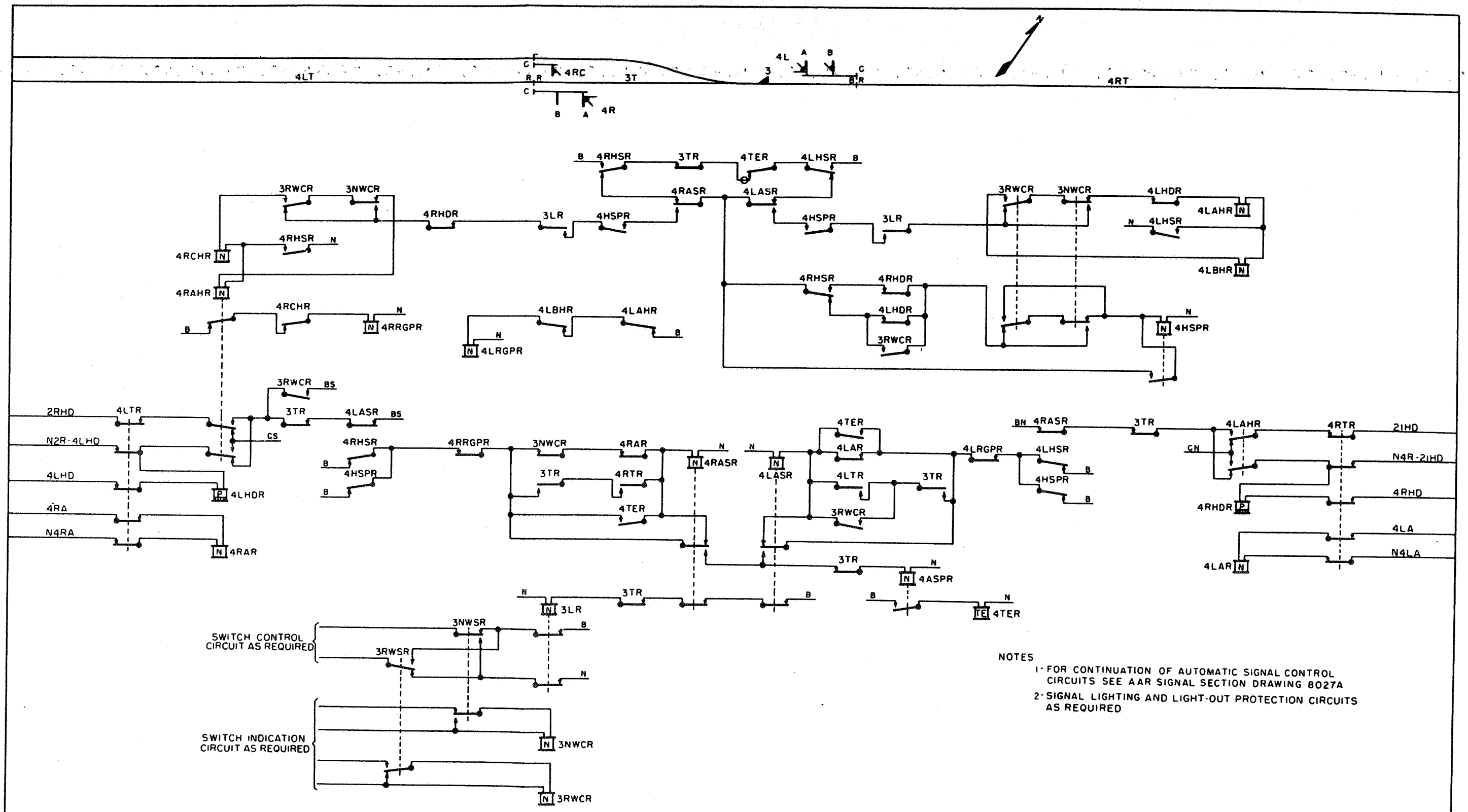
1 - EXACT ARRANGEMENT OF SWITCH CONTROL AND INDICATION CIRCUITS WILL VARY WITH TYPE OF SWITCH MACHINE AND CONTROL APPARATUS.

TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

RAILROAD CROSSING - LOCAL CONTROL

AAR SIG. SEC. 8056A

SEPT 1951



NOTES

1- FOR CONTINUATION OF AUTOMATIC SIGNAL CONTROL CIRCUITS SEE AAR SIGNAL SECTION DRAWING 8027A

2- SIGNAL LIGHTING AND LIGHT-OUT PROTECTION CIRCUITS AS REQUIRED

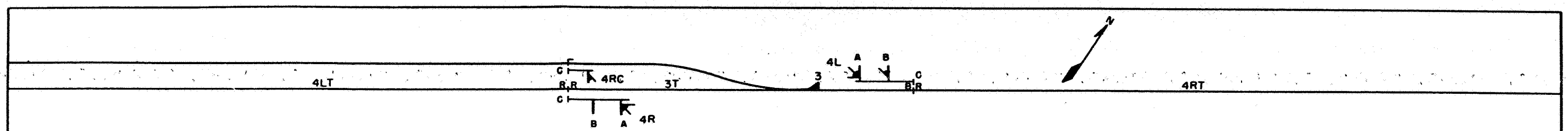
TYPICAL CIRCUITS REMOTE CONTROL SWITCH AND COLORLIGHT SIGNALS

CODE CONTROL USING 3 WIRE HD LINE CIRCUITS

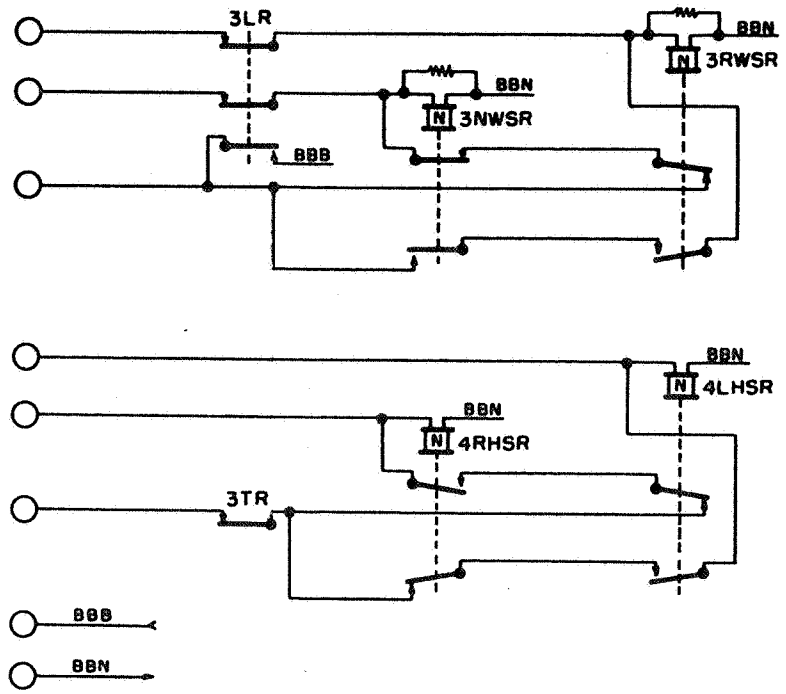
AAR SIG.SEC. 8058A

SEPT 1951

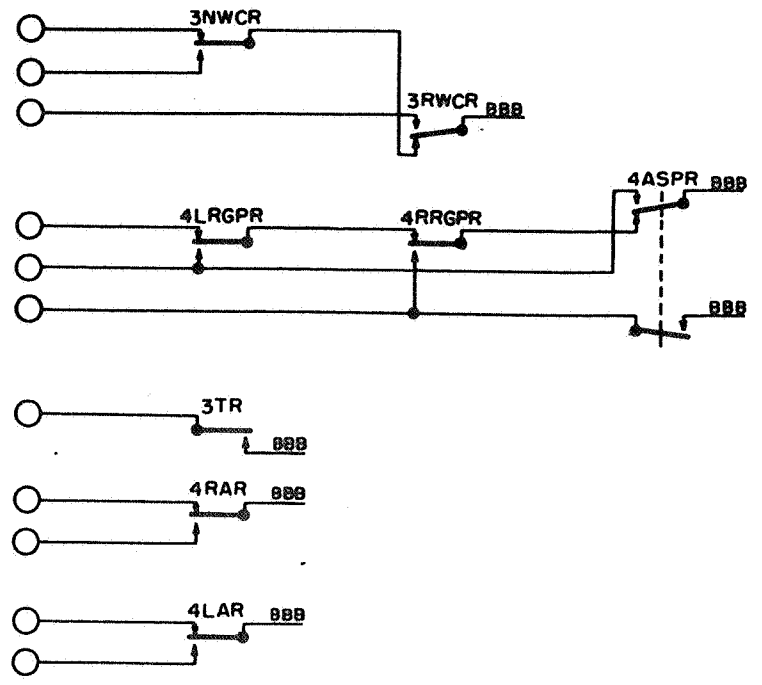
SHEET 1



TERMINALS ON FIELD CODE UNIT



TERMINALS ON FIELD CODE UNIT



NOTE:
THESE CIRCUITS WILL VARY WITH THE TYPE OF CODE SYSTEM EMPLOYED.

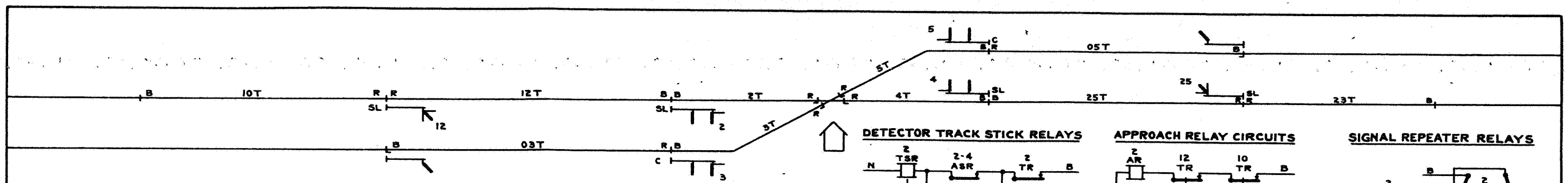
TYPICAL CIRCUITS REMOTE CONTROL SWITCH AND COLORLIGHT SIGNALS

CODE CONTROL USING 3 WIRE HD LINE CIRCUITS

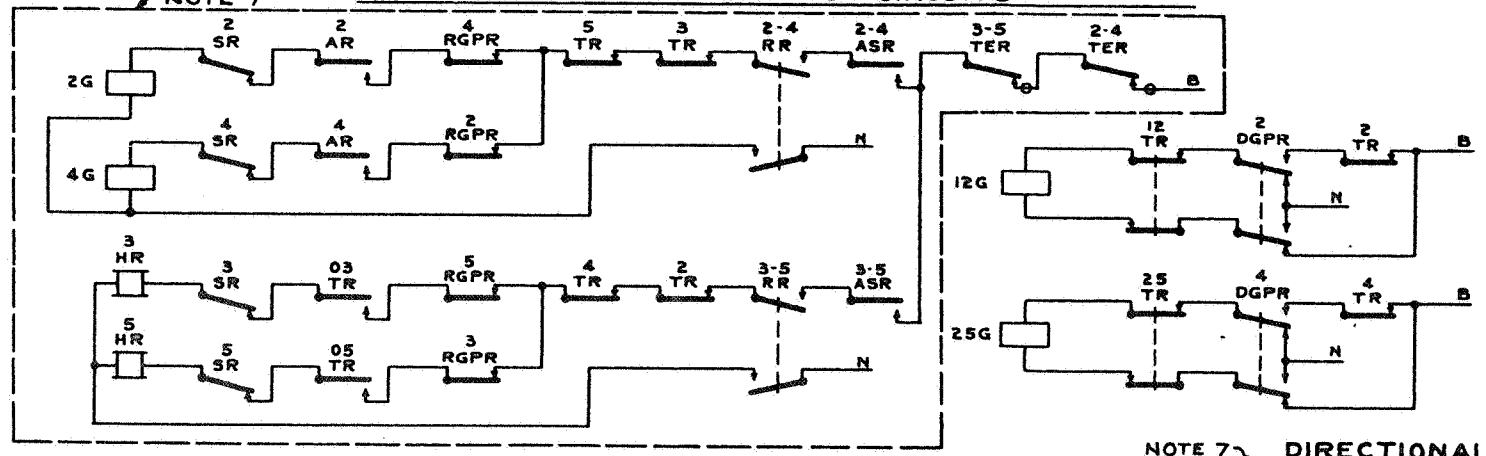
SEPT. 1951

AAR SIG.SEC. 8058A

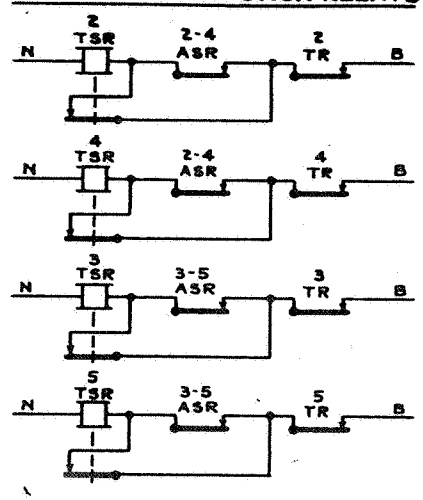
SHEET 2



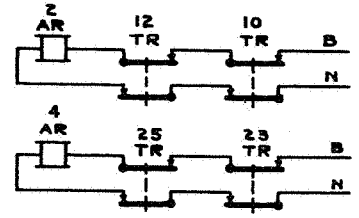
SIGNAL CONTROL CIRCUITS



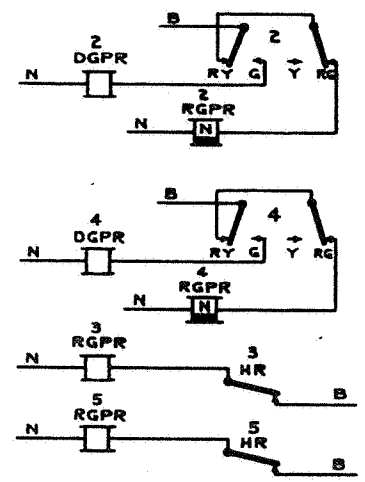
DETECTOR TRACK STICK RELAYS



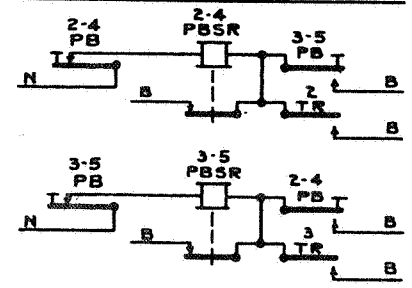
APPROACH RELAY CIRCUITS



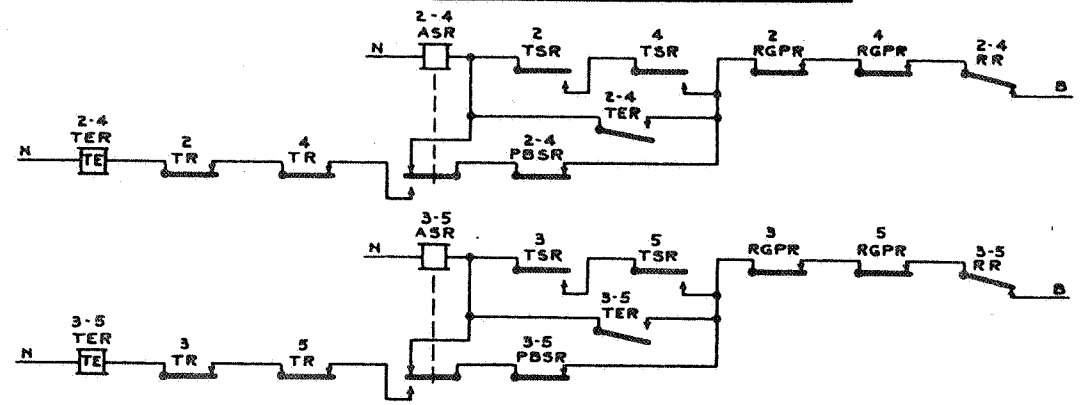
SIGNAL REPEATER RELAYS

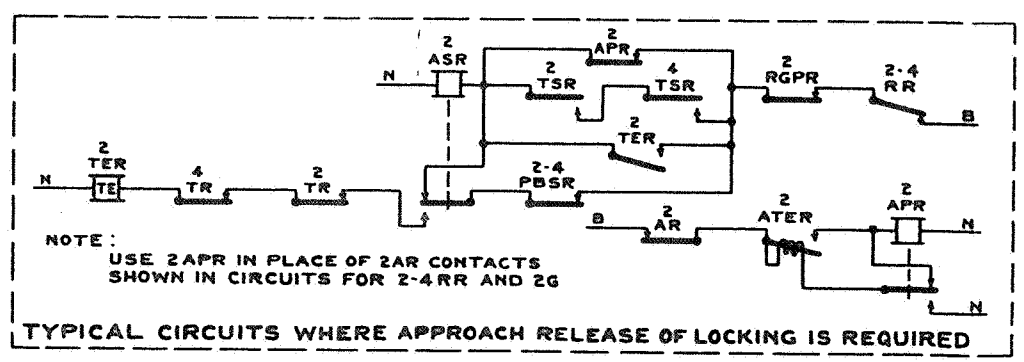


PUSH BUTTON RELEASE RELAYS



TIME LOCKING RELAYS

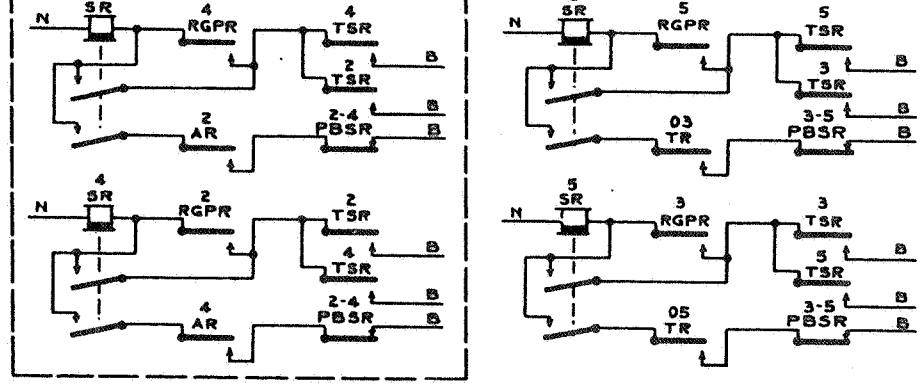




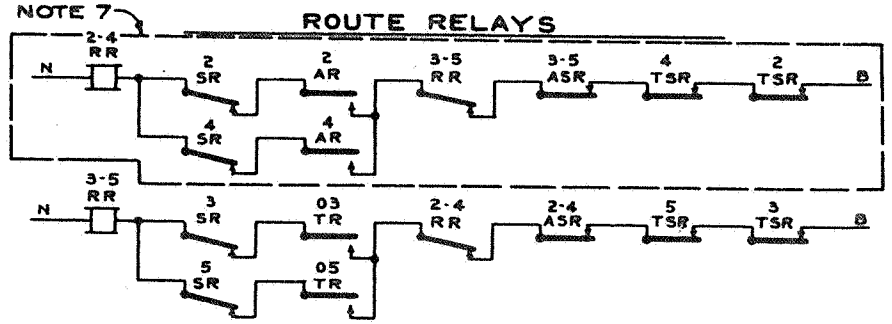
NOTE:
USE 2APR IN PLACE OF 2AR CONTACTS SHOWN IN CIRCUITS FOR 2-4RR AND 2G

TYPICAL CIRCUITS WHERE APPROACH RELEASE OF LOCKING IS REQUIRED

DIRECTIONAL STICK RELAYS



ROUTE RELAYS



NOTE:

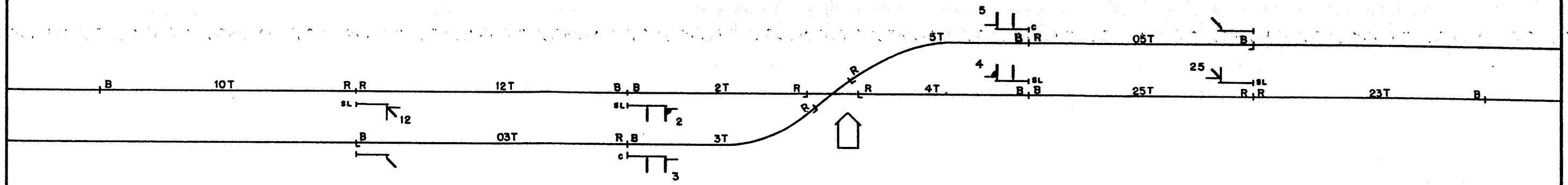
1. HOME SIGNALS MAY BE CONTROLLED THROUGH OPPOSING APPROACH CIRCUIT IF DESIRED.
2. SIGNAL CONTROL CIRCUIT FOR CONFLICTING ROAD OPEN BEFORE CONTROL CIRCUIT IS CLOSED TO CLEAR SIGNAL FOR APPROACHING TRAIN.
3. HOME SIGNAL WILL RETURN TO STOP IN EVENT OF LOSS OF SHUNT BUT ROUTE CANNOT BE CHANGED UNTIL EXPIRATION OF FULL TIME INTERVAL, IF SHUNT IS RETURNED PRIOR TO EXPIRATION OF TIME INTERVAL THE SIGNAL WILL RECLEAR.
   WHEN APPROACH LOCKING IS USED SIGNAL WILL REMAIN CLEAR A PREDETERMINED TIME INTERVAL IN EVENT OF LOSS OF SHUNT.
4. CIRCUITS PREVENT SUCCESSIVE TRAINS ON ONE ROAD RETAINING ROUTE WHEN CONFLICTING ROAD OCCUPIES APPROACH SECTION.
5. DOUBLE TRACK CIRCUIT RELEASE PROTECTS AGAINST RELEASE OF ROUTE IN EVENT ONE DETECTOR TRACK IS MOMENTARILY DE-ENERGIZED.
6. HOME SIGNAL CONTROLS SELECTED THROUGH CHECK CONTACTS OF TIME ELEMENT RELAYS TO INSURE FULL TIME INTERVAL FOR CHANGE OF ROUTE.
7. WHERE SUPERVISORY CONTROL IS DESIRED ON SIGNALS 2 & 4 OMIT CIRCUITS SHOWN INSIDE DOTTED LINE AND INCLUDE CIRCUITS SHOWN ON SHEET 2.

TYPICAL CIRCUITS FOR AUTOMATIC INTERLOCKING

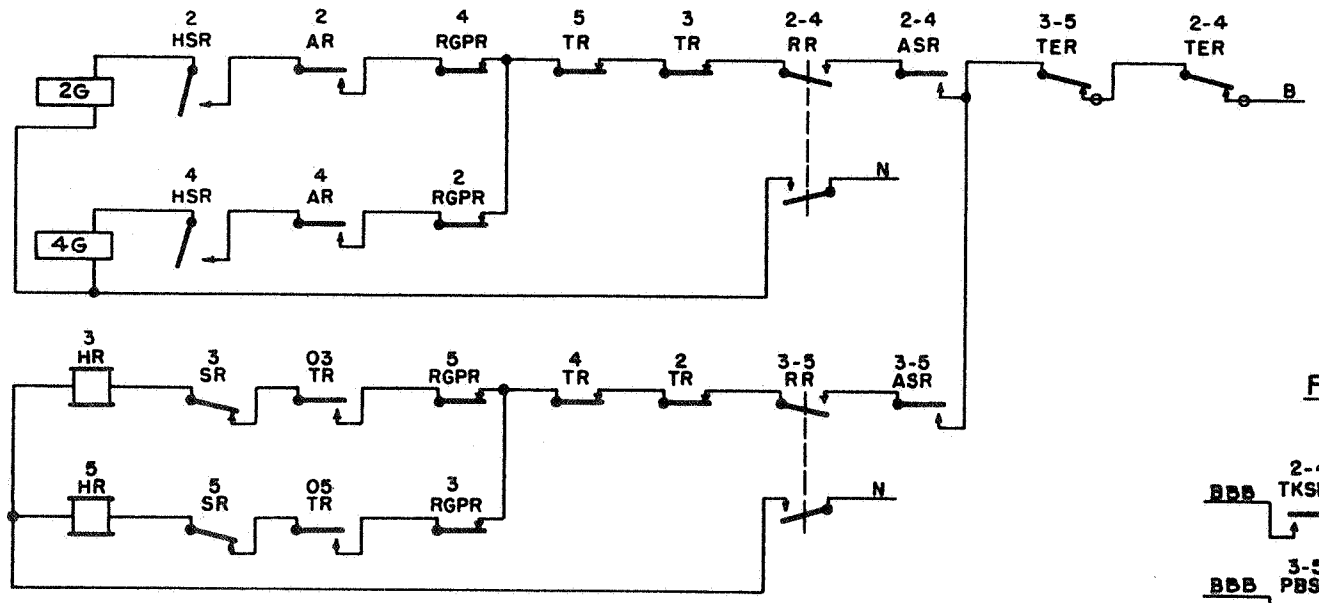
USING ROUTE RELAYS

SEPT. 1957	SEPT. 1952	AAR SIG. SEC. 8070B

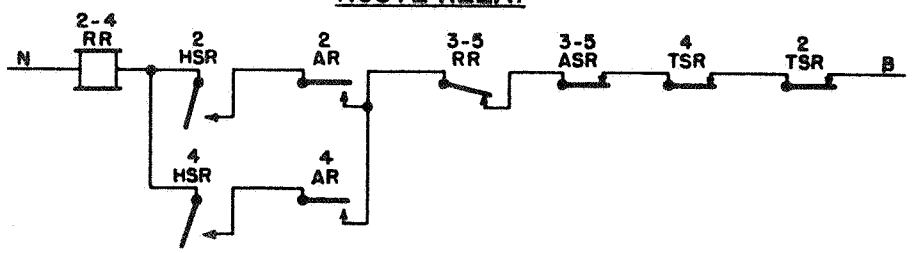
SHEET 1



SIGNAL CONTROL CIRCUITS



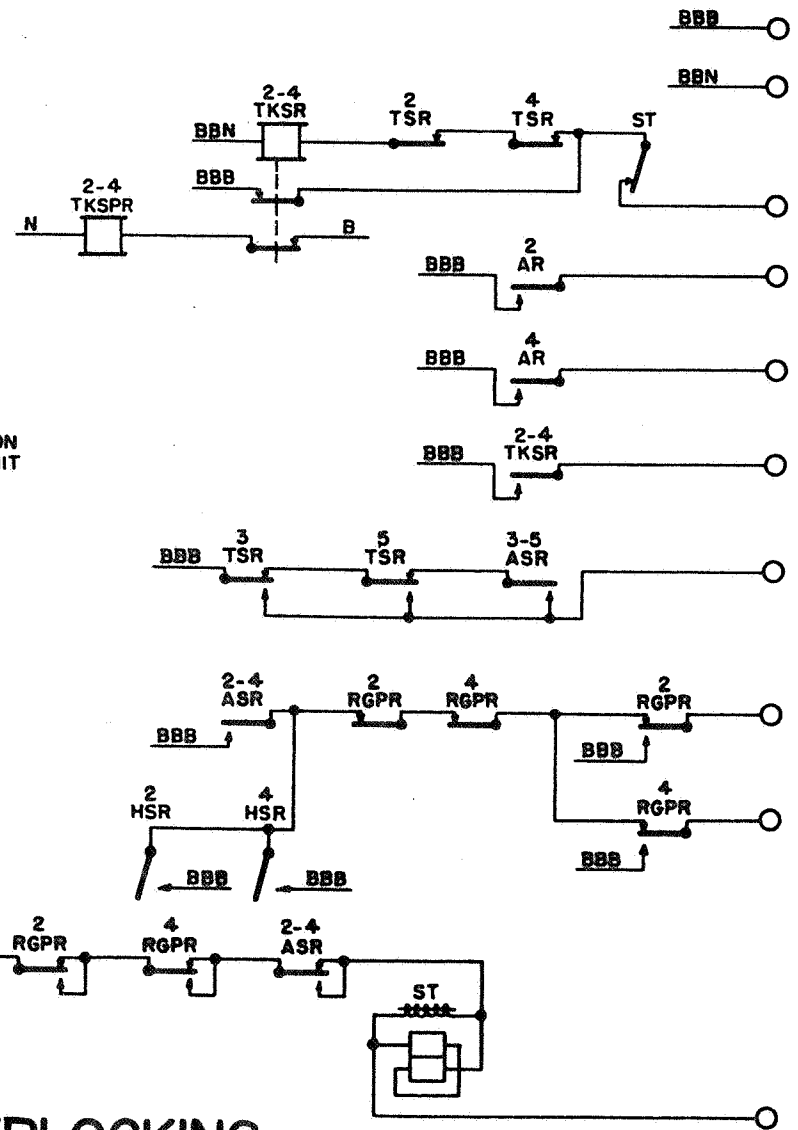
ROUTE RELAY



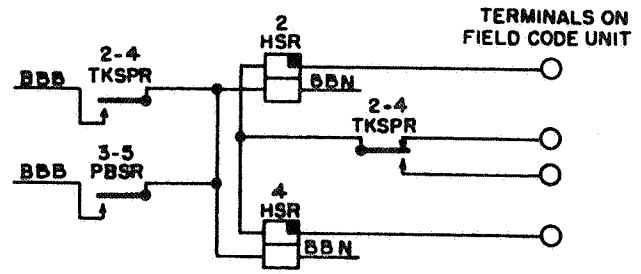
NOTE:

1. THESE CIRCUITS SUPPLEMENT THOSE ON SHEET 1, 8070B
2. THESE CIRCUITS WILL VARY WITH THE TYPE OF CODE SYSTEM EMPLOYED.

INDICATION CIRCUITS



FUNCTION CONTROL CIRCUIT



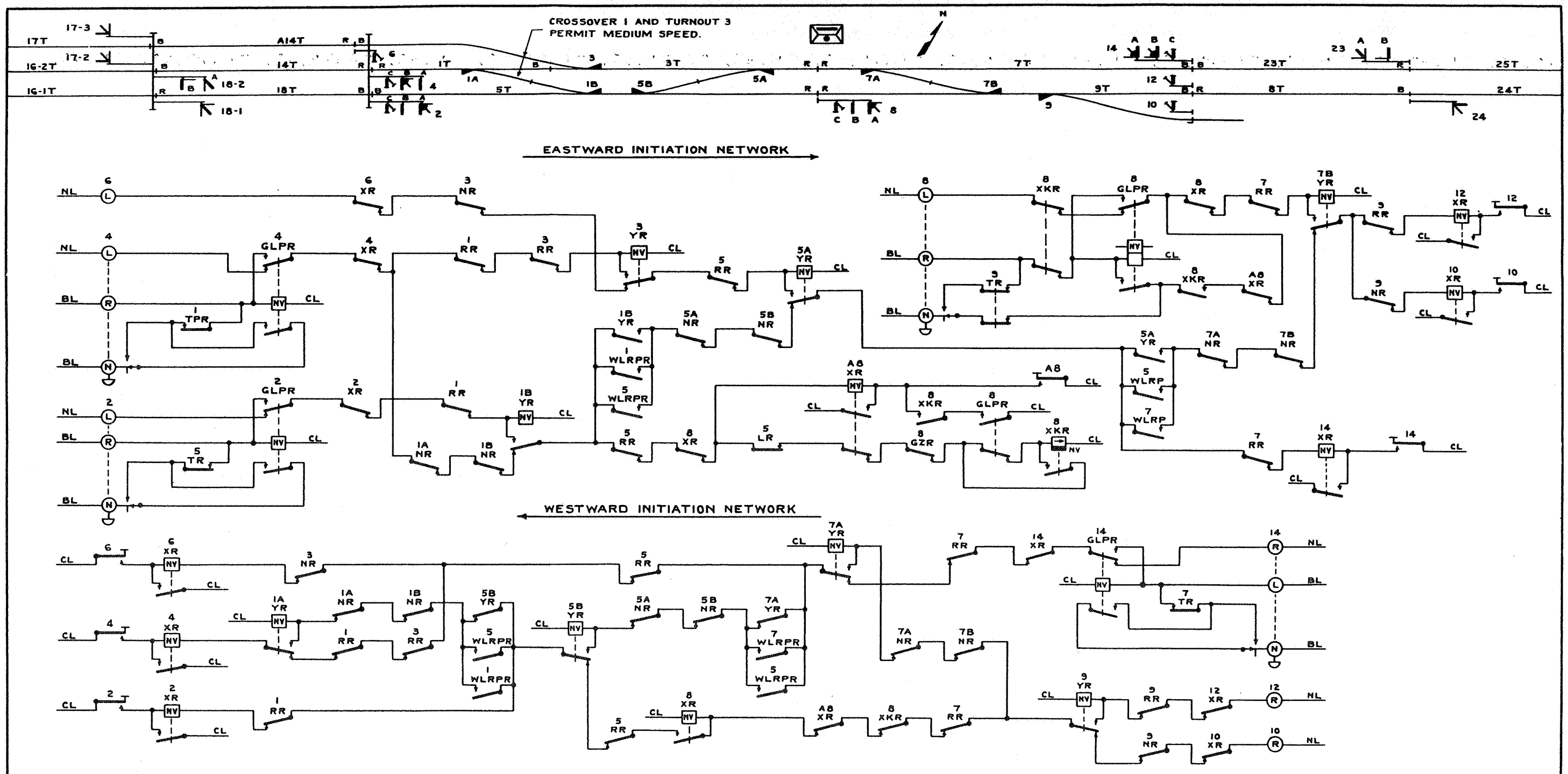
TYPICAL CIRCUITS FOR AUTOMATIC INTERLOCKING

USING ROUTE RELAYS (WITH SUPERVISORY CONTROL OF SIGNALS 2 & 4)

SEPT. 1957

AAR SIG. SEC. 8070B

SHEET 2



NOTE:

1- (N) CONTACT MADE ONLY WHEN KNOB IS PUSHED. CONTACT BROKEN ONLY WHEN KNOB IS PULLED OR ROTATED.

2- (L) CONTACT MADE ONLY WHEN KNOB IS ROTATED LEFT (COUNTERCLOCKWISE).

3- (R) CONTACT MADE ONLY WHEN KNOB IS ROTATED RIGHT (CLOCKWISE).

NOTE (CONT.)

4- XR = EXIT RELAY

5- YR = ROUTE SELECTING RELAY.

6- ZR = COMPLETION RELAY.

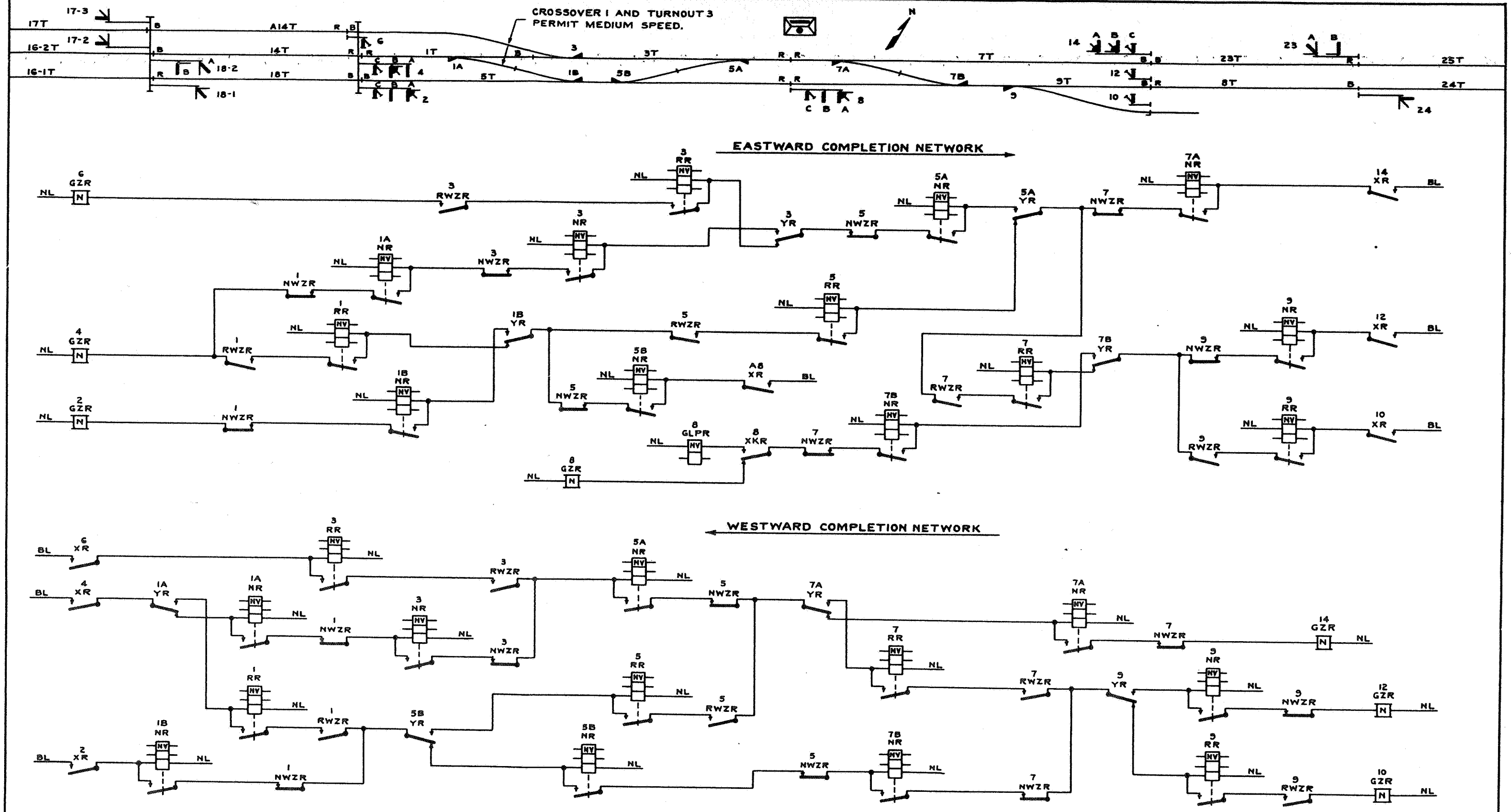
7- UNLESS OTHERWISE INDICATED ALL RELAYS ARE NEUTRAL.

TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

LOCAL CONTROL-ROUTE TYPE-SIGNAL LEVERS AND MOVABLE POINT ROUTE INDICATORS IN DIAGRAM

SEPT. 1953

AAR SIG. SEC. 8071A

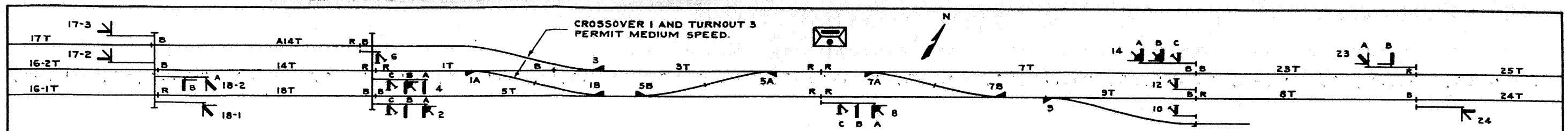


TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

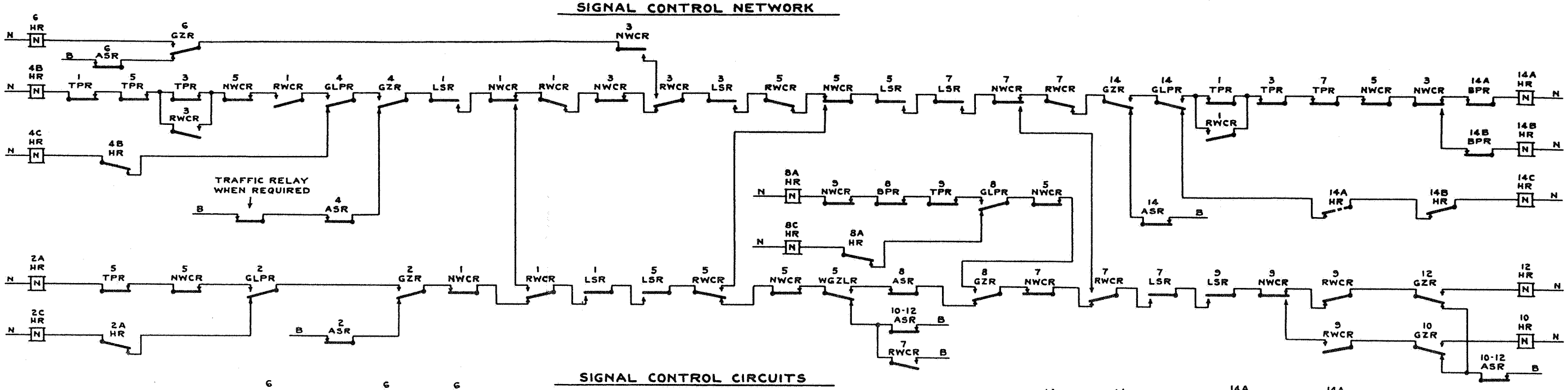
LOCAL CONTROL-ROUTE TYPE-SIGNAL LEVERS AND MOVABLE POINT ROUTE INDICATORS IN DIAGRAM

AAR SIG. SEC. 8071A

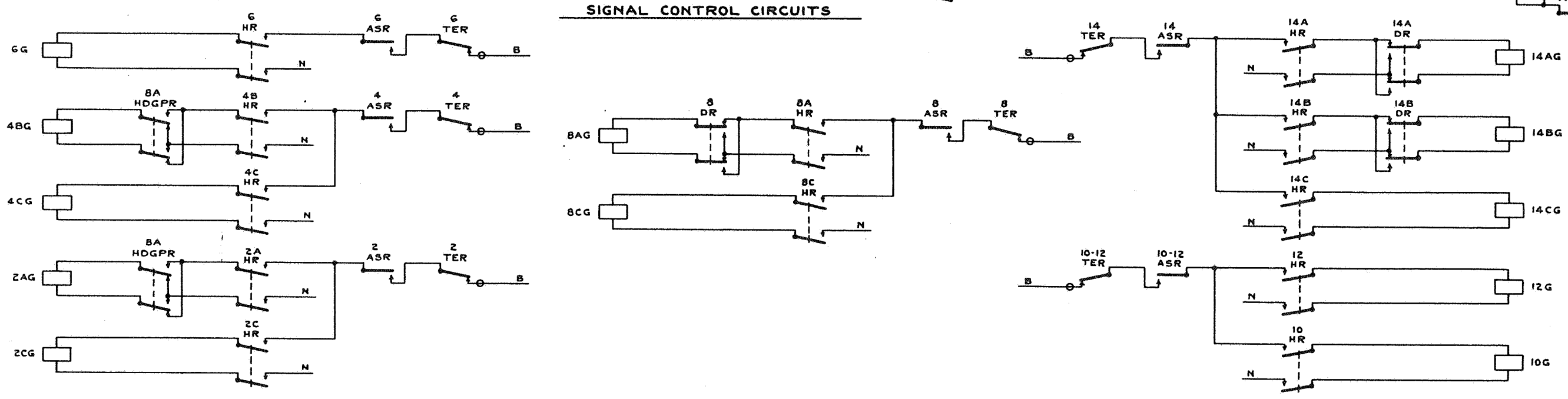
SEPT. 1953



SIGNAL CONTROL NETWORK



SIGNAL CONTROL CIRCUITS

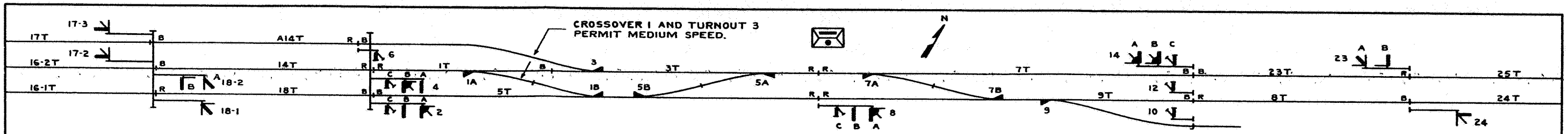


TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

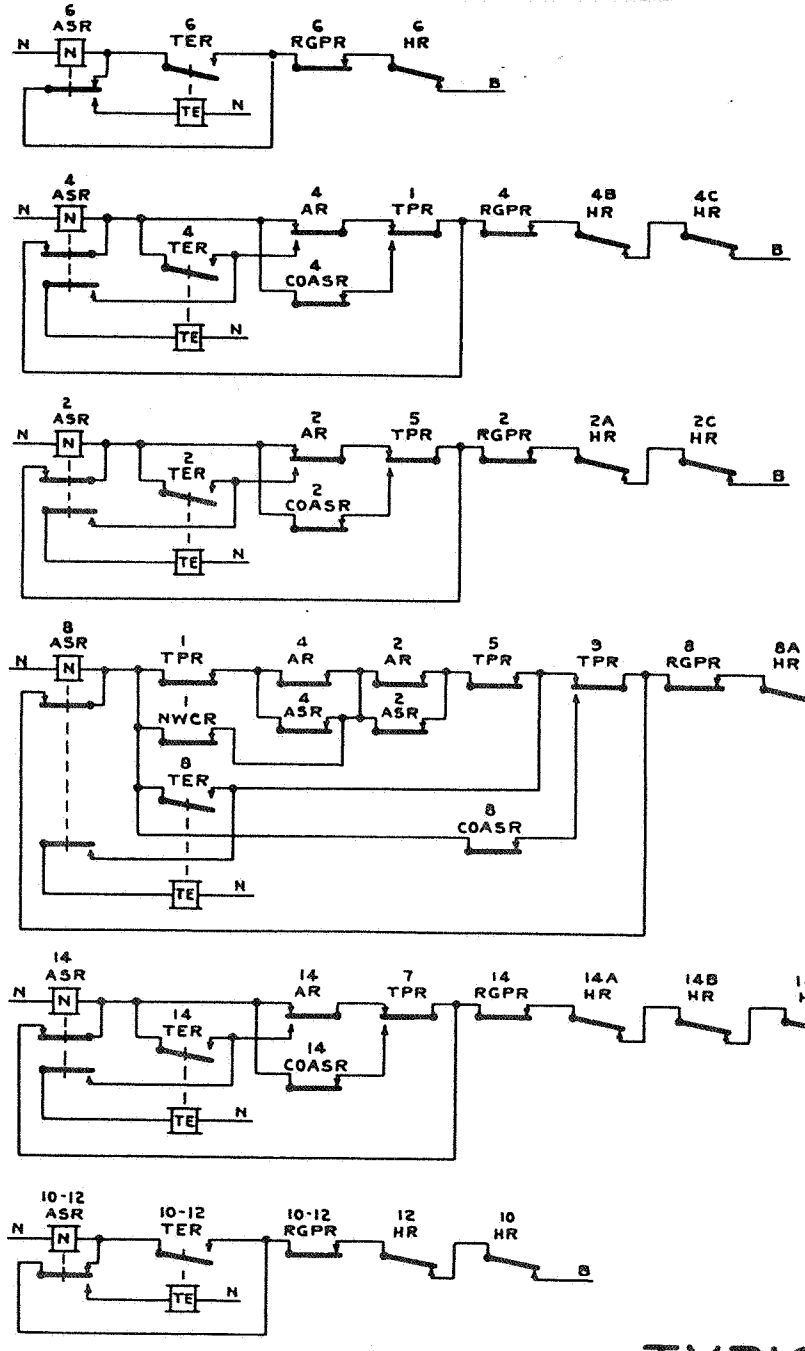
LOCAL CONTROL - ROUTE TYPE - SIGNAL LEVERS AND MOVABLE POINT ROUTE INDICATORS IN DIAGRAM

AAR SIG. SEC. 8071A

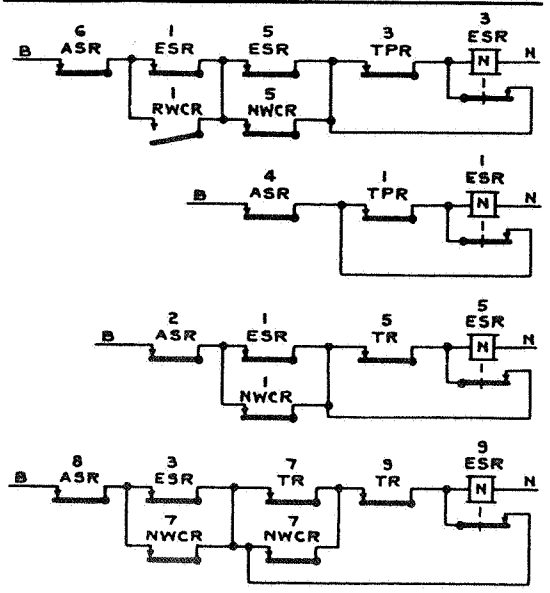
SEPT. 1953



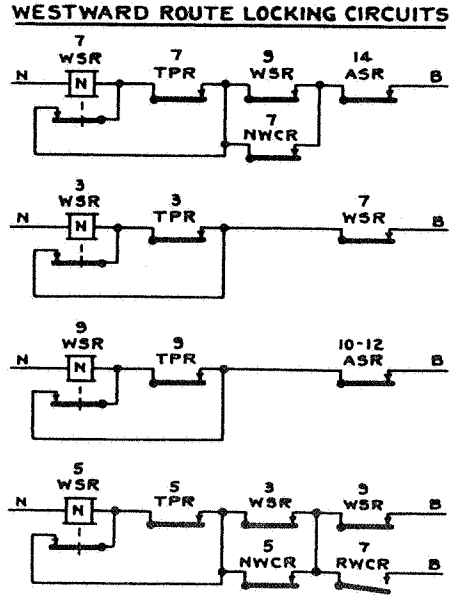
APPROACH AND TIME LOCKING CIRCUITS



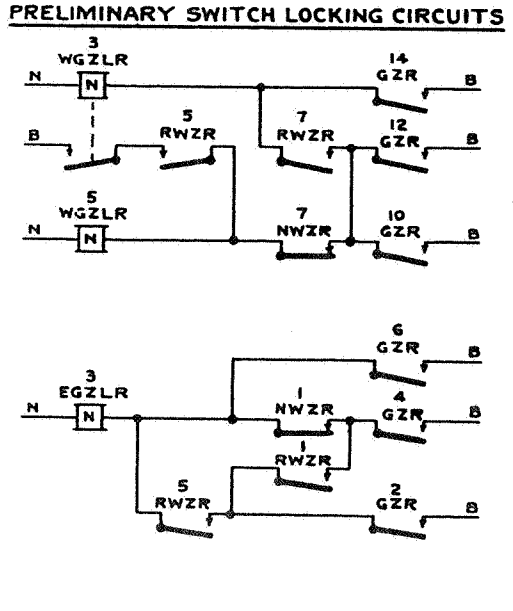
EASTWARD ROUTE LOCKING CIRCUITS



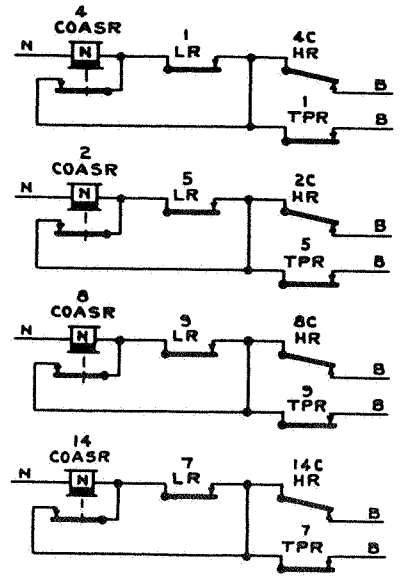
WESTWARD ROUTE LOCKING CIRCUITS



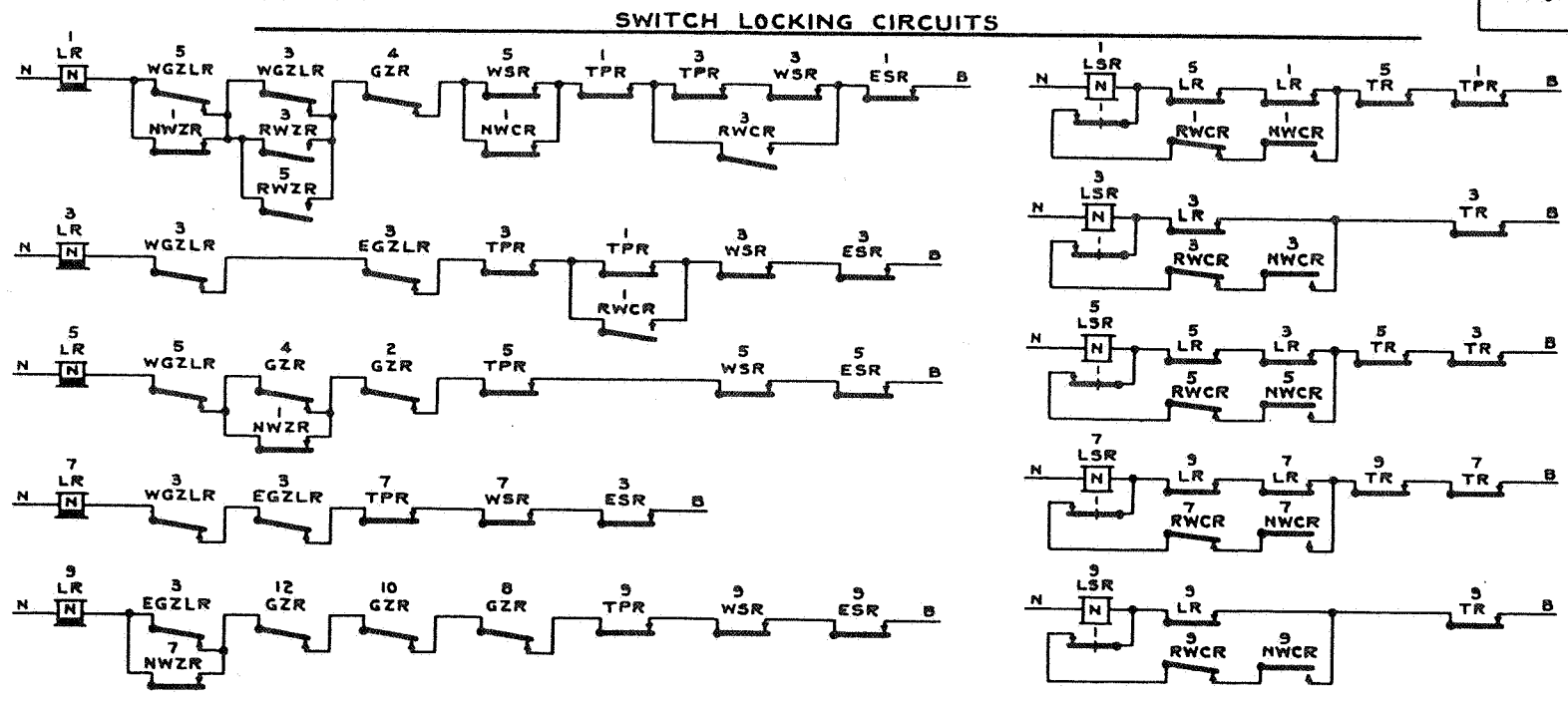
PRELIMINARY SWITCH LOCKING CIRCUITS



NOTE:
COASR RELAYS ARE NOT REQUIRED IF RESTRICTING SIGNALS ARE CONTROLLED THROUGH FIRST TRACK CIRCUITS.



SWITCH LOCKING CIRCUITS

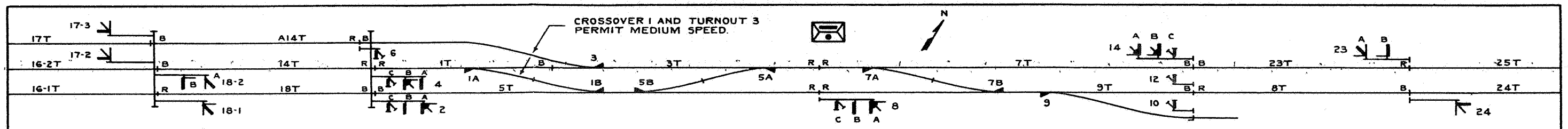


TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

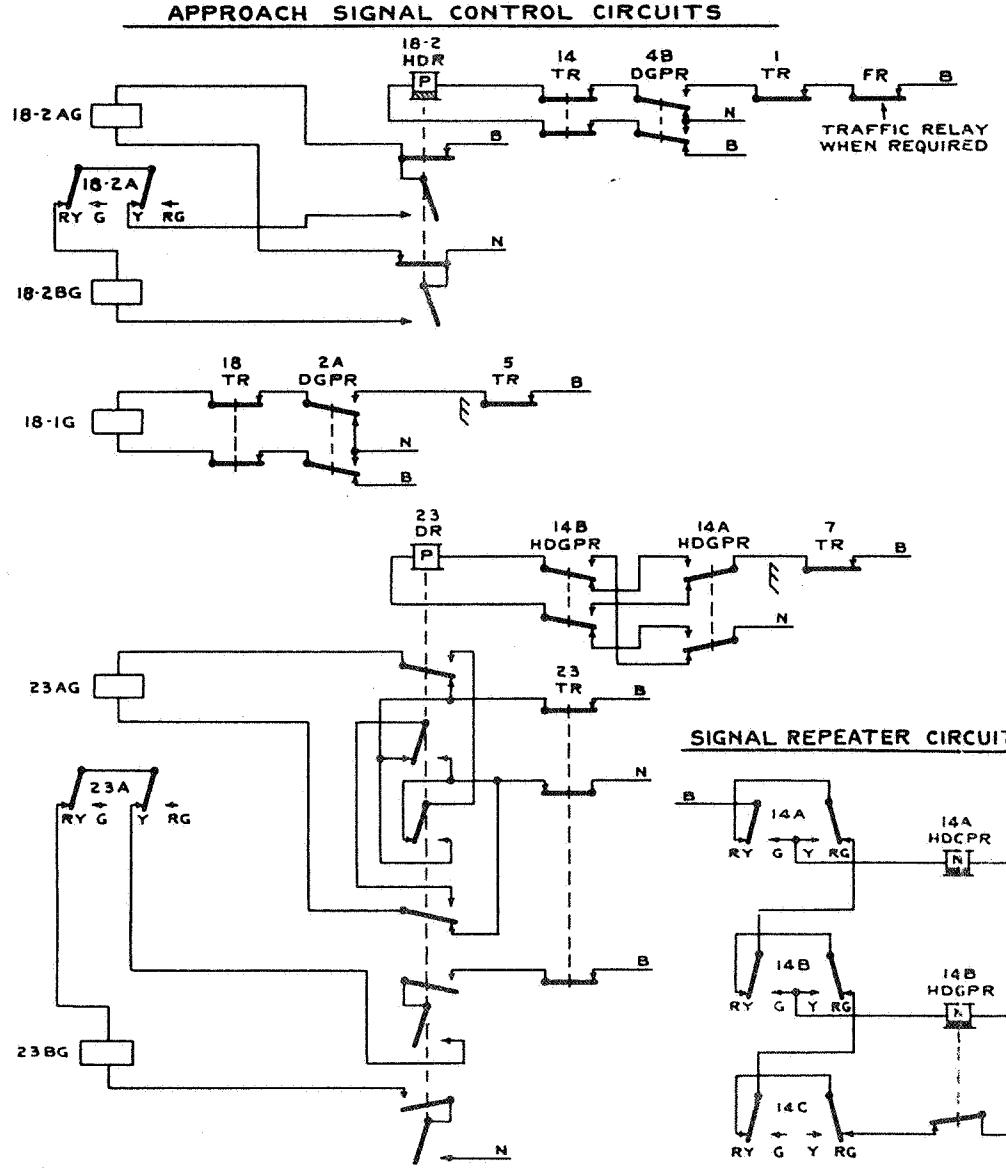
LOCAL CONTROL - ROUTE TYPE - SIGNAL LEVERS AND MOVABLE POINT ROUTE INDICATORS IN DIAGRAM

SEPT. 1953

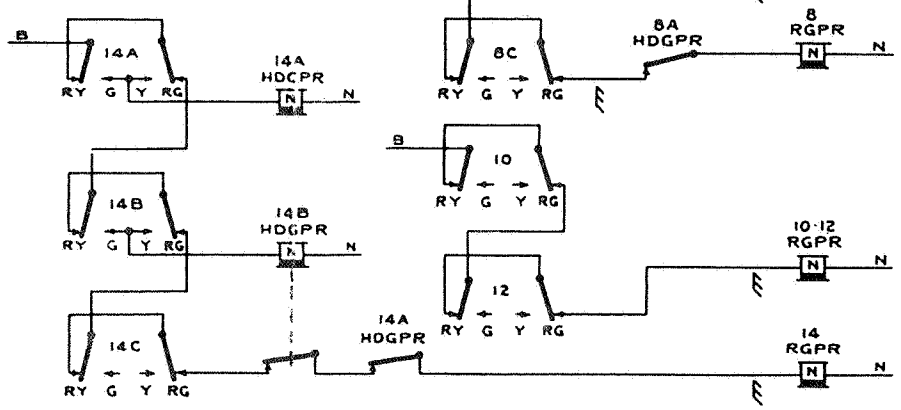
AAR SIG. SEC. 8071A



APPROACH SIGNAL CONTROL CIRCUITS

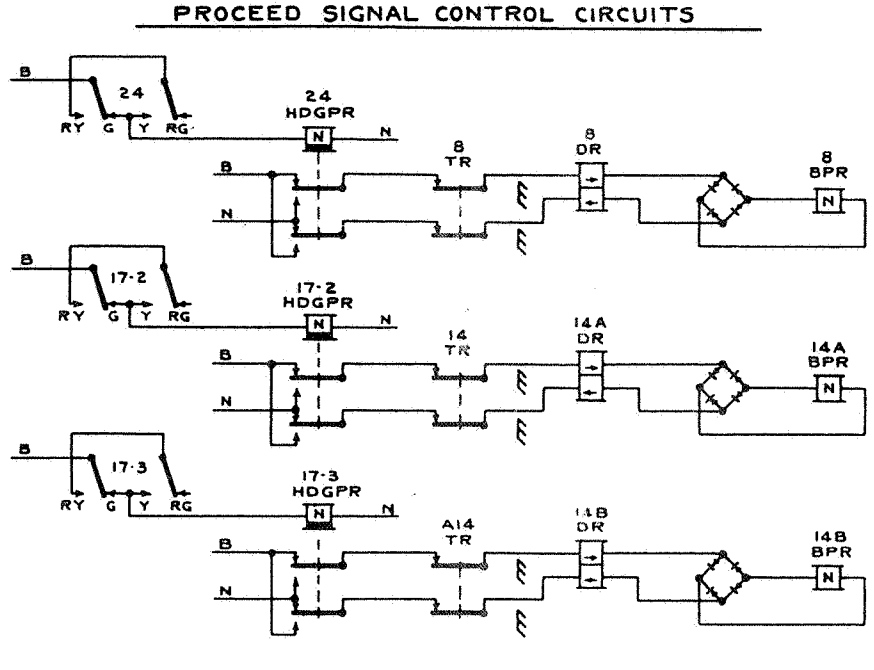


SIGNAL REPEATER CIRCUITS

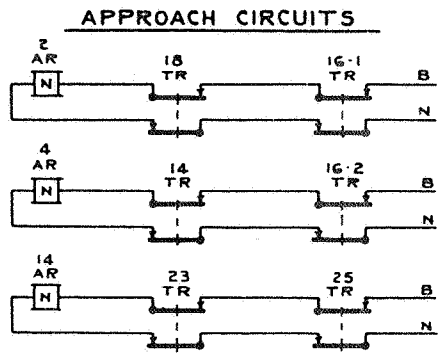


SIGNAL REPEATER CIRCUITS

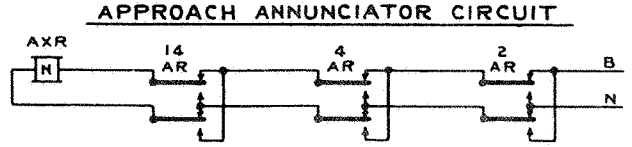
PROCEED SIGNAL CONTROL CIRCUITS



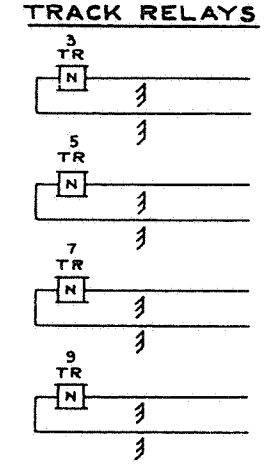
APPROACH CIRCUITS



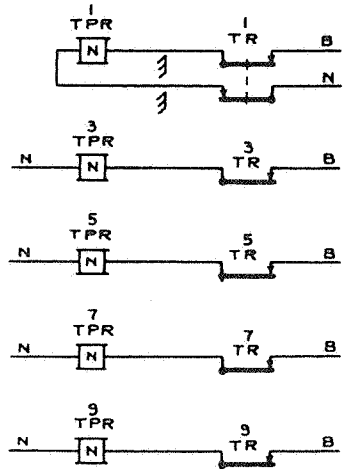
APPROACH ANNUNCIATOR CIRCUIT



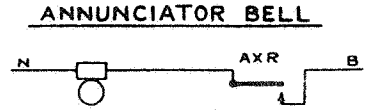
TRACK RELAYS



TRACK REPEATER CIRCUITS



ANNUNCIATOR BELL

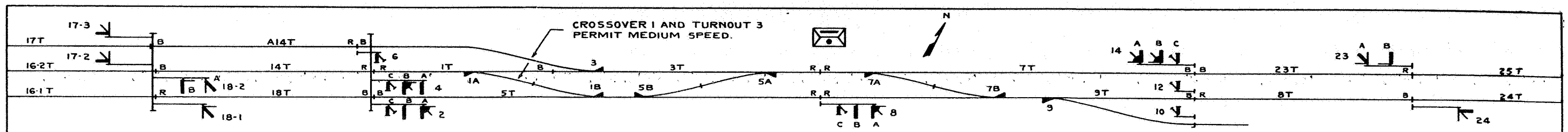


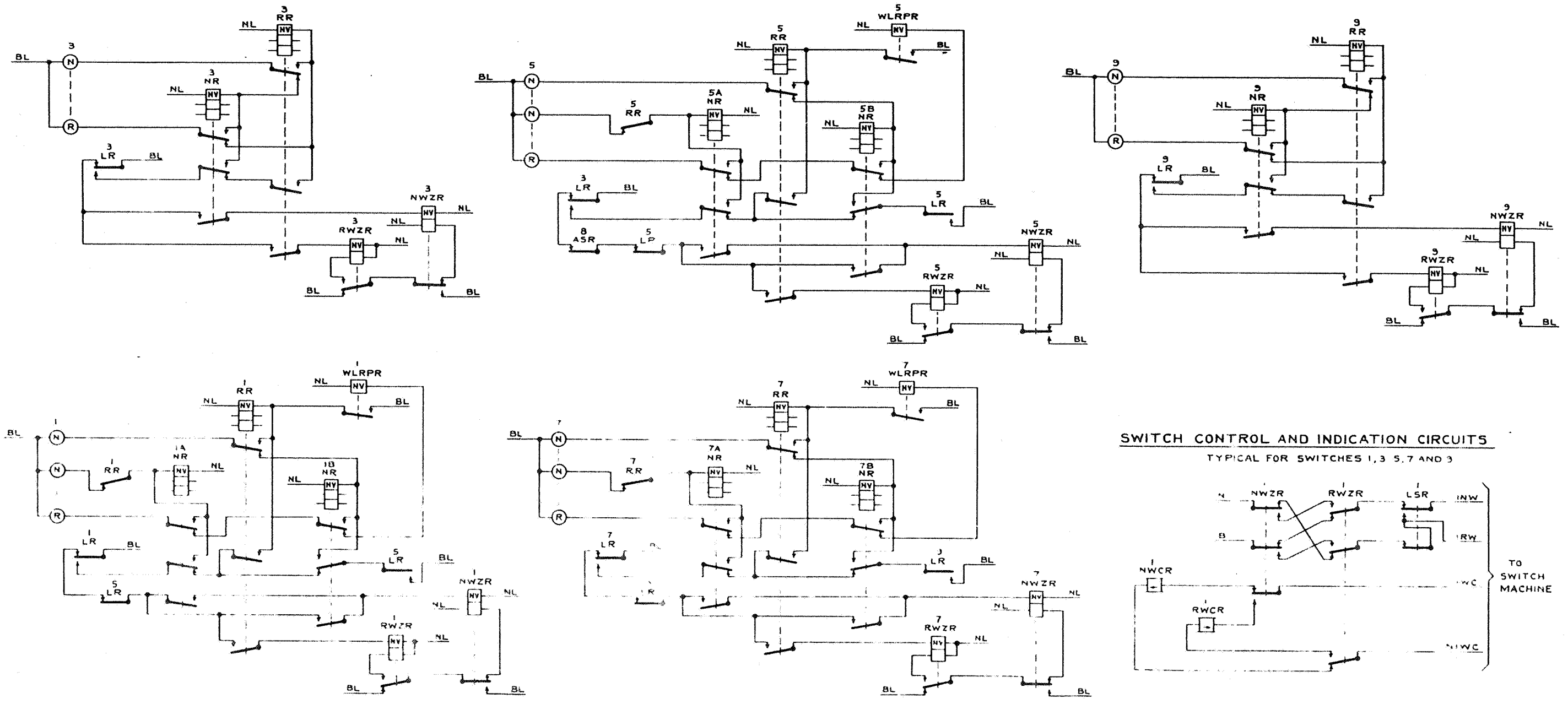
TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

LOCAL CONTROL - ROUTE TYPE - SIGNAL LEVERS AND MOVABLE POINT ROUTE INDICATORS IN DIAGRAM

SEPT. 1953

AAR SIG. SEC. 8071A





SWITCH CONTROL AND INDICATION CIRCUITS

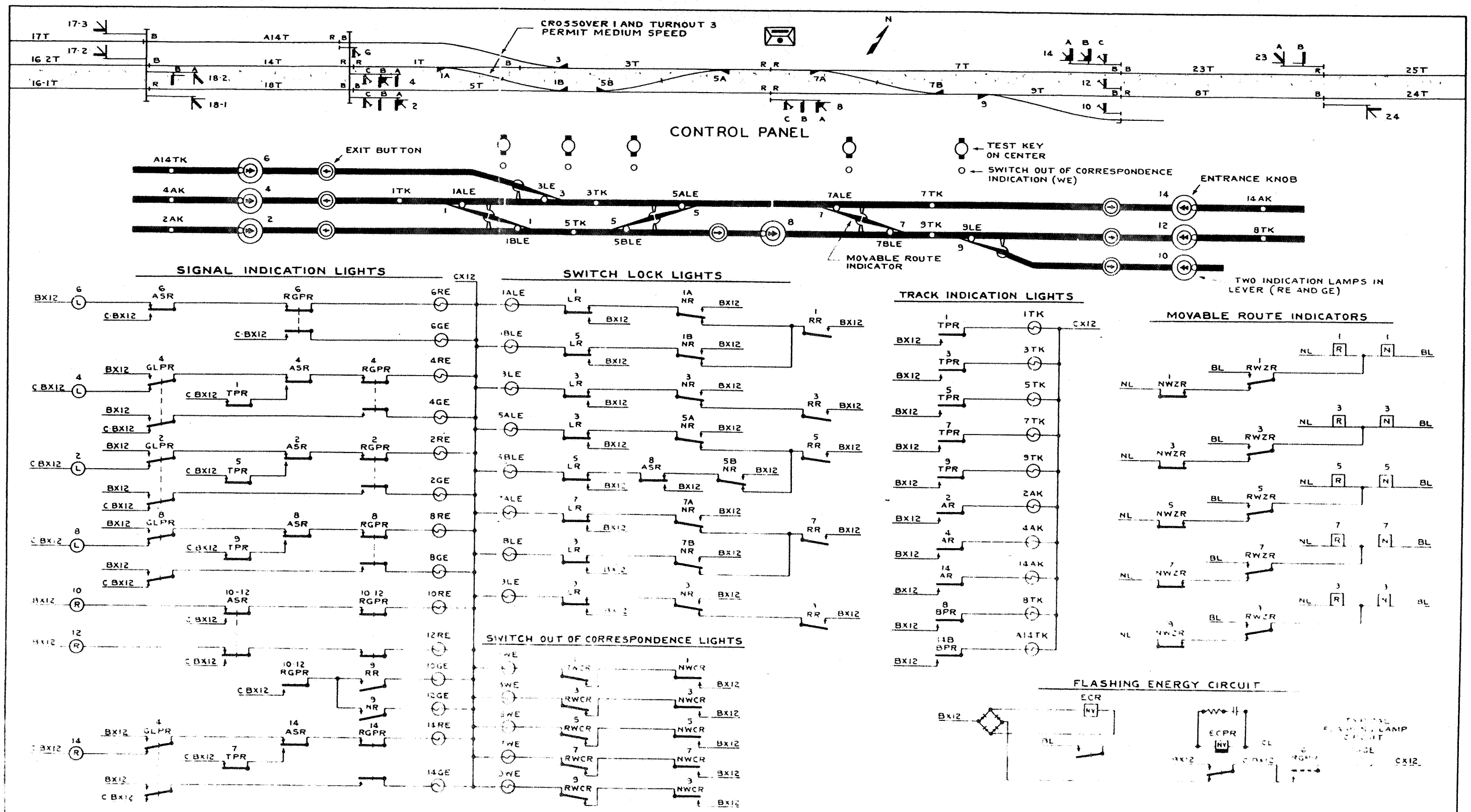
TYPICAL FOR SWITCHES 1, 3 5, 7 AND 9

TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

LOCAL CONTROL - ROUTE TYPE - SIGNAL LEVERS AND MOVABLE POINT ROUTE INDICATORS IN DIAGRAM

AAR SIG. SEC. 8071A

SEPT. 1953



TYPICAL RELAY TYPE INTERLOCKING CIRCUITS

LOCAL CONTROL - ROUTE TYPE - SIGNAL LEVERS AND MOVABLE POINT ROUTE INDICATORS IN DIAGRAM

AAR SIG. SEC. 8071A

SEPT 1953

SHEET 7 OF 7 SHEETS