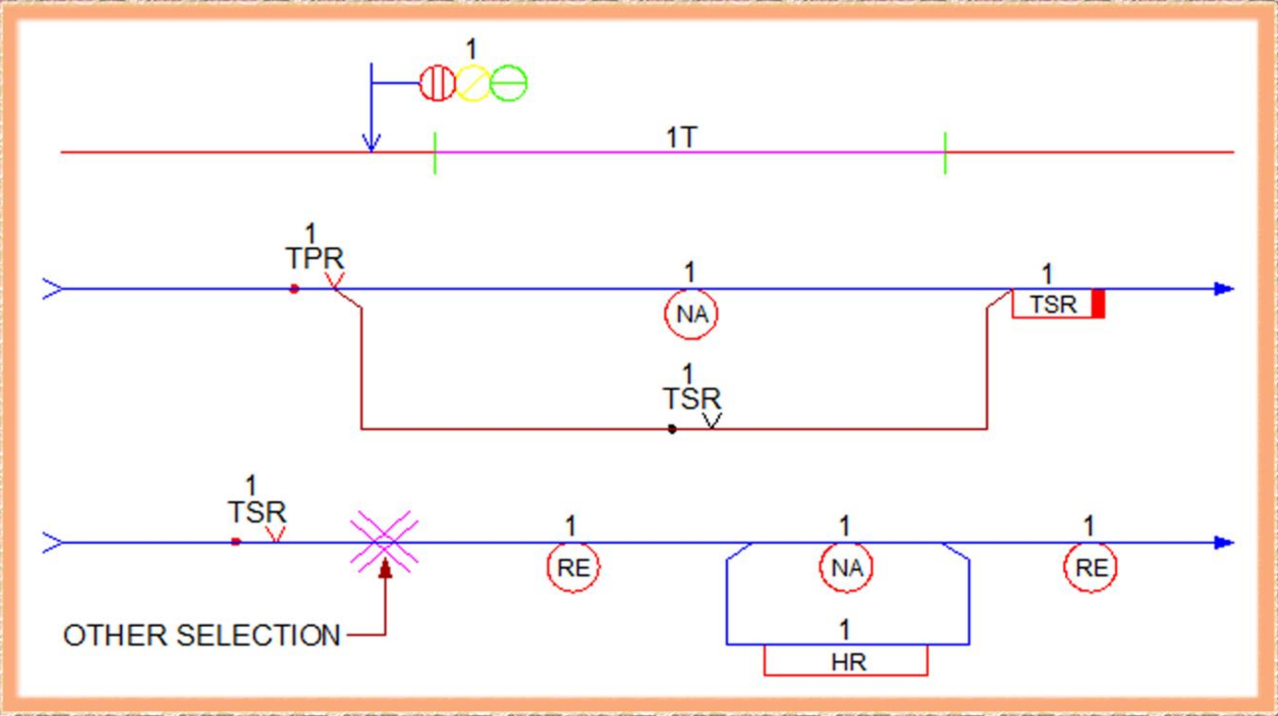
इरिसेट IRISET

S 11

SELECTION CIRCUITS AND CONTROL TABLES



Indian Railways Institute of
Signal Engineering and Telecommunications
SECUNDERABAD - 500 017

S11

SELECTION CIRCUITS AND CONTROL TABLES

VISION:	TO MAKE IRISET AN INSTITUTE OF INTERNATIONAL REPUTE, SETTING ITS OWN STANDARDS AND BENCHMARKS
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INDIAN RAILWAYS INSTITUTE OF SIGNAL ENGINEERING & TELECOMMUNICATIONS

SECUNDERABAD - 500 017

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S-11

SELECTION CIRCUITS AND CONTROL TABLES

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CHAPTER 1: SIGNAL CONTROL CIRCUITS

1.1 INTRODUCTION

Selection circuits consist of

(i) Indication Circuits (for Tracks, Points and Signals etc.)

(ii) Signal Control Circuits

(iii) Route Indicator Circuits

(iv) Track Locking Circuits

(v) Indication Locking Circuits (for points and signals)

(vi) Approach Locking Circuits

(vii) Sectional Route Release Circuits.

Selection circuits can be broadly divided into two types, namely, vital circuits, such as, locking, operating, detecting circuits and signal control circuits and non vital circuits, such as, those used for repeat indications, bells and buzzers, etc.

In vital circuits, closed circuit principle should be followed i.e. the operative part (Relay/ Lever lock/signal/point) should be energised through front contacts of relays required to be proved in that circuit.

In non vital circuits this is not rigidly followed. We can use both front and back contacts as per requirement. To ensure safety, it is necessary to design these circuits with proper attention and with due consideration for simplicity, consistency and economy.

1.2 Signal Control Circuits

Signal Control Circuits are designed in accordance with the essentials of interlocking, Signal Engineering Manual and General Rules. Following are the conditions to be fulfilled electrically before clearing a signal i.e., before energizing Signal Controlling Relay (HR). Each signal will be provided with one HR (signal control relay).

(a) All points concerned are correctly set, and locked wherever required, as detailed below:

(i) For Home signal

- Points in Route, in Isolation & in overlap.

(ii) For Starter signals

- Points in Route, in Isolation.

(iii) For Shunt signals

- Points in Route (Isolation not compulsory).

(iv) For calling-on signal

- Points in Route & in Isolation.

(b) Wherever points are operated by point machine it shall be ensured that the crank handle concerned used for manual operation of point are kept locked. To ensure this, ‘Crank Handle’ is kept locked inside an electrical key transmitter (EKT) or in special relay box (KLCR) meant for it. When crank handle is in and locked a relay CHLR/KLCR picks up. Crank handle interlocking arrangement is dealt in para 4.1 of this notes.

(c) All track circuits concerned are clear as detailed below:

(i) For Home signal

- Track circuits in the route up to next signal /dead end and Overlap tracks.

(ii) For Starter signal

- Tracks upto next signal in advance in the route.

(iii) For Shunt signals

- Normally upto next signal (may be main/shunt signal whichever comes first) in the route. In big yards, where intermediate shunts are there, the line is clear upto next intermediate shunt signal in advance.

(iv) For Calling-on signal:

- To enable clearance of calling on signal in case of failure of main signal above it due to failure of one or more track circuits in route/berthing/overlap. No track circuit in advance need to be proved. However it shall be possible to clear Calling-on signal only when the train has come to a stop at the foot of the signal. This is achieved by a pre- determined time delay after train occupies the calling on track circuit provided in rear of the signal. In case of automatic signalling system, where there is a possibility of the second train coming on calling-on track (passing the automatic signal in rear at ON) the first track ahead of signal and the TSR concerned shall be proved in the calling on signal circuit to put back calling on signal to ON, the moment the first train passes calling on signal.

(v) Advance starter: One track circuit in advance of the signal.

(d) In case of stations/yards where no track circuit or axle counter is provided on berthing tracks, a line verification box can be used to verify the clearance of the tracks.

(e) In case of signals controlled by more than one agency, the slot concerned has been received from other agencies. Separate slots shall be received for calling on signals also, since the overlap conditions for main signal and calling on signal are different. (No track circuits are proved in calling on signal slot circuit)

(f) In case of Goods yards where points are locally operated (either from a lever frame or from a ground frame) the points are correctly set by the yard master and a control is given to enable reception or dispatch as the case may be.

(g) Conflicting signals are at ON/not taken off :-Though locking of conflicting signals can be achieved by mechanical locking between levers concerned, the controlling relays of conflicting signals are also proved in de-energised condition for further safety.(HR/HHR/DR↓)

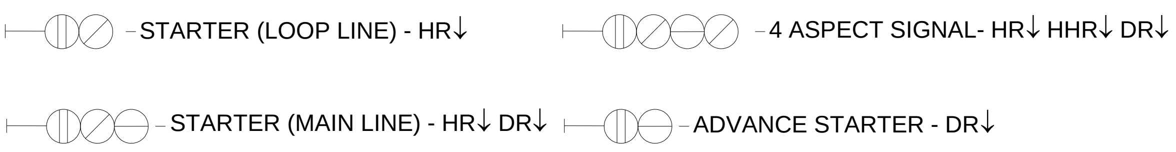


Fig. 1.1

The conflicting signals can be of different types:

(i) Directly opposite

Opposing signals on same line of the track

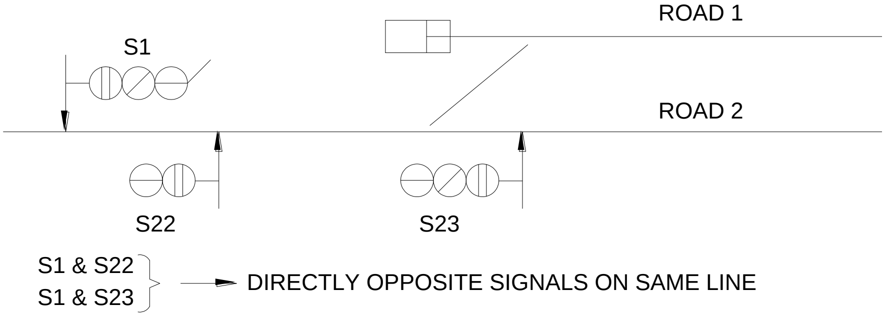


Fig. 1.2

(ii) Indirectly opposite (infringing in the Overlap zone)

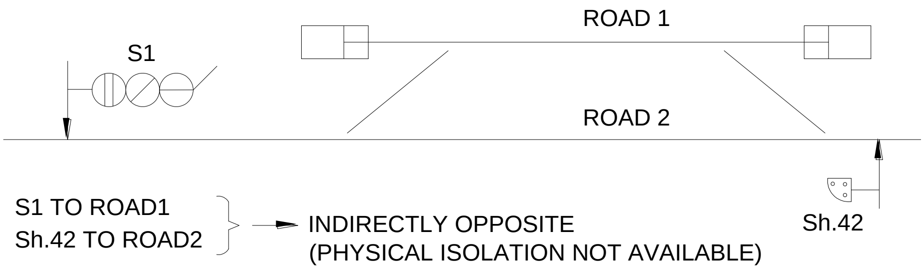


Fig.1.3

(iii) Conflicting in the same direction

Either on the same post (home and Calling on) or on a separate post (home and Shunt)

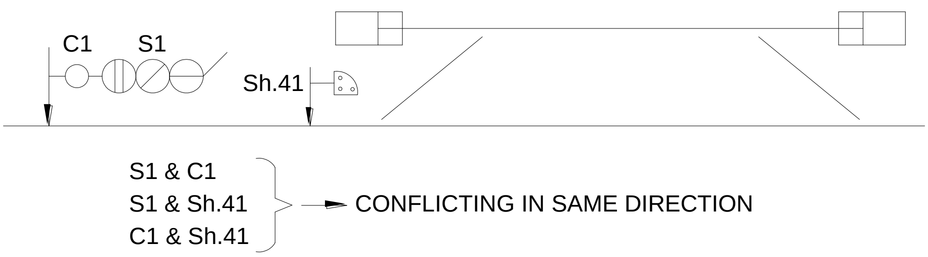


Fig.1.4

(h) One Signal One Movement: - Signal re clearing automatically after a train completely passed the route which is prevented by a relay LS or SR or TSR and the feature is explained in para 1.3 of this notes.

(i) Cancellation of route not in progress: - Wherever facility is provided to cancel a signalled move by normalising the signal lever after a specified time delay, it shall be proved before clearing a signal that the timer circuit concerned NJPR/JR is normal.(for further details refer Para 2.3.2.& 2.4.2)

(j) Various types of timers are used and accordingly the circuits adopted differ for each type of circuit.

(k) The relays used to prove the sequential occupation & clearance of track circuits & release of the route after passage of train namely UYRs concerned are proved in de-energized condition to ensure that, these are normalised after every movement, and in case of any malfunctioning of the relays, signal clearance for the subsequent train is prevented.

(l) In case of signals provided with junction type route indicators it shall be ensured that

(i) The route indicator is not lit for straight line (M/L). This is proved by UECR and the controlling relays of route indicators (UR's/UCR's/UHR's) are in de-energised condition.

(ii) The route indicator is lit with adequate (minimum 3) number of bulbs for the loop line concerned. This is achieved by proving the controlling relay concerned and UECR are in the energised condition.

(m) In case of Last Stop Signal (LSS), the line clear condition shall be proved to ensure that the proper line clear has been obtained in addition to SM's control, if any.

(n) It shall be ensured that interlocked LC gate, if any, is closed and locked against the road traffic. This is achieved by proving LXPR/LCPR in energised condition.

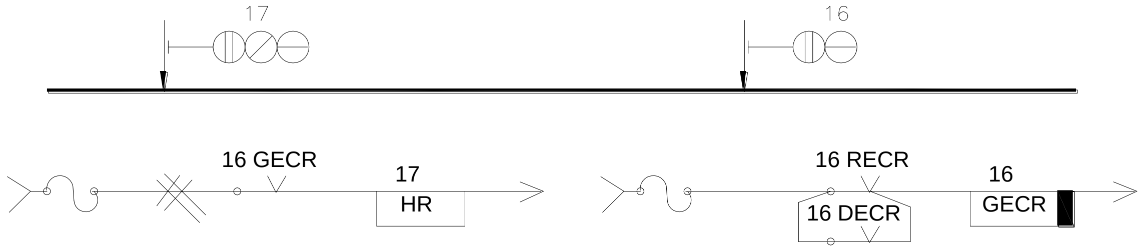
(o) In case of Sidings of locally worked points, if any, in route or overlap (for running signals like Home, Calling-on and Starter signals) is set in normal condition. This is achieved by proving Siding NPR in energised condition.(Para 4.2)

(p) Unless signal lever/switch concerned is reversed 'signal controlling relay (HR/HHR/DR/UHR'S) should not be energised. Circuit controller 'R' Contact of the signal lever concerned is proved on both +ve side and on -ve side of the relay so that a single fault cannot cause any unsafe condition. (Double cutting arrangement)

(q) Cross protection arrangement: - In addition to the double cutting arrangement explained above, the signal control relay concerned or route indicator control relay is provided with a bye pass by 'N' contact of the signal lever. More details about cross-protection and double cutting are given in para1.8.

(r) Red Lamp Protection: - It is mandatory to prove that when a signal is cleared, the signal immediately in advance is not blank. To ensure this, the energised contact of ECR's of signal immediately in advance is proved in Signal Controlling Relay of signal immediately in rear. HR of signal in rear is made slow to release, to avoid de-energising when signal in advance changes its aspects.

Another method is to energise a relay (GECR) when any one of the aspects of signal ahead is lit and this relay contact is used in HR circuit of signal in rear. In this case HR relay need not be made slow to release.



In case of Electro-mechanical signalling with Relay interlocking arrangement in addition to provision of lever locks on signal, points & lock levers, etc., the following additional conditions also to be ensured which are dealt in detail in IRISET Notes S12.

(a) Points concerned locked electrically	- points lock relay concerned- WLRs↓ (for motor operated points only)
(b) Route set correctly	- Route checking Relay - UCR↑
(c) Route locked	- ASR Concerned↓
(d) Overlap locked	- OVSR↓
(e) Sub routes locked	- directional relay concerned, TRSR/TLSRs↓
(f) Conflicting moves not initiated over the subroutes	- opposite directional relays TLSR/TRSRs↑
(g) Conflicting routes not initiated	- Conflicting ASRs↑
(h) Route initiated	- RR↑

According to the different types of Signals, the conditions concerned discussed above are proved before clearing a signal. Let us consider the following layout and prepare the HR circuit for a signal leading to one route only Fig: 1.6 and signal leading to more than one route Fig: 1.7.

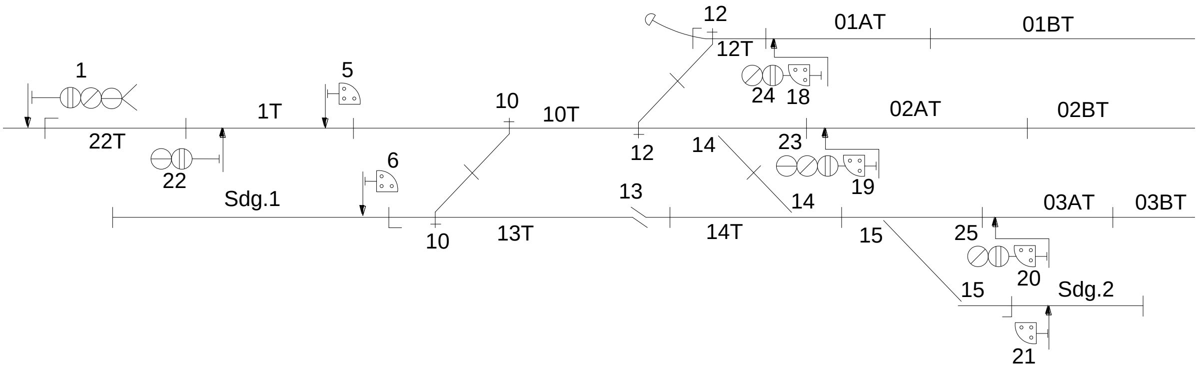
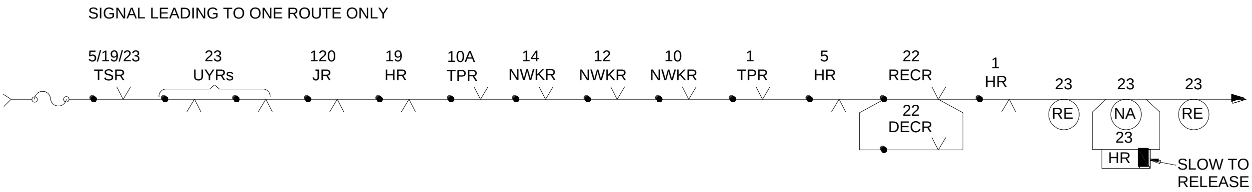
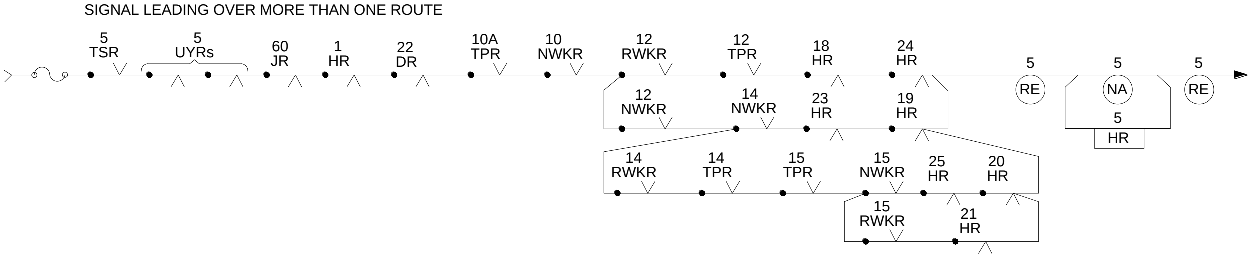


Fig.1.5



(w.r.t yard in Fig. 1.5)

Fig.1.6



(w.r.t yard in Fig. 1.5)

Fig: 1.7

Wherever Rod operated points locked by separate facing point lock lever on either end, it may not be possible to get point detection as lock negotiated in trailing direction is locked in normal position. In these cases respective point lever 'NA' contact shall be proved instead of NWKR.

1.3 One Signal one movement (Track Stick relay (TSR)/Stick Relay (SR)/ Lock Stick Relay (LSR))

In Signal Controlling Circuit it is seen that once the train clears the route, the signal can assume OFF aspect on its own, if the signal lever continues to be in 'Reverse' position. This feature is undesirable. To ensure One Signal One Movement, a Stick Relay is introduced. The stick relay (LS/SR/TSR) is controlled by the first track circuit immediately in advance of the signal and the normal position of the signal levers concerned. Once energised through normal position of the signal levers concerned, the stick relay holds through its own contact, bye-passing the signal lever contacts. The TSR drops after the train passes the signal and requires normalization of all signal levers concerned, to pick up again. TSR is made slow to release to prevent it from dropping in the event of bobbing of controlling track circuit after the signal is cleared. If the track circuit repeater relay (TPR) is QSPA1 (which is both slow to pickup and slow to release), then TSR need not be made slow to release.

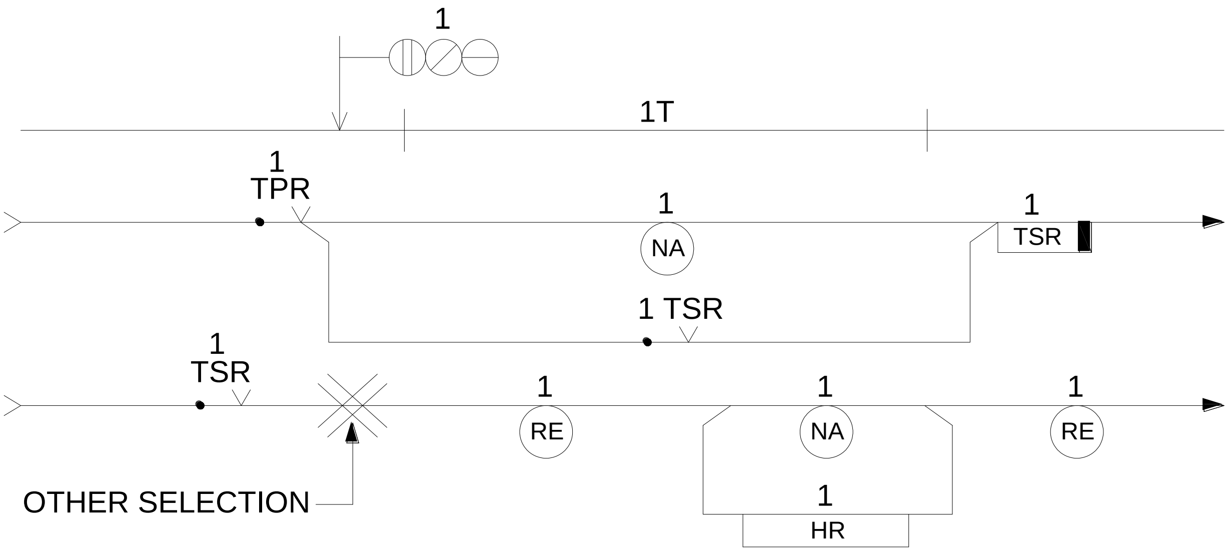


Fig. 1.8 TSR Circuit

Common TSR for more than one Signal

Instead of having individual TSR for each signal in the yard, wherever possible a common TSR may be provided to reduce number of relays required in an installation.

Common TSR can be provided for

(a) The signals which are of conflicting in nature and

(b) Having common controlling track circuit.

Ex: (i) Home and opposite Advance Starter on Single line Section;

(ii) A starter signal and shunt below it;

(iii) Starter signals and shunt back.

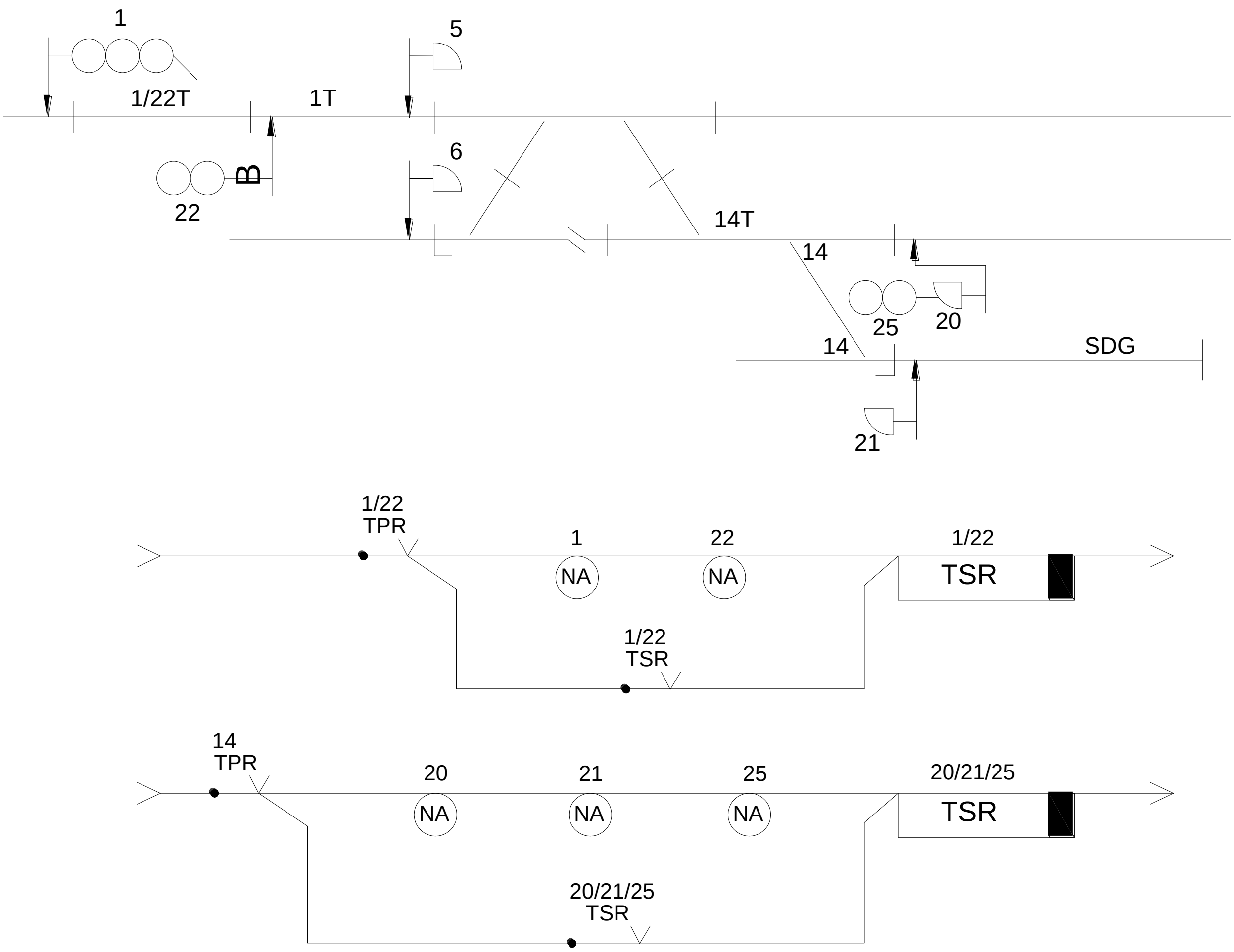


Fig. 1.9 Common TSR Circuit

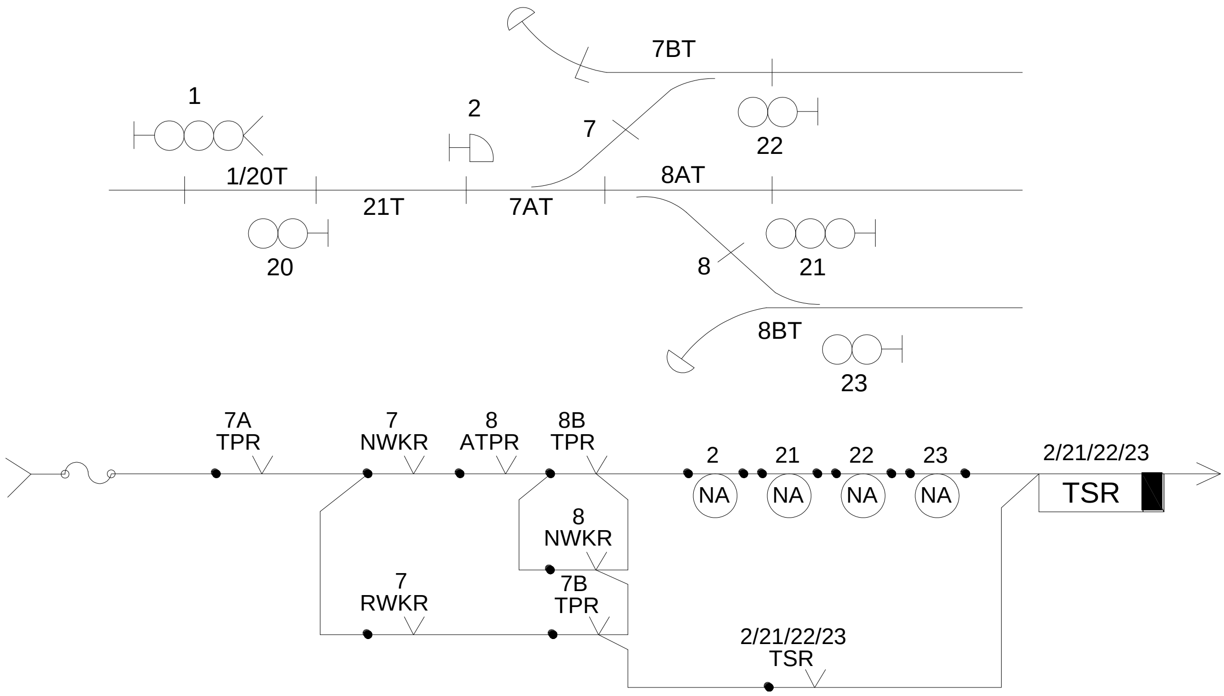


Fig. 1.10 Common TSR Circuit

1.4 Inter Cabin Slotting

When a signal is controlled by more than one agency, it cannot be taken OFF by the cabin man/Operator unless consent from other agencies are obtained. The principles of intercabin slot circuit are explained in IRISET Notes S-20 and the requirements are as under:-

Each person giving slot shall ensure:-

(a) Correctness of points, clearance of track circuit, crank handle interlocking (in case of motor operated points), locking of conflicting signals, closing and locking of interlocked level crossing gates, if any in his zone.

(b) With the given slot only one train can be dealt. (One slot-One train feature)

(c) Separate slots are provided for main & calling-on signal as conditions to be satisfied are different. Calling-on slot is mainly to lock the conflicting signals from other side.

For example in the layout shown in figure 1.11 to take OFF home signal No.1, Cabin A requires permission from SM and cabin B, that conditions are favourable to receive the trains with the signal no.1 to the nominated road.

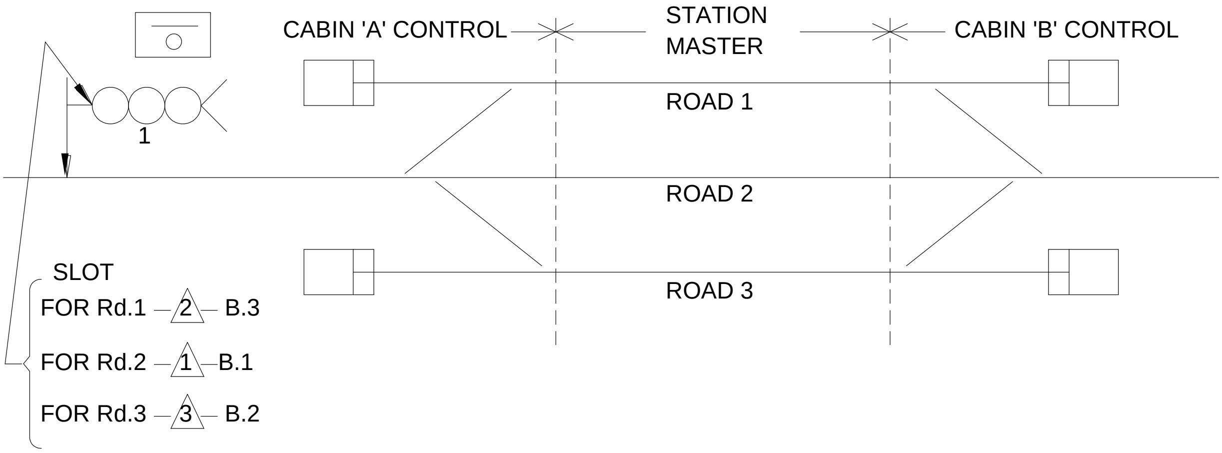


Fig. 1.11

The relay energised in cabin A is called as slot relay (YR) and is controlled by respective lever of cabin B and SM's slide.

It may also be noted that, for signals leading to more than one route, separate slots must be obtained for each route.

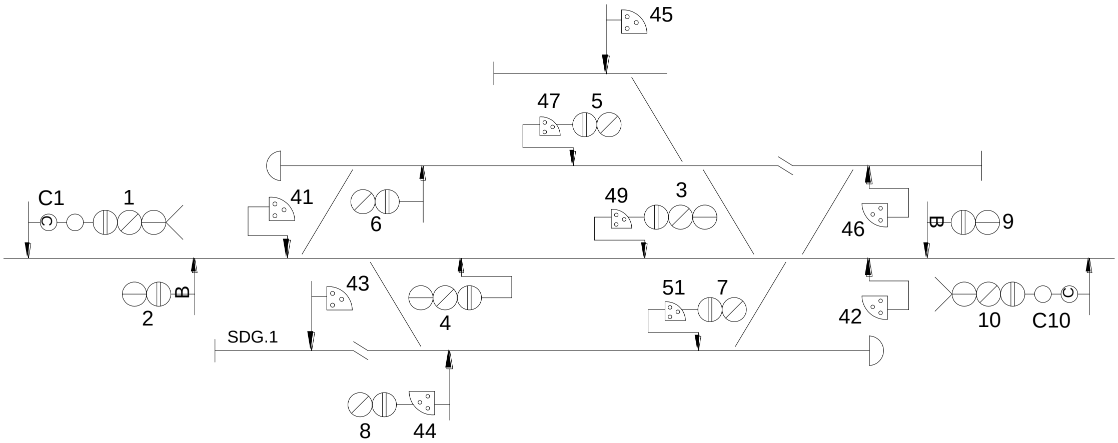
Slot is also required if block instrument is controlled by Station Master and operation of signalling functions controlled by cabinman/leverman. From cabin the signal controlling entry into the block section (last stop signal) shall be taken OFF only after receiving the respective slot from station master.

Note: *Normally shunt does not require slots.*

1.5 Shunt Signals

Shunt signals are subsidiary signals provided to facilitate shunting movements in the yard. These signals are provided either on a separate post or below a stop signal except First Stop Signal of the station. When a shunt signal is provided on a separate post it displays ON and OFF aspects and when provided below a stop signal it displays OFF aspect only.

In addition to the conditions discussed in para 1.2 with necessary circuits, when points and signals in the yard are controlled by a centralised agency, the following additional points to be observed in locking the conflicting signals in the yard. These are discussed below Fig. 1.12.



NOTE:- SHUNT 44 LEADS TO SIDING I ONLY AND ALL OTHER SHUNTS LEAD TO ALL LINES AHEAD

Fig. 1.12

(i) Shunt locks any signal above it (on the same post) if it is leading on the same route/routes.

(a) 5 locks 47
(b) 3 locks 49
(c) 7 locks 51

Note: *8 locks 44 become redundant and do not require direct locking since it is achieved through points.*

(ii) Shunts being subsidiary signals, locks respective main signals on the same line in same or opposite direction.

(a) 1 locks 41
(b) C1 locks 41
(c) 2 locks41
(d) 41 to Road 1 locks 5
(e) 41 to Road 2 locks 3
(f) 41to Road 3 locks 7

(iii) Shunt does not require overlap points to be proved. Hence any move with main signals in the overlap without physical isolation must be locked.

(a) 41 to Road 2 locks signal 3, 5, 7, 10, C10.

(b) 42 to Road 2 locks signal 4,6,8,1,C1

Note: *Shunt locking another shunt moves in the overlap without physical isolation is not necessary and shunt to another shunt in opposite direction on the same line only to be locked.*

(iv) In smaller yards (way side stations) where only one movement is expected from the same berthing line, starter locks another starter/shunt leading in opposite direction is also provided (Platform Locking). This is necessary to avoid confusion to the Loco Pilot, in deciding the direction of his journey.

(a) 3 locks 4
(b) 5 locks 6
(c) 7 locks 8
(d) 47 locks 6
(e) 49 locks 4
(f) 51 locks 8

However in busy yards the above platform locking may be dispensed with to facilitate simultaneous opposite movements from the same line.

1.6 Route Indicators

In diverging junctions, each route is provided with a signal in case of semaphore signalling. To avoid number of signals with colour light signalling an arrangement is adopted in which only one signal is provided with an indicating apparatus known as “Route Indicator” to work in conjunction with the signal. This Route Indicator indicates the line on which the train is signalled by displaying a row of white lights or by displaying illuminated letters or numbers.

The various types of Route indicators are

(a) Stencil Type Route Indicator

(b) Multi lamp Type Route Indicator

(c) Junction Type Route Indicator

1.6.1 Stencil Type Route Indicators

This indicator consists of a short metal case and divided into as many number of compartments as there are routes. Each compartment is provided with a stencil with letter/figure as required fixed behind a ground glass. Two lamps are provided in the compartment connected in parallel for illuminating the stencils so that fusing of one lamp may not cause a failure of route indicator. The visibility of this indicator is very poor as such they are used on signals where the trains stop and start, generally starters. The maximum number of routes which can be indicated by using Stencil type route indicator is four (If more than 4 routes are provided, it creates confusion /hardship to Loco Pilot). All lines ahead are indicated individually including main line, either by an alphabet (M = Mainline; B = Branch Line; 0 = Goods or S = Secunderabad; D = Delhi) or by the number.

1.6.2 Multi Lamp Route Indicators

As the name implies, this indicator consists of number of lamps in a case arranged in different rows and columns. These lamps are illuminated in such a manner that they form a numeric or an Alphabet. There are two types of multi lamp route indicators, one consisting of 35 lamps and the other with 49 lamps. In the first type each row is provided with 5 lamps and there are 7 rows. This indicator can exhibit any letters and numerals upto 9. In second type each row is provided with seven lamps and there are 7 rows. This indicator can exhibit any letters and numerals upto 19. When still more number of routes are to be exhibited two indicators of 35 lamps type can be kept side by side numerals up to 99 can be displayed. In short, this route indictor can be used to display any number of routes. The visibility of this indicator is better than the stencil type indicator. This is normally used on Home Signals where more number of routes is to be displayed. The lamps in the route indicators may be connected in parallel or series as required. One or two lamps fusing, when lamps are connected in parallel may give a wrong figure, and fusing of any lamp extinguishes the entire route when connected in series. When lamps are connected in series it becomes very easy for providing lamp proving arrangements, but it requires a special transformer with number of tappings as the number of lamps in each route are different. The circuit also becomes complicated compared to the circuit in which lamps are connected in parallel. All routs including straight line are indicated by a Number or Alphabet. Generally this route indicator is used in junction stations.

SIGNAL CONTROL RELAY CIRCUIT WITH STENCIL TYPE OR MULTI LAMP ROUTE INDICATOR

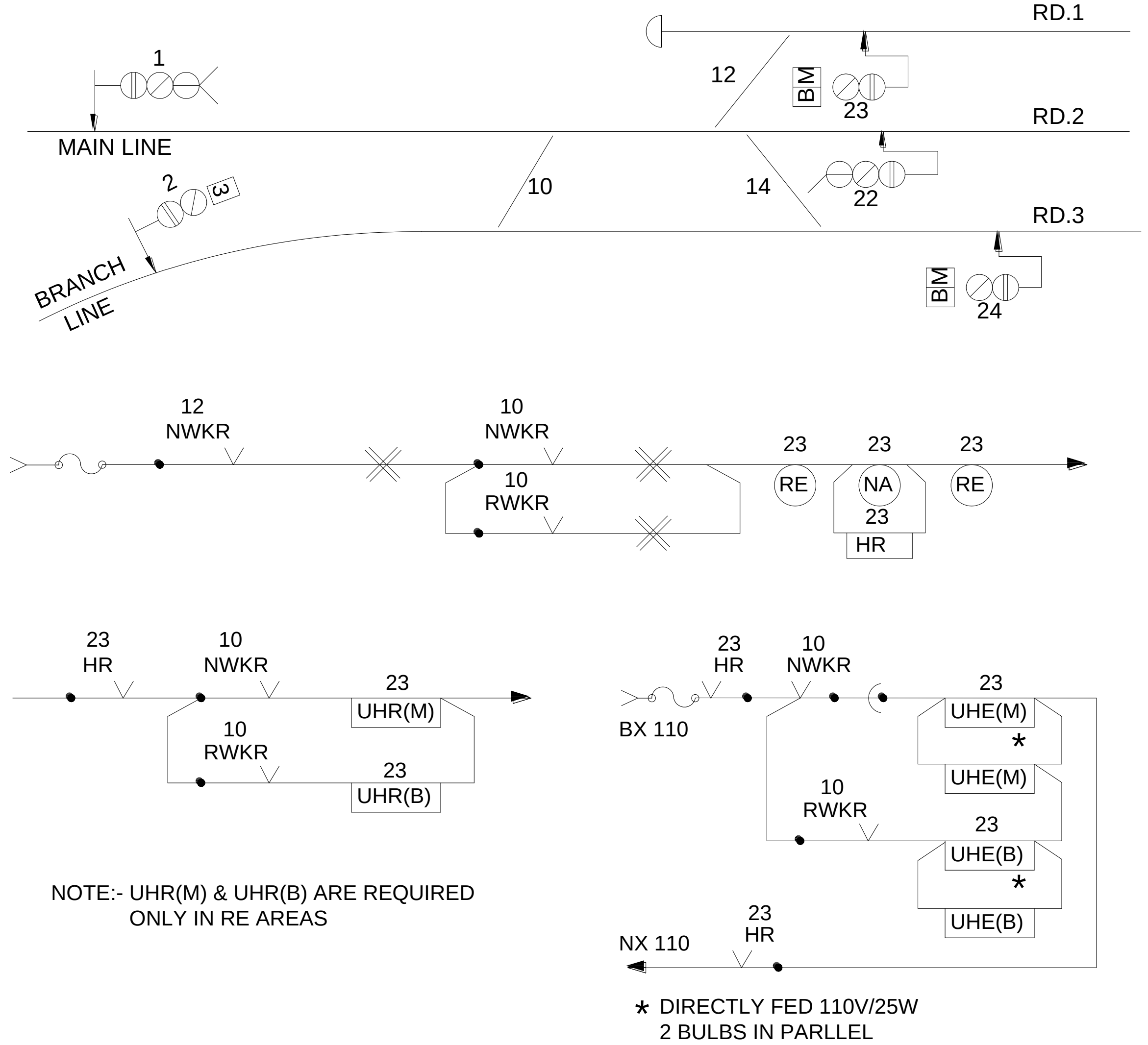


Fig. 1.13

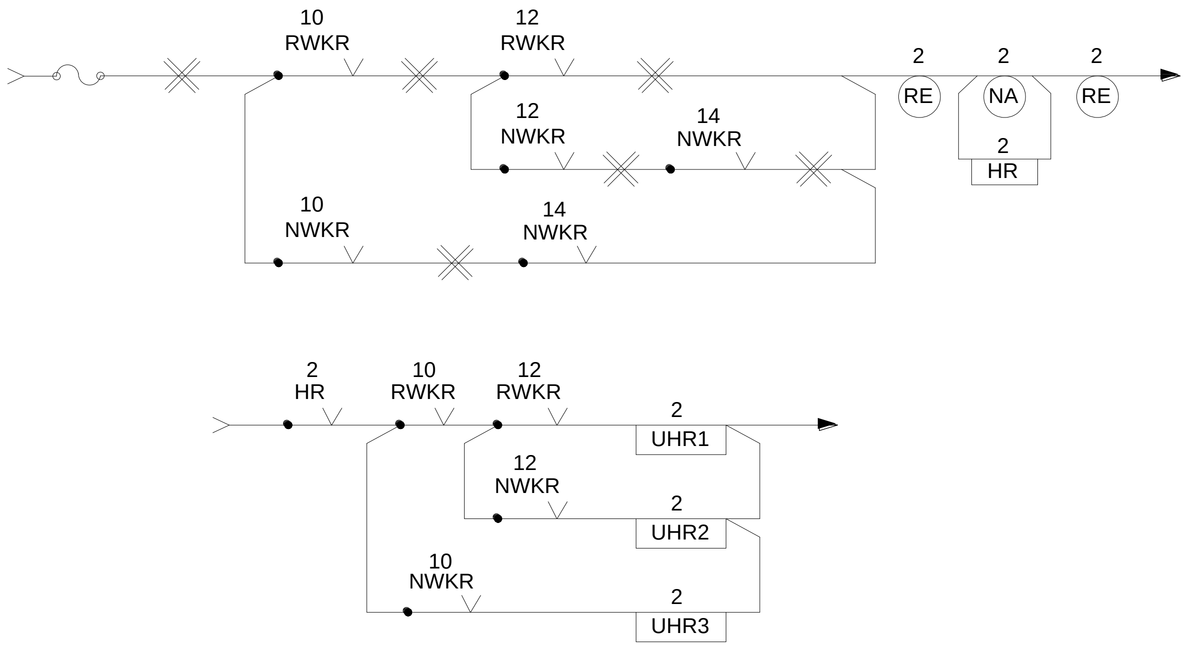


Fig: 1.14

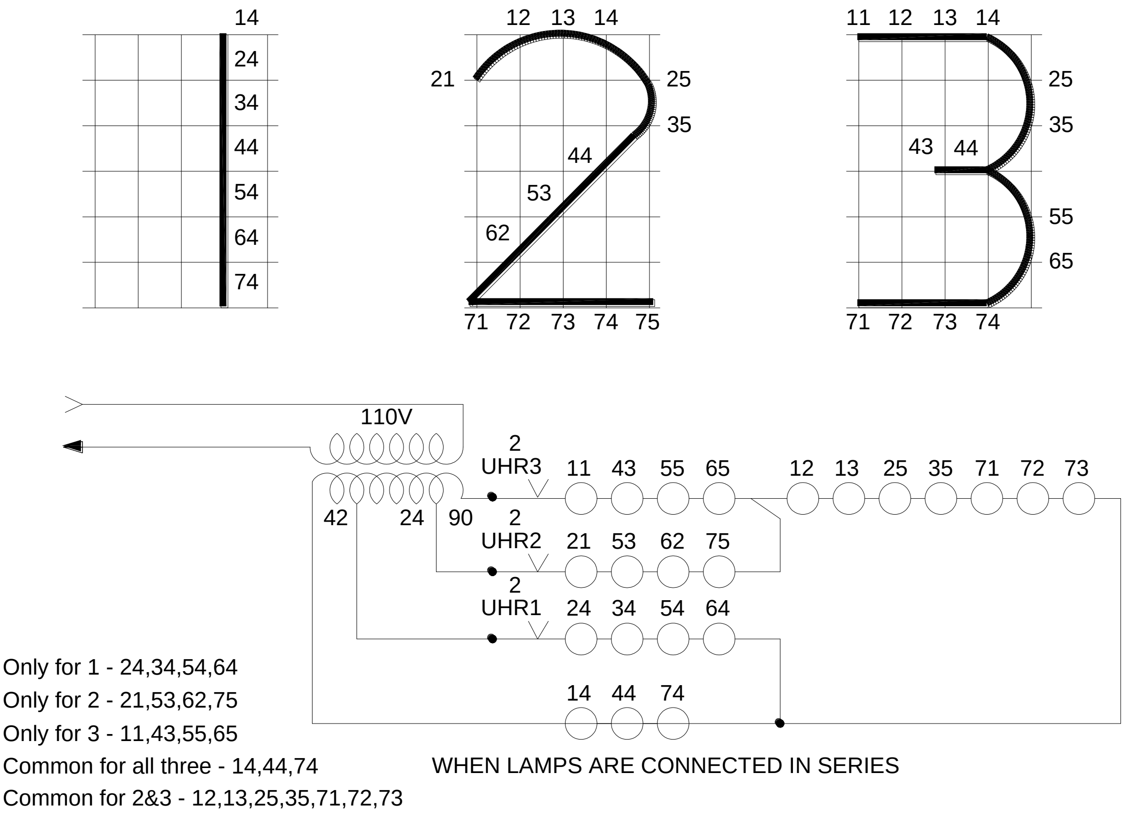
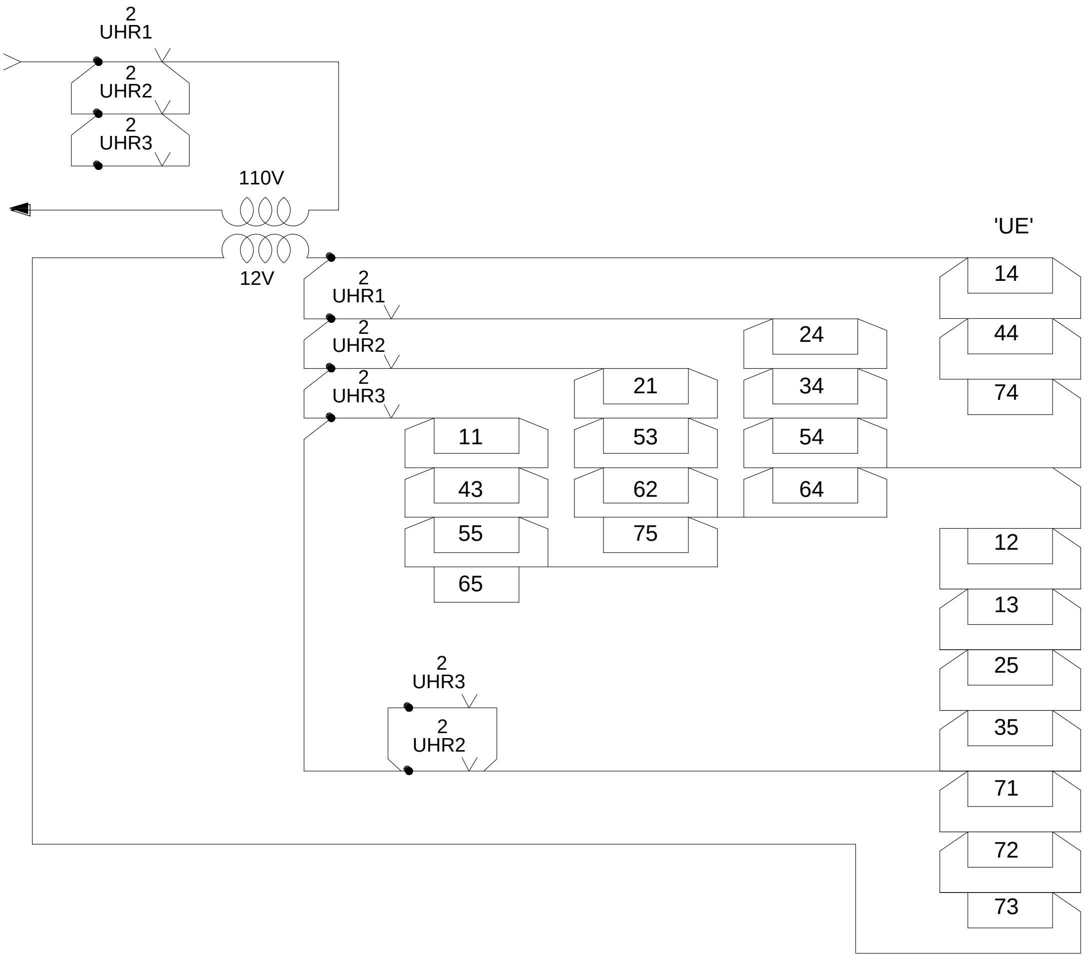


Fig: 1.15



WHEN LAMPS ARE CONNECTED IN PARALLEL

Fig.1.16

1.6.3 Junction Type Route Indicators

These are known as position light type route indicators or direction type route indicators. When a route is set, it is indicated by a row of 5 white lights pointing towards left or right of the signal. This indicator can exhibit a maximum of 3 routes on either side of the main line and no route indication is displayed for the main line. Fusing of one or two lamps may not give wrong indication. Since it has better visibility, it is used in high speed junctions, and at way side stations.

Circuit Arrangements of Junction type Route Indicators

When the signal is displaying yellow without any route, it indicates that the train is being received on the straight route and when it displays yellow with route indicator it indicates that the train is signalled over a turnout and the Loco Pilot has to reduce the speed as necessary. When the signal could be cleared for the turnout without the route lamps burning, it will misguide the Loco Pilot that he is being received on the straight route. As such, he may not reduce the speed as necessary and negotiate the crossover and may cause derailment when he negotiates the turnout with a higher speed. To avoid this unsafe feature, circuit arrangements are so made that the signal cannot assume OFF aspect when the train is signalled over a turnout unless the route indicator lamps are burning. This feature is not considered as essential with other type of route indicators as they exhibit indication for the straight route also.

In junction type route indicators, the above objective is achieved by the provision of a route lamp checking relay (UECR). The route lamp checking relay is energised when the lamp in the indicators lit. For each route other than straight route, a route initiation/control relay (UR/UHR) will be energised. Through this relay, the lamps in the particular route will be lit. The circuit is shown in Fig. 1.17.

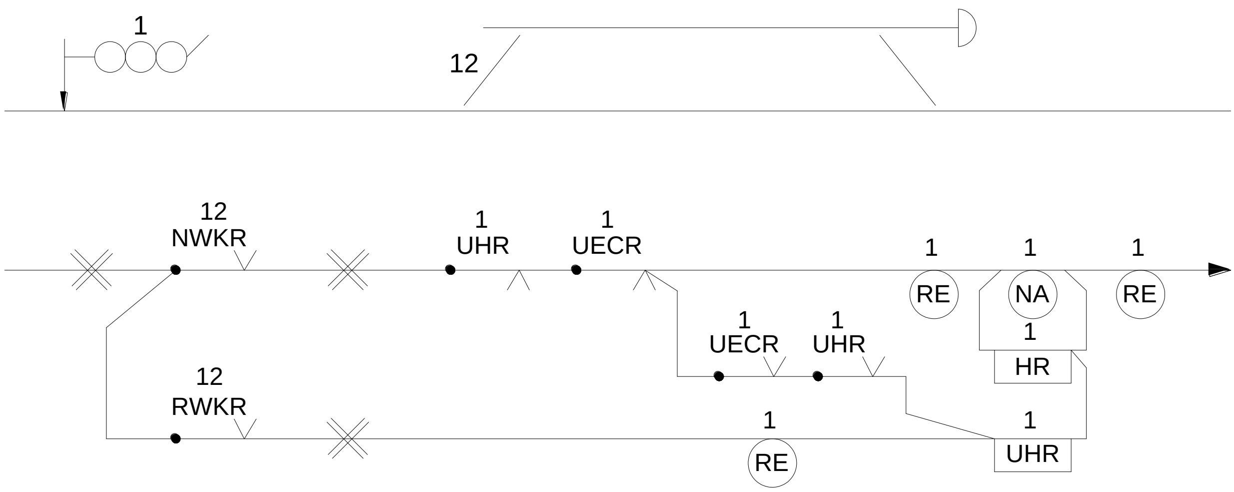
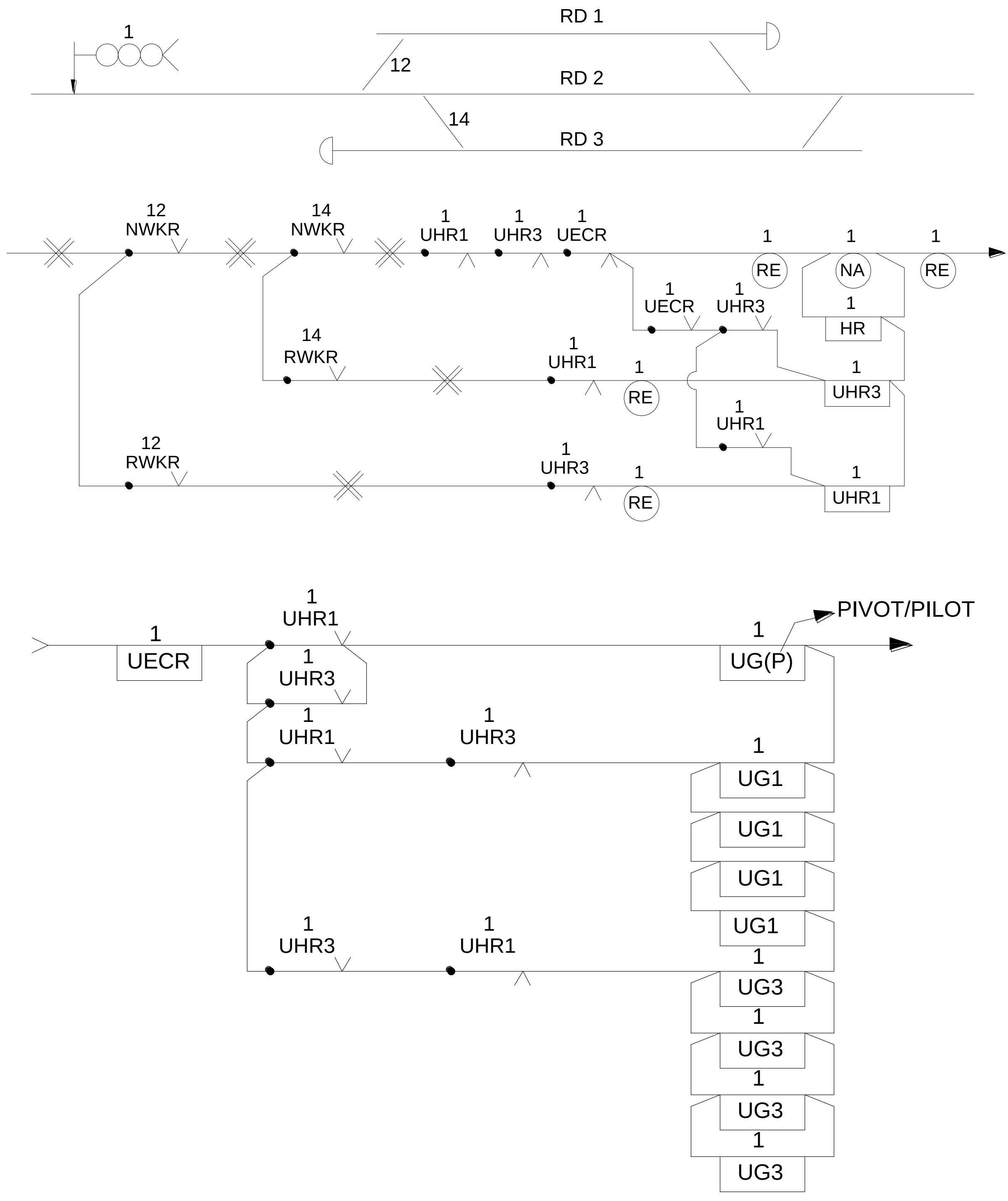


Fig. 1.17

When more than one route are involved as shown in layout Fig. 1.18, repeat indications for different routes are provided by proving respective UHR contact along with the common UECR as shown in Fig. 1.18, When a common UHR and common UECR are employed point selection is to be taken in the route indicator lighting circuits as shown in Fig.1.19, Point lever contacts or point detection relay contacts shall be proved in route indicator circuits.



1
RD 1
12
RD 2
14
RD 3
12 NWKR
14 NWKR
1 UHR1
1 UHR3
1 UECR
1 RE
1 NA
1 RE
1 UECR
1 UHR3
1 HR
14 RWKR
1 UHR1
1 RE
1 UHR3
1 UHR1
12 RWKR
1 UHR3
1 RE
1 UHR1
1 UECR
1 UHR1
1 UHR3
1 UG(P)
PIVOT/PILOT
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1 UHR3
1 UG1
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Fig. 1.18

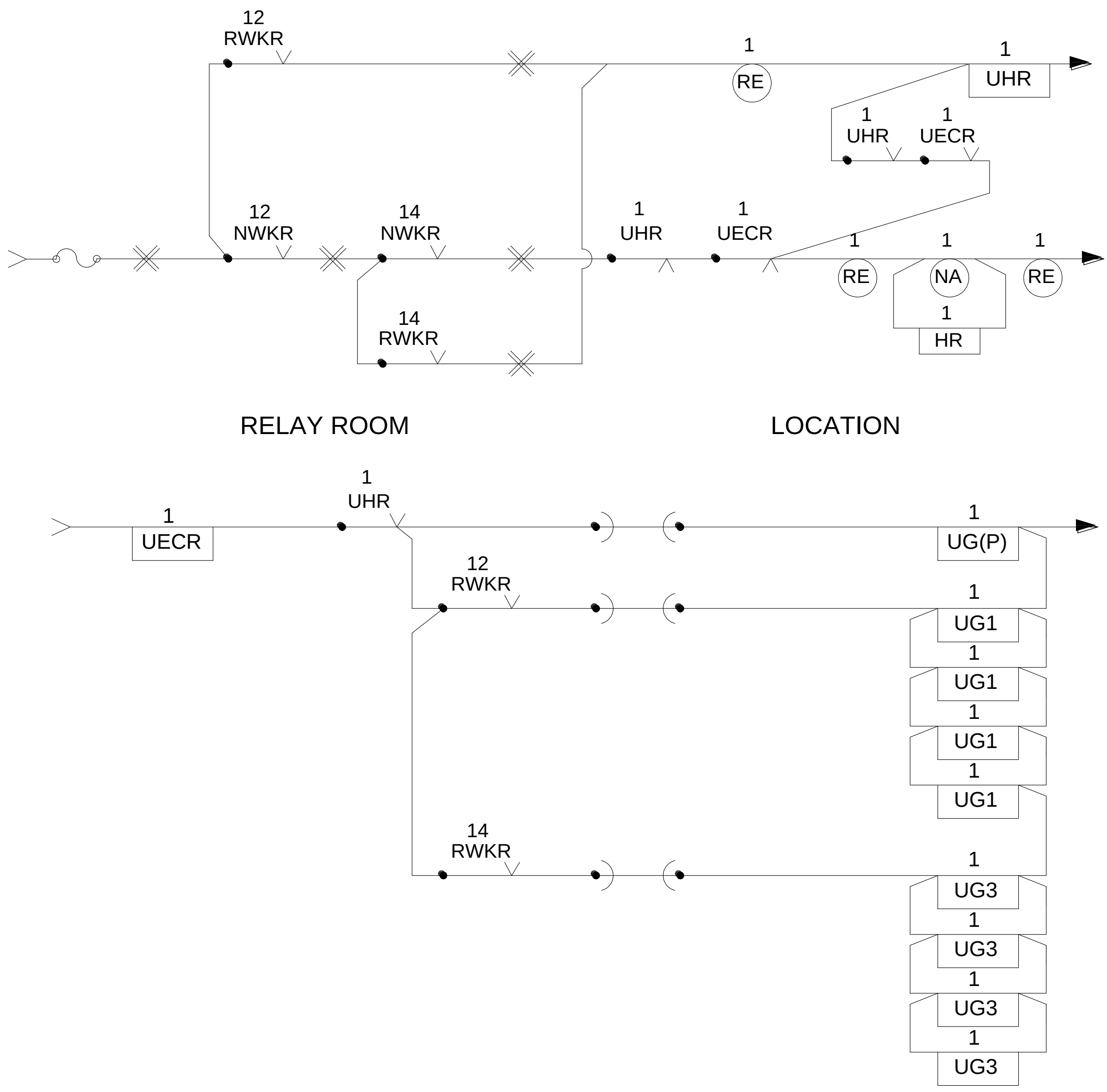


Fig. 1.19

Normally UHR's are kept in the cabin and the route indicators are fed from the cabin. But if the distance between the signal and the cabin is more, then feeding the route indicators from the cabin is not satisfactory due to more voltage drop. As such, the UHR's are repeated near the signal and the route indicators are fed locally. In such a case UECR has to be kept at site, and it has to be repeated to the cabin by UECPR, whose contact is included in the HR circuit as shown in Fig 1.20. Such arrangements are adopted in RE areas. UECR is designed in such a way that it picks up only when minimum three lamps are lit in the route indicator.

In the case of stencil type or Multi-lamp route indicators, since an indication is given for straight route also, it is not so important to prove that route is displayed before the signal is taken off. As such normally, when such indicators are used the signal is taken off first and proving that the signal control relay has picked up, the route relay UHR is energised and route is displayed as shown in Fig.1.13 for signals with stencil type route indicator and in case of multi-lamp indicator, the lighting circuit is shown in Fig 1.14, 1.15 & 1.16.

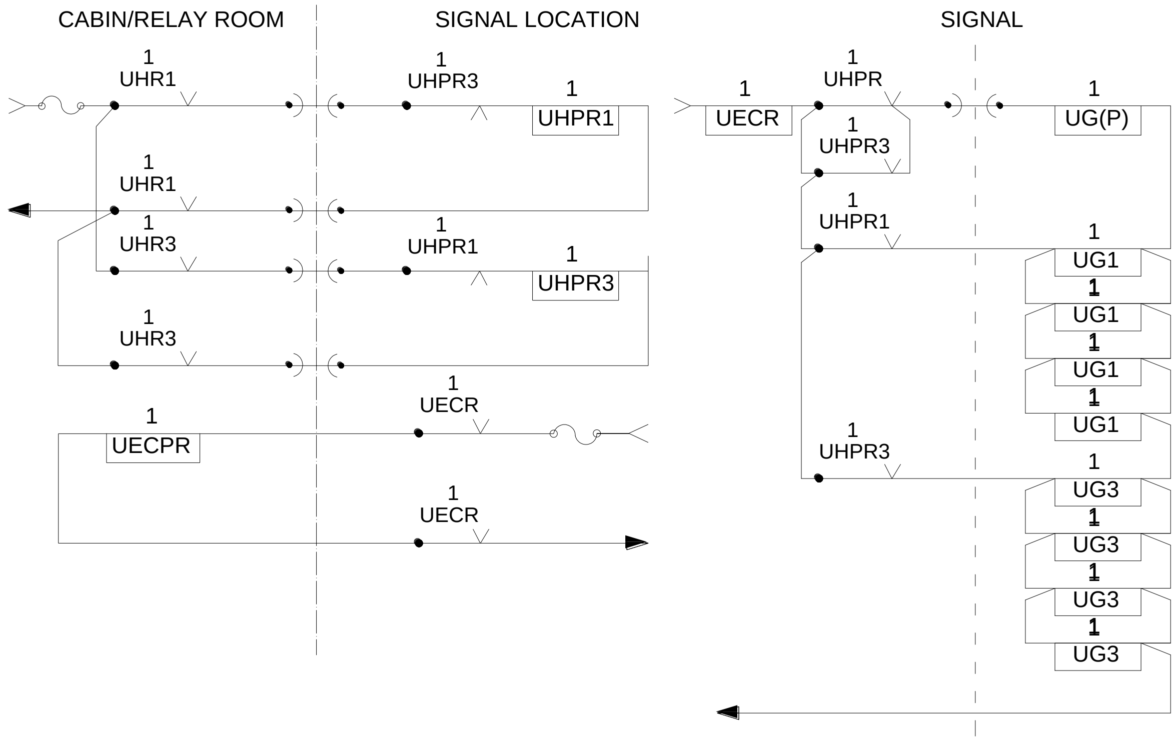


Fig. 1.20

1.7 Semi Automatic Signal

A signal, which is capable of being worked as a manual stop signal as well as an automatic signal, is known as semi automatic signal. This is controlled by Track circuits, Points/LC gate and the respective controlling agency.

In practice, a manual stop signal is converted in to an auto signal by the operation of King Lever. King Lever is released by the signal lever concerned. Already we have discussed about the HR circuit. It can be noted that after the passage of train, all the selections in HR circuit are available again except TSR front Contact (assuming signal lever concerned have not been replaced to normal).If the TSR is made to pick up after the clearance of respective controlling track by the train, the signal will reclear automatically. This principle is adopted in converting a manual stop signal into automatic signal.

By the operation of King Lever, the signal lever is back locked and the reverse contact of the King Lever is bridged across the normal contact of signal lever in TSR Circuit as shown in Fig.1.21.King lever can be operated to ‘R’ only when all points are set & locked to straight route

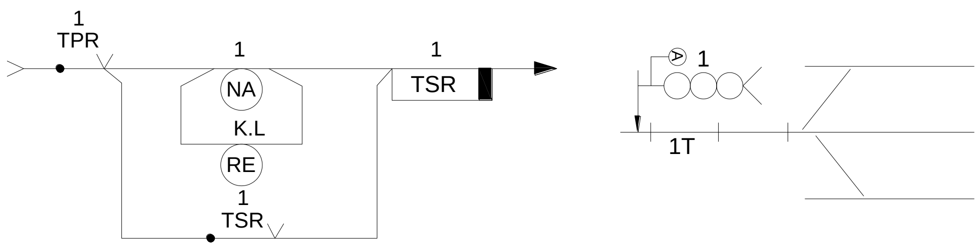


Fig.1.21

As soon as the train passes the signal, TSR drops. When the train clears the controlling track (1T), TSR picks up again through Reverse contact of the king lever, even though signal lever normal contact is not available. Signal clears again, when the other track circuits concerned are cleared.

In addition to clearing of the Signal Automatically, 'A' marker light has to be illuminated. King Lever Reverse contact is made use of in lighting up the "A" marker lamps. There are two methods adopted in this circuit.

In one method, 'A' marker lamp is lit only when signal is Red, since the role played by the 'A' marker when the signal is displaying OFF aspect is insignificant. When the signal is OFF, 'A' marker light is extinguished. In another method, 'A' marker lamp is lit as soon as the King Lever is reversed irrespective of the aspect of the signal. The second method is widely adopted by all railways. 'A' marker light shall be repeated in the cabin/Indication panel.

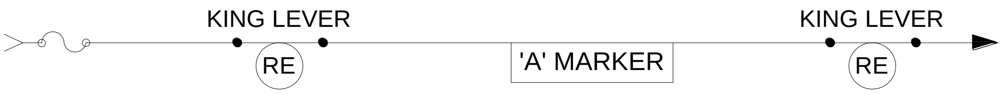


Fig. 1.22

1.8 CROSS PROTECTION & DOUBLE CUTTING

The power signalling systems mainly depend upon the integrity of equipments. Therefore, it is necessary to ensure that such vital equipments do not operate by cross or false feed. To achieve this objective, arrangements called Cross Protection and Double Cutting are employed.

In Railways, various methods adopted are,

(a) The inoperative line is connected to the return polarity. By this arrangement it is ensured that a false feed connected across the relay is connected to negative thus protecting the relay from operating due to false feed.

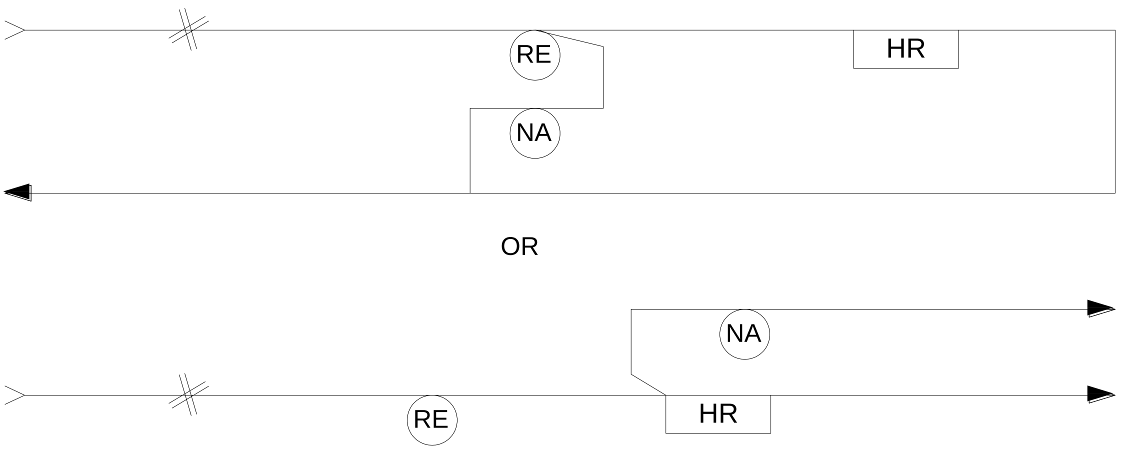
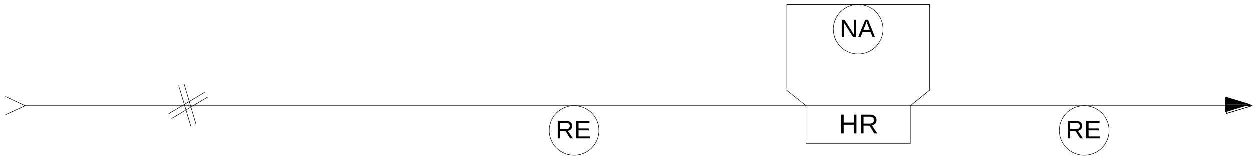


Fig: 1.23

(b) By adopting double cutting i.e. by proving the control contacts on either side of the relay. A single fault cannot cause the HR to energise. However, if both polarities are applied to terminals of HR, it may energise.

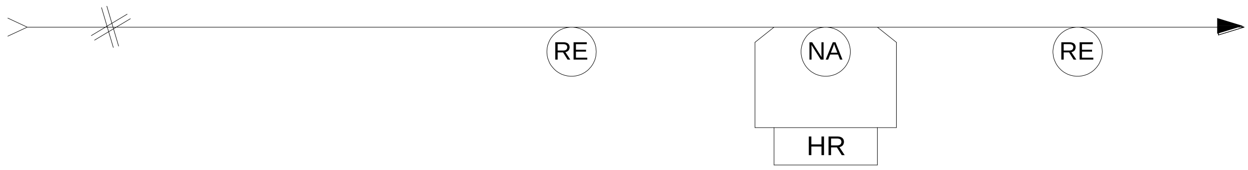
Fig: 1.24

(c) It is therefore necessary that in addition to the double cutting discussed above, The HR is bridged by the normal contact of the controlling lever, Fig.1.25. By doing so, when the lever is normal and both polarities appear across HR, still the relay may not energise. But breakage in the wire connected to the normal contact, may not be detected, unless cross protection tests are conducted regularly, as this break may not affect the normal working. To ensure that a breakage in the cross protection is detected immediately the circuit is wired as shown in Fig.1.26. By this arrangement, a break in the wire connected to HR may cause a failure, which is noticed immediately and rectified. Similar methods of providing cross protection in other circuits are illustrated.



Break in cross protection can not be detected.

Fig: 1.25



Break in cross protection can be detected

Fig: 1.26

Such arrangements are adopted for Track repeating relays and other vital circuits also(Fig.1.27)

TPR CIRCUIT FOR PLUG IN TYPE RELAY

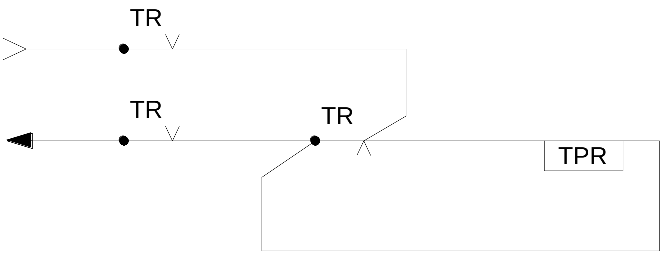


Fig: 1.27

CHAPTER 2: ELECTRICAL LOCKINGS ON POINT & SIGNAL LEVERS

Topics covered in this chapter are

(a) Track Locking

(b) Indication Locking

(c) Approach Locking and Dead Approach Locking

(d) Back or Route Locking

2.1 General

This chapter covers topic related to electromechanical yard (mechanical yard with lock for point but without lock bar) and the various electrical locking provided on mechanical lever. Interlocking, either mechanical or electrical is provided between different levers for operation of points, locks and signals in such a manner that these levers can be operated in a predetermined sequence to ensure safe movement of train and to see that conflicting movements cannot take place. In mechanical interlocking, the signal lever is the last lever to be operated after route of the signal is set. Reversed signal lever locks the route, hence any point in route, in the isolation and Level crossing Gate in route cannot be operated. The reversed signal lever holds the route it means that when signal lever is normalised then route is unlocked as no lock bar is provided, mechanism to prevent the operation of point while train still on point section shall be provided.

In power signaling, additional electric Locking is provided on point and signal lever to ensure that

(a) The route set cannot be altered in the face of an approaching train unless the train has come to a stop at the signal and conditions are safe

(b) The route set cannot be altered where the train has passed the signal and still in the route.

(c) The point can not be operated when the point section is occupied

(d) The point lever cannot be operated to full Normal/Reverse position unless the points controlled by them have responded to the lever.

(e) The signal lever cannot be operated to its full normal position unless the signal has assumed ON position.

(f) When a signal at OFF is to be put back to ON, in case of emergency or otherwise, then the signal can be put back to ON but lever cannot be taken to full normal position.

2.1.1 Operation of Signals by Electrical means

Where levers are used to operate signals by electrical means, they shall be provided with 'normal'indication locks adapted directly to prevent the full return movement of the lever to the normal position unless the signal has returned to the ON position. This rule does not apply to a mechanical interlocking frame if

(a) The signal is easily visible, or

(b) The position of the signal is repeated.

2.1.2 Operation of points by Electrical means

Except where alternative electric locking is provided, the lever operating electrically worked points shall be provided with ‘normal’ and ‘reverse’ indication locks adapted directly to prevent the full movement of the lever, unless the point mechanism has made the required movement and the points are set and locked in a position corresponding to that of the lever and in the case of facing points, they are correctly set and locked.

Visual indicators shall be provided to show the ‘normal’ and ‘reverse’ positions of all points, the condition of all track circuited sections, route setting and to repeat the indications of Colour Light Signals.

2.2 Electrical Locking on Point Levers

(a) Track Locking:

Track locking is defined in B.S.I.Spec.No.719-l936 as “an electric lock on a point mechanism and/or on its connections, effective when a train occupies a given track circuit, to prevent manipulation of points which would endanger the train whilst on the track circuit”.

Purpose: - prevent operation of point while train is still on point zone section.

Application: - In mechanical interlocking, track locking is effective on

(i) Point Lever controlling point machine

(ii) Lock lever

(iii) Fouling bar lever

(In relay interlocking track locking is achieved at point initiation or point control or point operation level.)

Track locking is provided on point lever such that the lever cannot be operated either from N to R or from R to N when the point zone track circuit is occupied by train or point zone track circuit failed. This locking performs the function of a lock bar. In power signalling when lock bars are not provided on points, a track circuit on point section shall be provided. When the points are operated by point machines and both operation and locking of points are done by the same point lever, then electric locking shall be effective on the point lever, for both ‘N to R’ and ‘R to N’ operations. When Facing Point locks are provided to lock the points, the lock lever is operated for either movement over the points. The Track locking shall be effective on lock lever and the lock lever thus operated shall be checked at ‘E’ position of reverse to normal operation before unlocking the points.

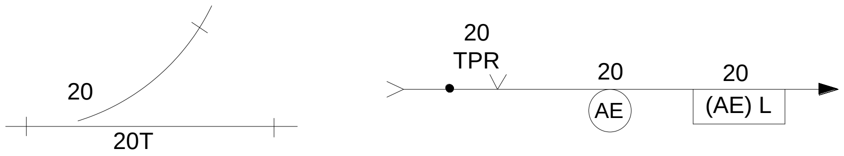


Fig: 2.1

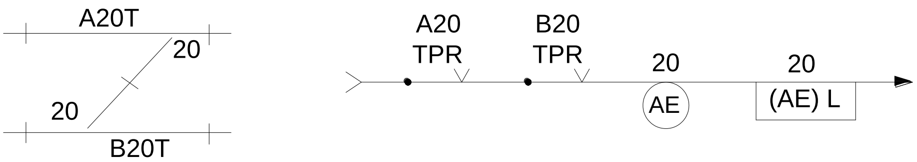


Fig: 2.2

In Fig.2.1, if 20T is occupied, the point lever No.20 cannot be operated either from Normal or Reverse Position. In case of cross over points, where two/three controlling track circuits are provided, all the track circuits are to be proved in track locking Fig 2.2. (Three controlling Track circuits, in case of insufficient fouling protection Fig: 2.3.)

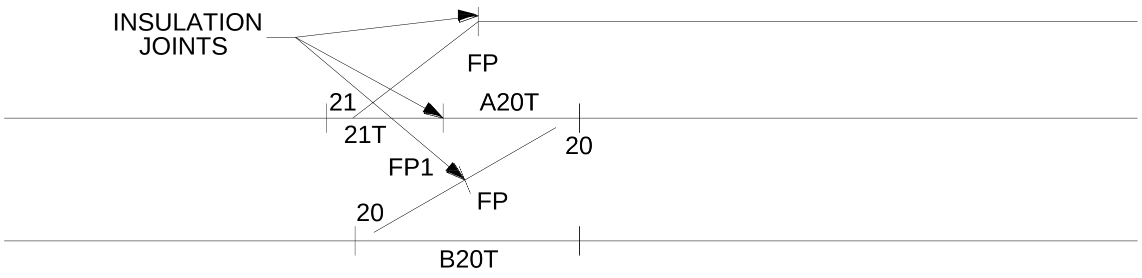
In yards adjacent tracks are laid with minimum distances required as per schedule of dimensions. In such cases the end insulation joints [as shown in Fig 2.3] cannot afford the fouling protection. Hence, the adjacent track circuits, as necessary, shall also be proved in Track locking circuit to effect the fouling protection.

(i) When Track centers are more than 15’ 6” (New work 17’ 38”) - fouling protection by track locking is not necessary.

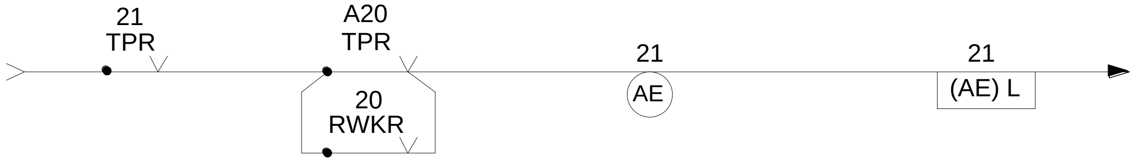
(ii) When Track centers are less than 15’ 6” (New work 17’ 38”) - fouling protection by track locking is necessary.

In Fig 2.3, let us assume that a train is moving in Right ward direction with 21 Normal. When it clears 21T, it should not be possible to operate point no. 21, even though track no.21T is cleared. Otherwise, a movement in leftward direction with 21 Reverse can cause side collision, with the train on A20T, as it is within the fouling mark of point No.21. So, for operating point No.21, it should be proved that A20T also is clear. However, when A2OT is occupied for a movement with point no. 20 ‘Reverse’, the above condition is not required for operating 21, since the movement with 21 Reverse is a parallel move with 20 reverse. To achieve this facility, a bypass for A20TPR is provided with 20RWKR on 21 Track lock circuit.

Track locking can also be achieved through lock lever, when lock lever is operated from ‘R’ to ‘N’ position. When track locking is provided on lock levers, it is effective at E Position as shown in Fig: 2.4.



FOULING PROTECTION BY TRACK LOCKING FOR POINTS 21



FOULING PROTECTION BY TRACK LOCKING FOR POINTS 20

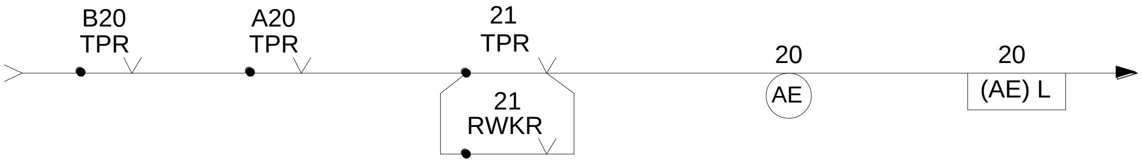


Fig: 2.3

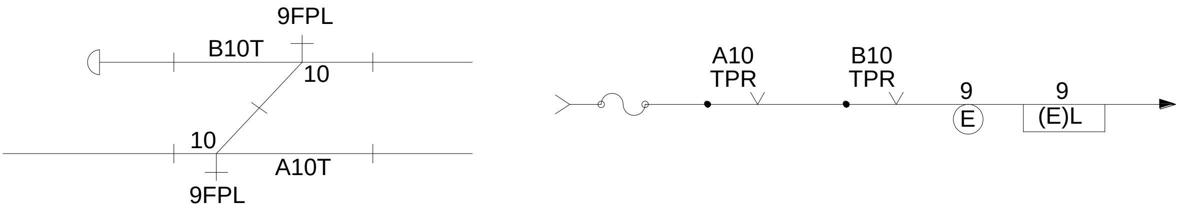


Fig: 2.4

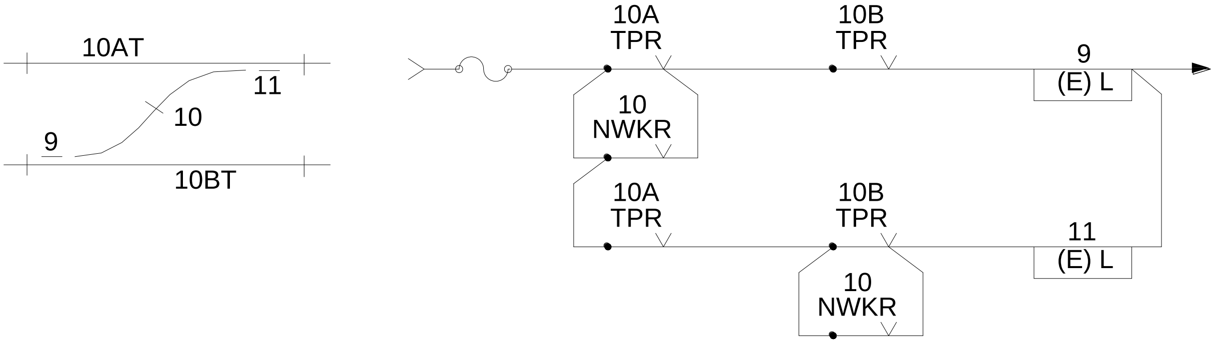


Fig: 2.5

Note: *Though there is no necessity of track locking in above case (since lockbar is performing that function) it is provided to ensure more safety.*

(b) Indication Locking

Indication locking is defined in B.S.I.Spec.T19-1936 as "an arrangement to prevent the full stroke of a lever in an interlocking frame until such time as the apparatus controlled by that lever has completed its movement". Indication locking is to be provided where there is no rigid connection between the lever and its function.

Purpose: - prevent out of correspondence between function position at site and control of that function.

Application: - In mechanical interlocking, track locking is effective on

(i) Point Lever controlling point machine

(ii) Signal lever controlling signal machine or sometimes CLS.

Generally indication locking in relay interlocking applicable to signal and is achieved at route locking circuit level. (Refer ASR circuit in British relay interlocking IRISET Notes S12).

2.2.1 Indication locking on Point levers

In case of motor operated points, where there is no rigid connection between the point lever and the point, there is a possibility that there may be out of correspondence between point and the lever. Hence, indication locking is provided on point levers to ensure that lever cannot be operated to its full normal or reverse position until such time the point has completed its movement to the required position.

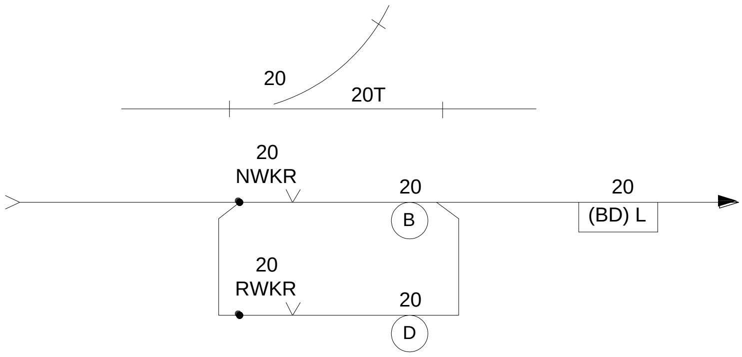


Fig: 2.6

The indication locking is effective at B position for reverse to normal operation and at D position for normal to reverse operation. In the Fig: 2.6, it is illustrated that when point is operated from N to R the lever is locked at D position and the lock at D cannot be energised unless RWKR is energised i.e., point is correctly set in reverse position. Similar arrangement is provided for normal operation also.

2.2.2 Combined Track and Indication Locking

Since both these Lockings are provided on point levers, they can be combined. Combined track and indication locking circuits are provided as shown in Fig. 2.7 to 2.9. The circuits used are of different types.

Circuit 1 When combined Track and indication locking circuits are used separate A and E spot contact should be used instead of one AE contact; otherwise, the indication locking may not function.

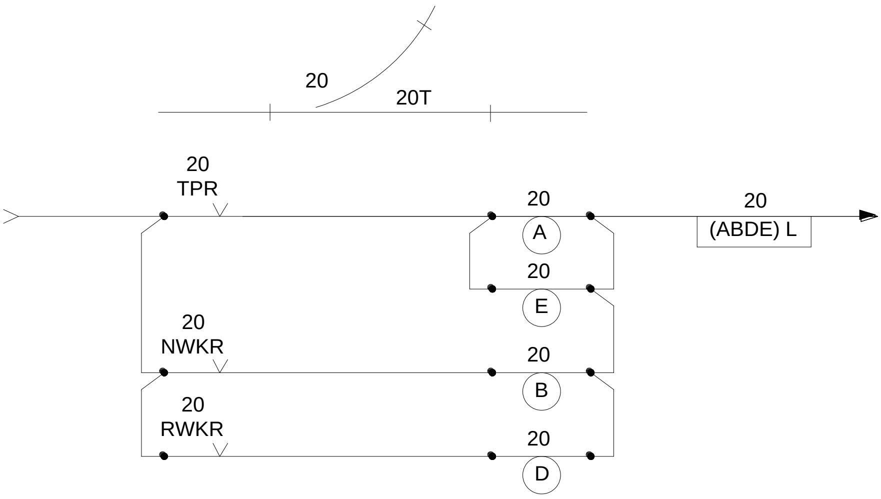


Fig: 2.7

Circuit 2 This circuit dispenses with spot contacts, but Track failure cause an indication Lock failure and the point indication failure may cause a failure of track locking.

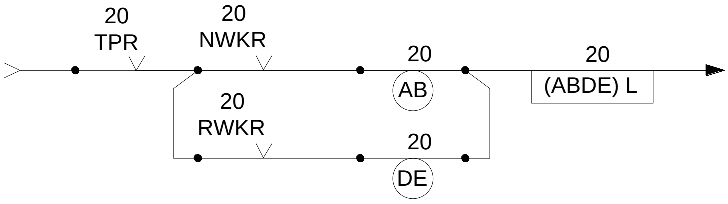


Fig: 2.8

Circuit 3 If two electric lever locks are used as shown below. The above said disadvantage can be eliminated. But this method is not economical.

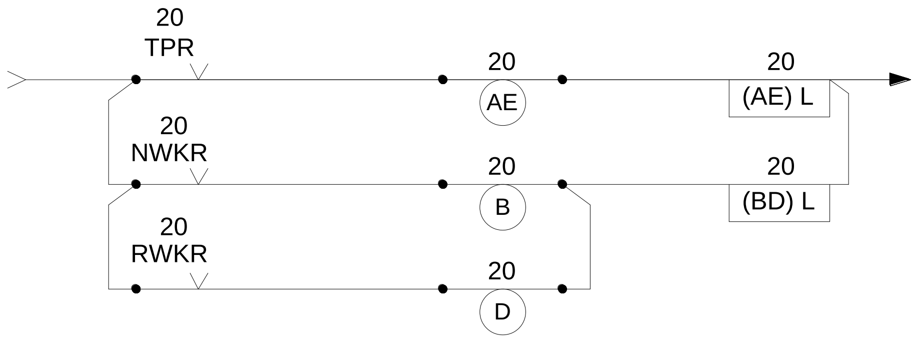


Fig: 2.9

***Note: -** The Normal practice followed in Railways is as per the circuit in fig: 2.7*

2.3 Electrical Locking on Signal Levers

2.3.1 Indication Locking

Where motor operated signals or colour light signals are used, it becomes necessary to ensure that before signal lever is replaced to Normal position, the signal has assumed ON aspect, as there is no rigid connection between the signal lever and the signal concerned. It is achieved by providing Indication locking on signal lever, which is effective at B position.

For Motor operated Semaphore Signals, ON aspect of signal is proved by 0^0 to 5^0 of arm contact or by signal normal relays which proves ON aspect of signals.

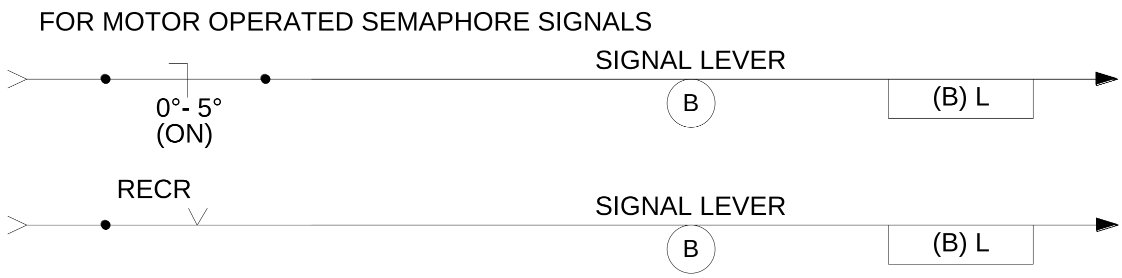


Fig: 2.10

For colour light signals, it is not usual to prove the integrity of ON aspect of signal lamps RECR contacts, as red lamp failure may cause hold up of concerned signal lever and thereby delay to traffic.

To avoid the above undue delay, instead of using an energised contact of RECR, all the de-energised contacts of signal controlling relays are proved in Indication locking circuit of signal.

For example:-

(a) For 2 aspect Colour light signal HR Concerned ↓

(b) For 3 aspect Colour light signal HR & DR Concerned ↓

(c) For 4 aspect Colour light signal HR, HHR & DR Concerned↓.

When signals are provided with Route indicators, to prove Route indicators are not lit (de-energised condition) all the UR/UGR/UHRs are proved along with UECR back contact.

FOR COLOUR LIGHT SIGNALS :

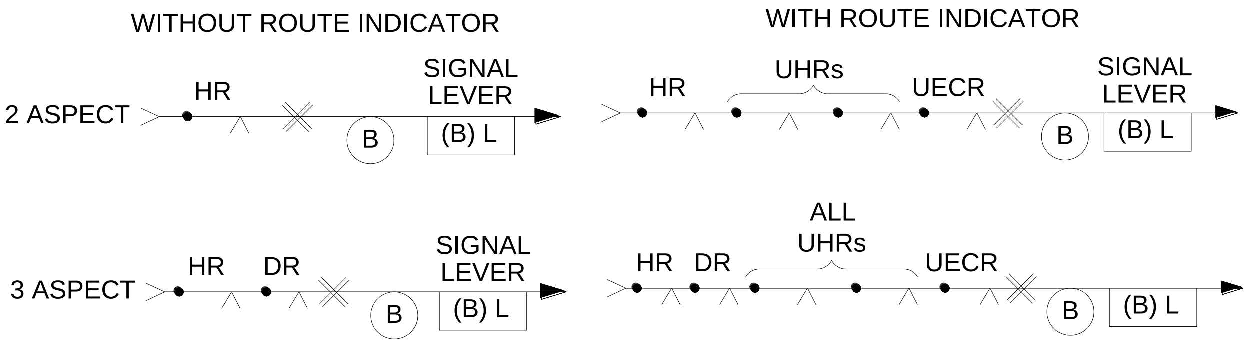


Fig: 2.11

In some railways as an extra precaution, before allowing the signal lever to be replaced full to its normal position, following conditions are introduced.

(a) The OFF aspect ECRs of the 4 aspects signals (HECR, HHECR & DECR) may also be proved in de-energised condition e.g. HECR↓,HHECR↓ & DECR↓.

(b) For the First stop Signal, not only the relays governing First stop Signal are proved, but also aspects of its pre-warning signal (i.e. Distant) is also proved. This is proved by Distant Signal controlling relays and the OFF aspects ECRs (DHHR, DDR, DHHECR & DDECR) in de-energized condition.

2.3.2 Approach Locking

Approach locking is provided on the signal lever to prevent the lever from going to normal position in the face of an approaching train and to prevent the route being altered. This is defined in B.S.I.Spec.No.719/1936 as ‘Electric locking effective whilst a train is approaching a signal and adopted to prevent manipulation of levers or devices that would endanger the train’.

Purpose: - to maintain route of signal in locked condition, once signal to that route is taken to OFF and Loco Pilot has accepted the signal.

Scope: - Approach locking is effective when signal is taken to OFF and train within normal breaking distance from signal.

This locking is made effective at B position of signal lever. This is achieved by using the front contact of the approach track in the circuit shown in Fig 2.12.

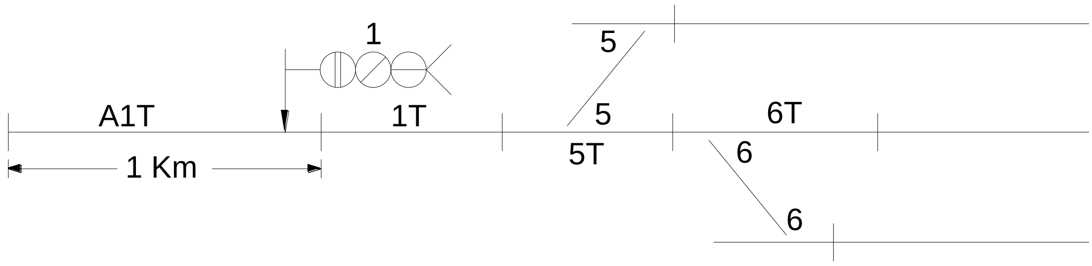


Fig: 2.12

By proving A1TPR front contact in the back lock [(B) lock] circuit, it is ensured that the lever1 cannot be put back to normal when the approach track is occupied. In busy sections where the trains follow one behind the other very closely, this circuit is not sufficient. For example when the first train is travelling on the route and if the second train occupies A1T, then the lever cannot be replaced to normal even after the first train clears the route. With the result the route cannot be altered after the passage of the first train. To enable the operator to put back lever to normal and to clear for the second train, 1TSR back contact bypasses the A1TPR front contact as shown in Fig.2.13.

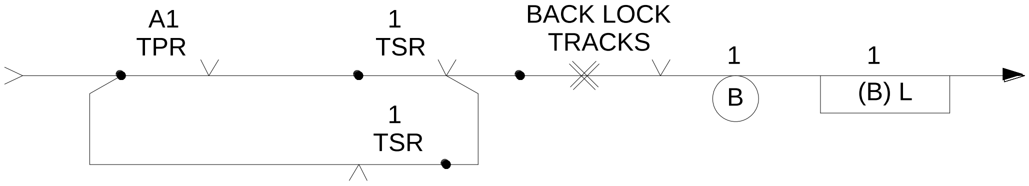


Fig: 2.13

When the first train passes the signal1, 1TSR drops. If the second train occupies A1T, before the first train clears the route, through the back contact of 1 TSR (proving that first train has passed the signal) the lock is released and lever put back to Normal. However this arrangement may result in a premature release of the route when the TSR fails in dropped condition. Therefore, proving of back contact of TSR is augmented by proving the front contacts of Sequential proving relays (UYRs) together with TSR to avoid premature route release. These relays may be made to operate in succession during the signalled move by the occupation and clearance of track circuits and the last relay in the sequence, (otherwise all UYR's) together with TSR back contact will effect release of signal lever. This is explained in section.

Sometimes it becomes necessary for the operator to stop the train which has already accepted the signal and to clear it over a different route or to arrange crossing/precedence. This is done by putting back the signal lever, which can go only up to B position as it is approach locked, However the signal is replaced to ON. To replace the signal lever to its normal position and to alter the route, if required, the timer circuit is initiated at B position (BD Band) of the signal lever. The front contact of JR (Output from JR after a stipulated time delay) bye passes the A1TPR front contact and TSR back contact.

Before releasing the approach locking it should be ensured that the train has come to a stop in rear of signal. This is achieved by proving the TSR energised contact together with all Approach TPRs in approach lock circuit of the signal lever. The timer relay may be of AC vane driven clock type, DC clock type, thermal type or an electronic type. In all the cases it is ensured that the contact used to release the approach locking will make only after a predetermined time lapse from the initiation of cancellation (Fig. 2.14).

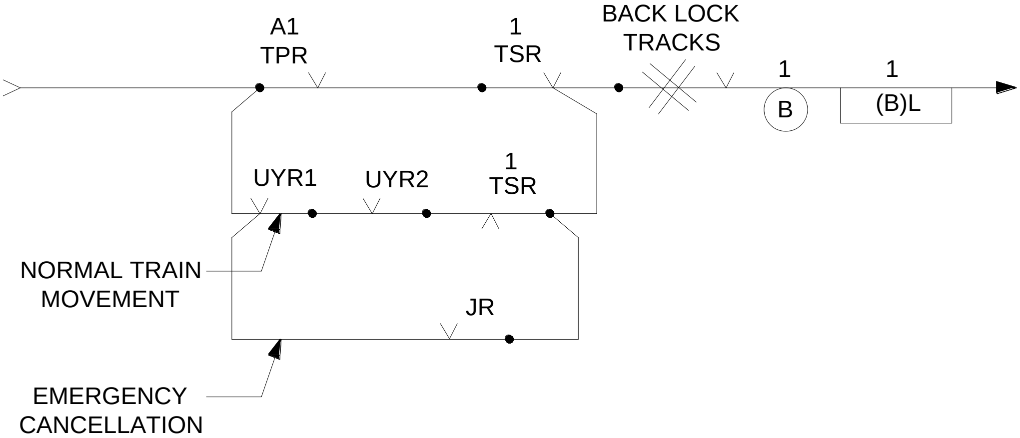


Fig: 2.14

The minimum requirement of approach track circuit for various signals is as under:

(a) Main Line Starter - 1 Km (EBD) in approach of signal i.e. upto Home Signal in rear.

(b) Loop Line Starter - Berthing Track circuit.

(c) Shunt Signal - One Track circuit before the signal.

(d) Home Signal - 1 Km (EBD) in approach of signal.

When no approach track circuit is provided for home signal, a different type of approach locking called Dead Approach Locking is provided.

The time release circuit differs according to the type of relay used. In case an AC clock worked type relay is used, the circuit is as shown in Fig.2.15. When the train is on A1T and the lever is replaced to B position the JR is energised after predetermined time delay.

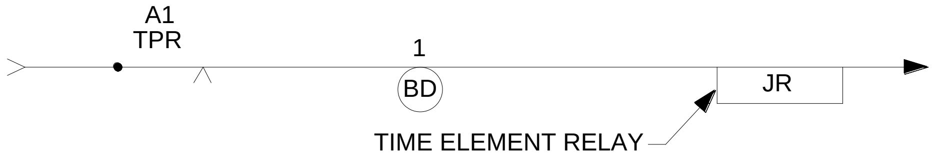


Fig: 2.15

When a thermal type relay is used the circuit differs slightly. When the cancellation action is initiated, the thermal element of JR is connected to supply and the bi-metallic strip over which the thermal element is wound is heated up, it bends and makes the hot contact after a time delay. This contact cannot be used to release the approach locking, as the time taken for making the hot contact may be reduced, if another attempt is made to release the Approach locking by the same relay, before it is fully cooled. So it becomes necessary to prove that the relay has made the cold contact before the locking is released so that the time taken for each cancellation remains the same.

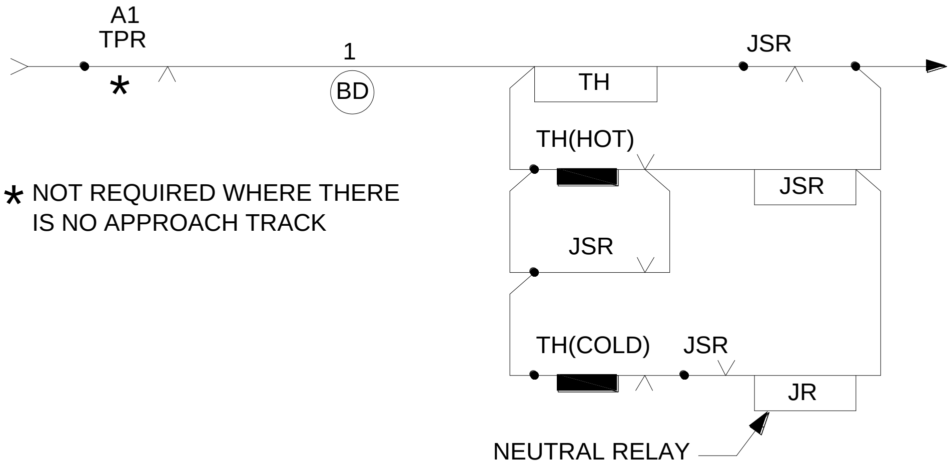


Fig: 2.16

If lever 1 is replaced to B position when the train is on A1T, the thermal element TH is heated through the back contact of a relay JSR. After the time delay the hot contact is made, which causes the JSR to pick up. When JSR picks up, the feed for Thermal element ‘TH’ is cut off and so it starts cooling. After a time delay the cold contact is made. Proving that the cold contact is made and JSR is picked up which proves that the hot contact was made, the JR is energised, the front contact of which is used to release the approach locking. Thus, JSR in this circuit proves that hot contact is made and cutting of power supply to bimetallic strip after the hot contact is made.

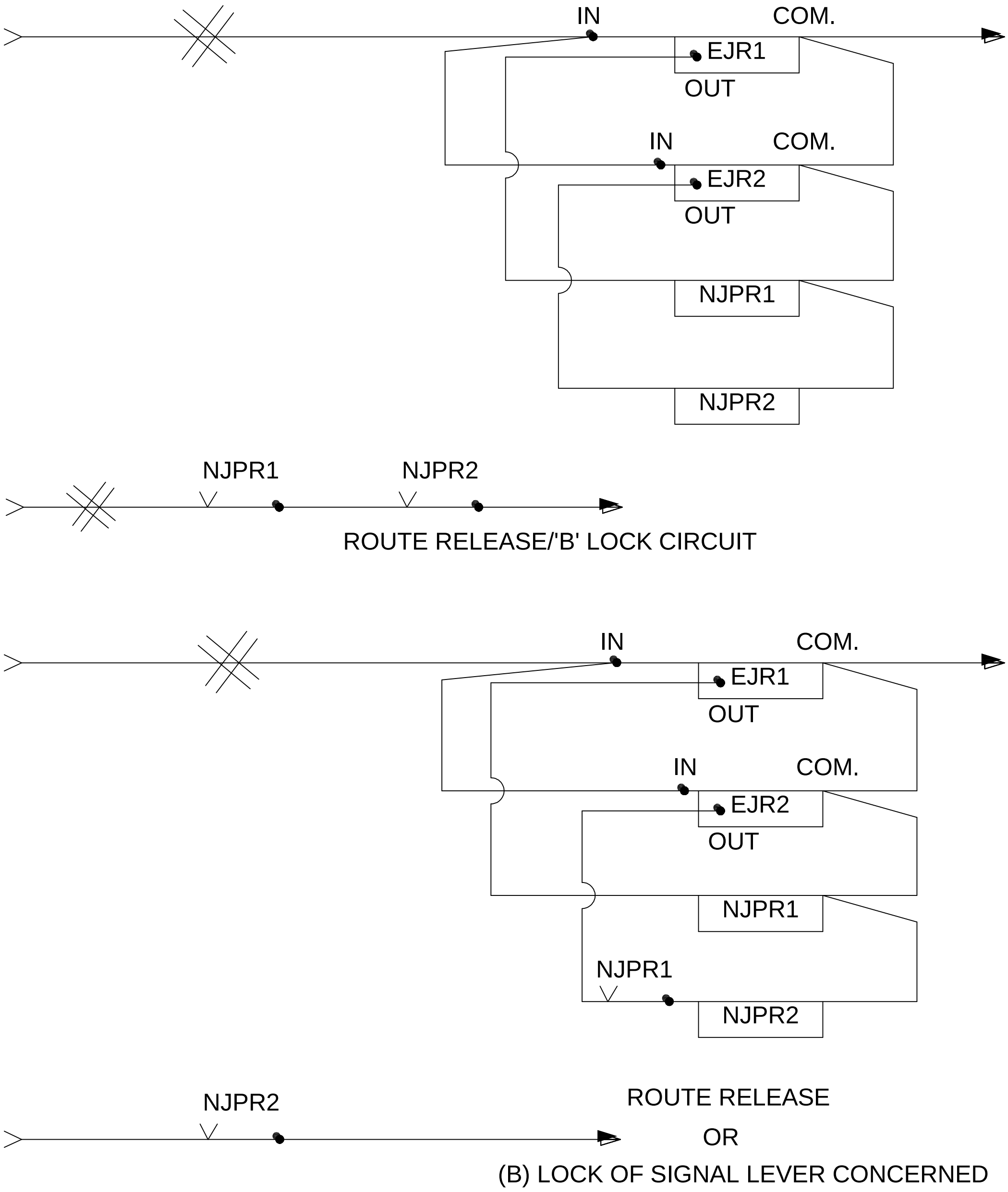


Fig: 2.17

Where electronic timers are used, they are worked in parallel and their outputs are proved in series so that no premature release will take place in the event of failure of any one of the timers. Each timer's output is connected to a neutral relay called NJPR. There are two methods in use. One method is by using the contacts of both NJPR1 and NJPR2 in series to affect the time delay or prove NJPR1 ↑ in NJPR2 and prove NJPR2 ↑ for route release etc.

2.3.3 Dead Approach Locking

Where no track circuits or sufficient length of track circuit is not provided in rear of a signal like Home signal, starter signals from goods yards, shunt signals from sidings, approach locking is not possible. In such cases another type of approach locking is adopted which becomes effective on the reversal of the signal lever and does not depend on approach of train. Such locking is known as Dead approach locking.

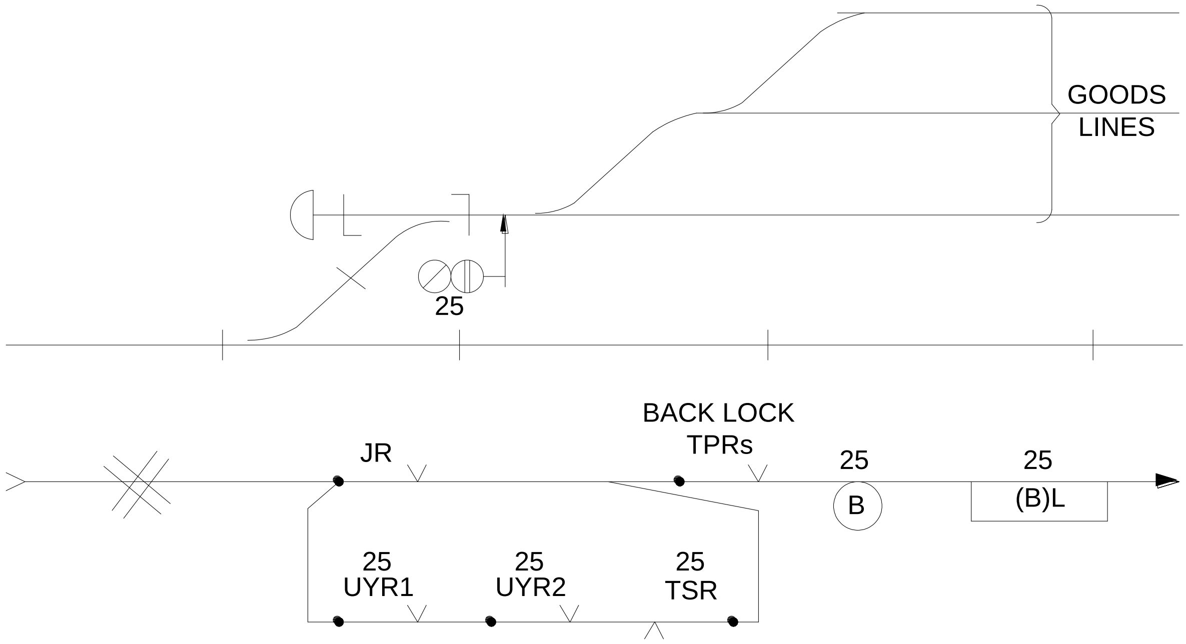


Fig: 2.18

From the Circuit it can be seen that, once signal lever 25 is reversed it cannot be put back to Normal unless the train passes the signal and causes the TSR to drop & Sequential proving relays picks up (refer para 2.4.2 Pre-mature route release) or a time interval is elapsed.

2.4 Route Locking

After the train passes the signal, it shall not be possible for cabin man/SM to alter the route unless the train clears the entire route, entered. This is achieved by preventing the signal lever from replacing to its normal position through an electric locking. This locking is known as Back or Route locking. This is made effective at B position.

The back or route locking is defined as “Electric locking effective when a train passes a signal and adopted to prevent manipulation of levers that would endanger a train while it is within the limits of the route entered.”

In the given layout, Fig.2.19 if signal 23 is cleared and train passed the signal, the back locking prevents the restoration of lever 23 to normal until the train clears the track circuit 10T.

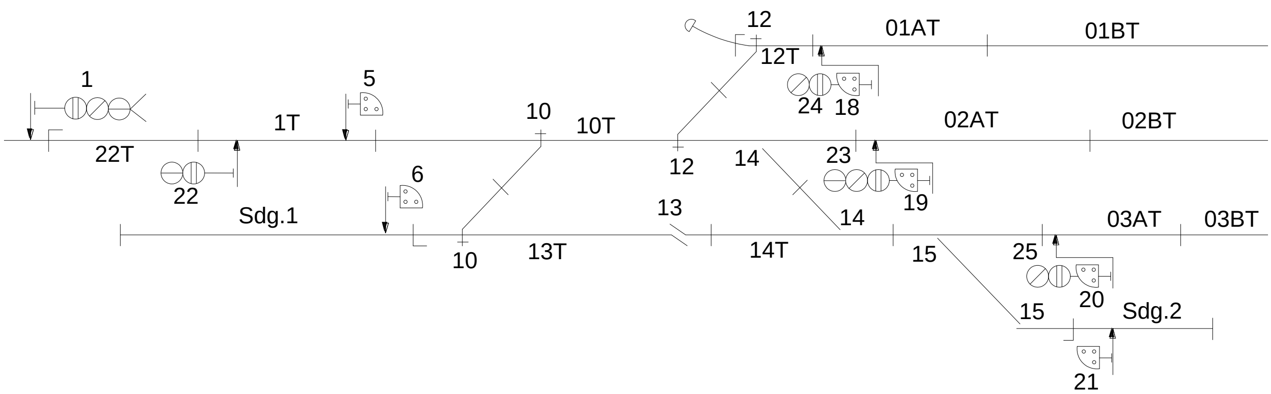


Fig: 2.19

Similarly for signal 25, it clears the entire route i.e. 14 T & 10 T

Fig: 2.20

In the case of signal 18, if it is cleared, it may either lead towards main line to clear of Shunt 5 or lead to Siding 1 to clear of Shunt 6. According to the route for which it is already set and cleared, the back locking on lever 18 prevents the restoration of lever to normal unless the train clears the last point track circuit on the route. Here points 12 is required in reverse condition and 12T & l0T are common back lock track circuits for both the routes cleared. The Track 13T happens to be last point track circuit if signal 18 is cleared to Siding and to include this in back locking, the last operated position of points 10 is utilised. Referring Fig. 2.21. It is seen that if the route for 18 was set and cleared to mainline the requirement of 13T is bypassed by the position of points 10 in Normal condition.

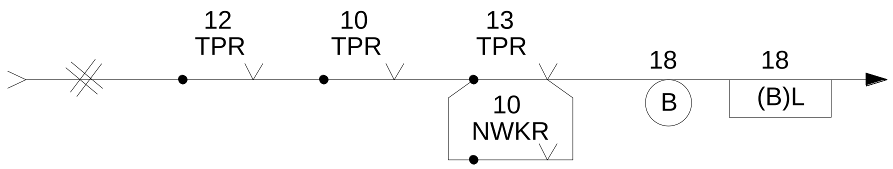


Fig: 2.21

Similarly for Signals 1 & 6 are shown in Fig. 2.22.The approach locking and back locking become effective at B position and as such, combined approach & back locking circuit is shown in Fig.2.23. Normal indication locking is also added in this circuit to ensure that lever can not be restored to Normal unless the Signal has gone to ON position.

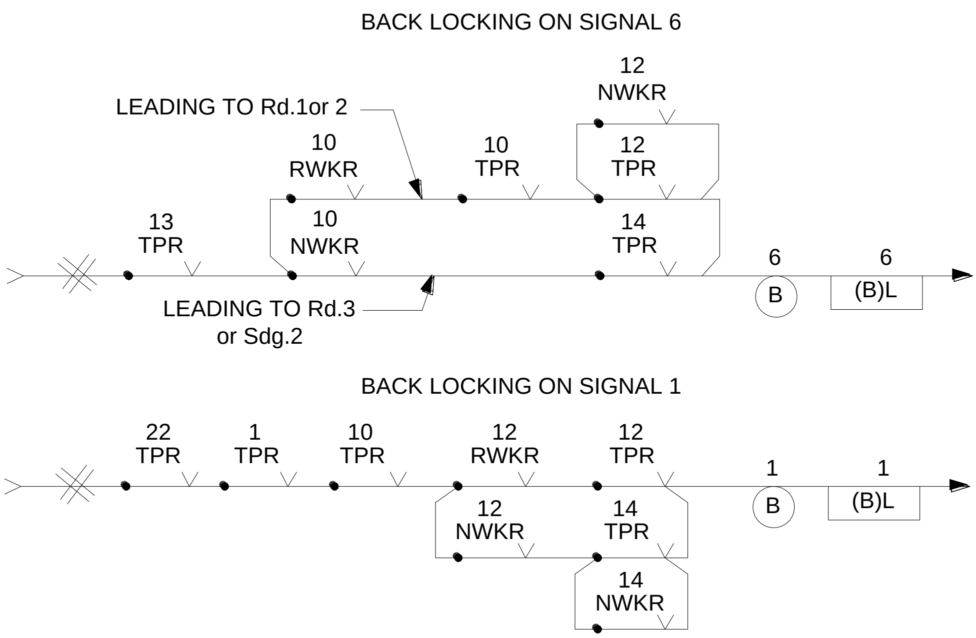


Fig: 2.22

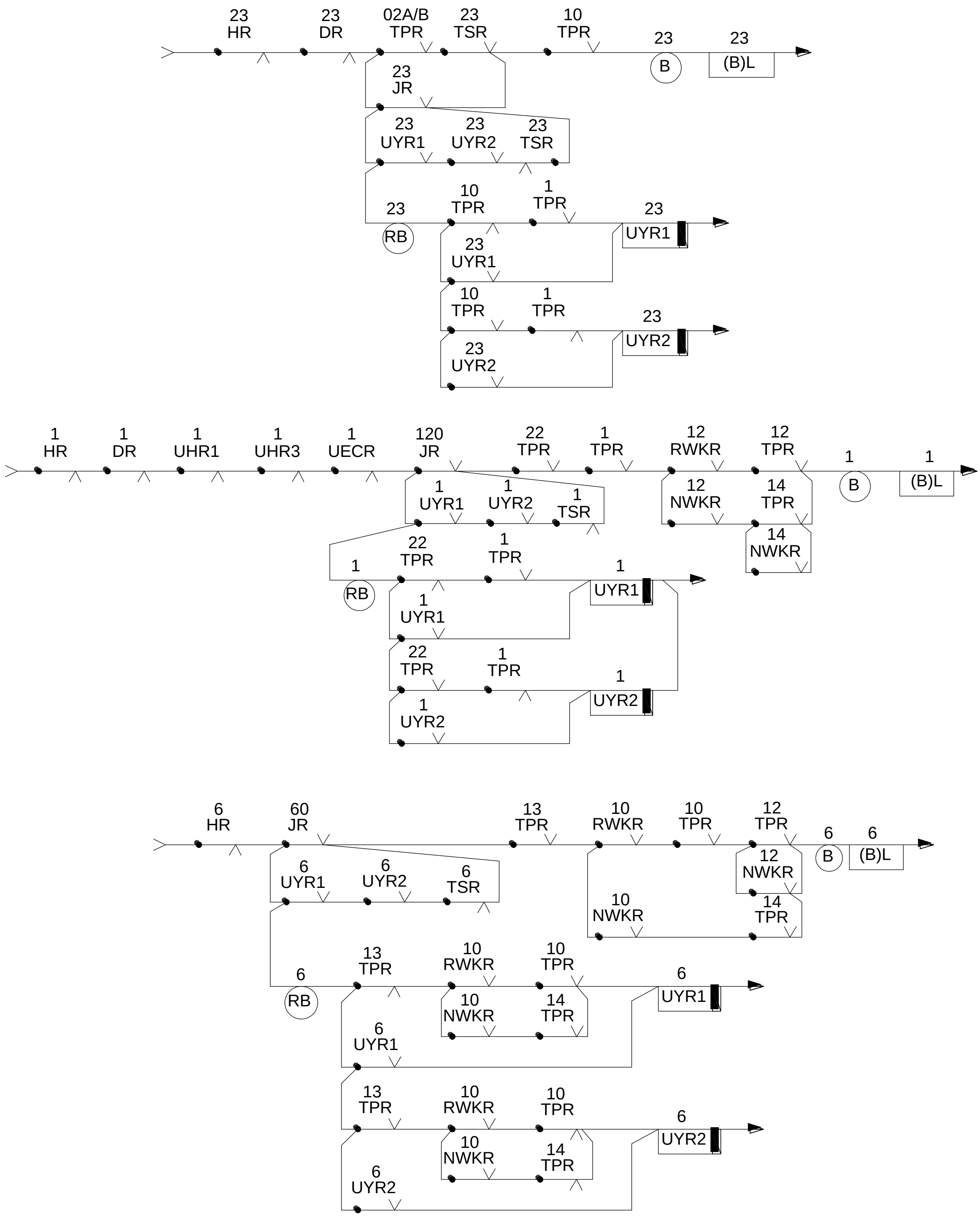

23 HR
23 DR
02A/B TPR
23 TSR
10 TPR
23 B
23 (B)L
23 JR
23 UYR1
23 UYR2
23 TSR
23 RB
10 TPR
1 TPR
23 UYR1
23 UYR1
10 TPR
1 TPR
23 UYR2
23 UYR2
1 HR
1 DR
1 UHR1
1 UHR3
1 UECR
120 JR
22 TPR
1 TPR
12 RWKR
12 TPR
1 B
1 (B)L
1 UYR1
1 UYR2
1 TSR
12 NWKR
14 TPR
14 NWKR
1 RB
22 TPR
1 TPR
1 UYR1
1 UYR1
22 TPR
1 TPR
1 UYR2
1 UYR2
6 HR
60 JR
13 TPR
10 RWKR
10 TPR
12 TPR
6 B
6 (B)L
6 UYR1
6 UYR2
6 TSR
12 NWKR
10 NWKR
14 TPR
6 RB
13 TPR
10 RWKR
10 TPR
6 UYR1
10 NWKR
14 TPR
6 UYR1
13 TPR
10 RWKR
10 TPR
6 UYR2
10 NWKR
14 TPR
6 UYR2

Fig: 2.23

2.4.2 Premature Route Release & Proving Sequential Occupation and clearance of Track Circuits.

Initially in the Route Release Circuits [(B)L], circuit in the case of Electro Mechanical Signalling provided with Lever locks (ASR circuit in the case of Relay Interlocking), the Train arrival condition was proved by the de-energised contacts of stick Relay, LS/SR/TSR ie. TSR↓ Ref. Fig 2.24 & 2.13 & 2.14.

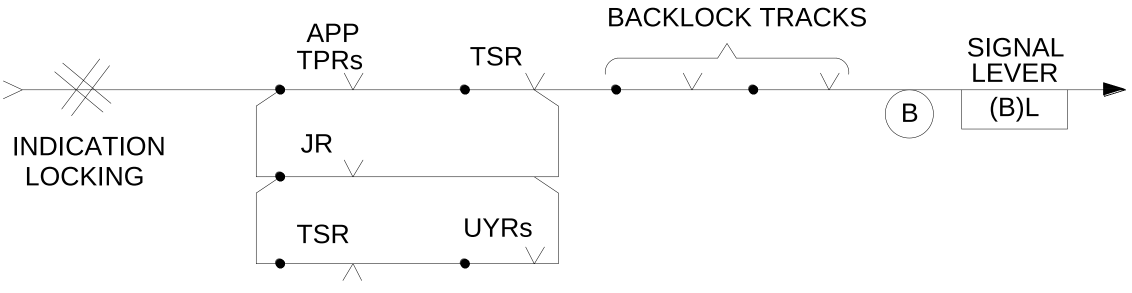


Fig: 2.24

TSR is controlled by Track circuit immediately after the signal. As the Train passes the signal and occupies the controlling Track, TSR de-energises and this back contact is proved to release the route after Train has cleared all back lock Tracks.

TSR is controlled by only one Track Circuit in advance of the signal. If this track drops momentarily and picks up again, TSR drops, and route gets released, when the train is still on the approach track circuit, without any time delay. This is more dangerous and this type of Route releasing is called 'Premature route release'.

To avoid Premature route release, instead of relying on the condition of only one Track Circuit, we are required to consider minimum two Track Circuits in succession after the signal.

Considering more than one Track Circuit for proving Train arrival condition, passing of train sequentially after the signal over the Track Circuits is proved by energising sequential proving relays, i.e. UYRs in succession.

2.4.3 Sequential Proving Relays

These are stick relays used for proving the condition of sequential occupation and clearance of track circuits. They are:

(a) Energised during Train movement by considering various conditions of Track circuits in succession after the signal.

(b) Kept in energised condition by stick path till the Route is released. (I.e. till signal lever normalised or ASR picks up).

Considering 2(two) Track Circuits in succession after signal, once the Train passes the signal and occupies first Track after the signal, the conditions available are,

(a) Signal control relay HR de-energises i.e. HR↓

(b) Signal lever may be anywhere between R and B position,

(c) 1st Track after the signal - occupied, 2nd Track after the signal – free.

With the above conditions fulfilled, a relay UYR1 picks up and kept in energised condition through a stick path bye-passing track circuits, which enables UYR1 to remain energised condition even if the momentary Track Circuit conditions changes due to travel of train. Ref fig.2.25

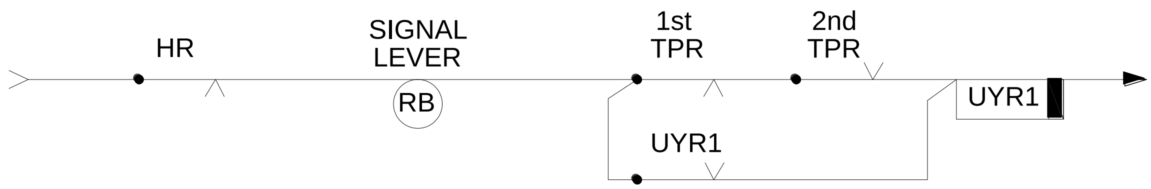


Fig: 2.25

As the Train continues to travel in the route one more condition will be available where, 1st track in rear of train is energised and 2nd track in de-energised condition. With this condition UYR2 picks up and sticks through its own front contact bye-passing Track Circuits, Ref fig.2.26.

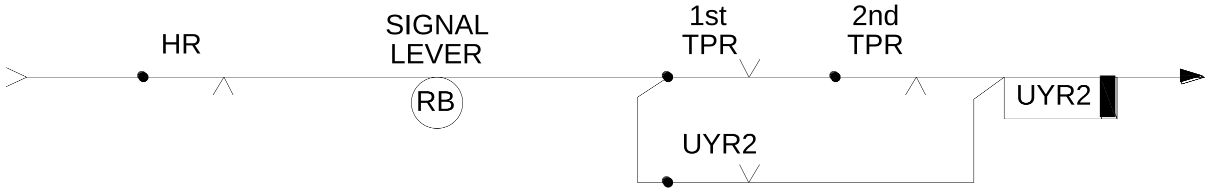


Fig: 2.26

When the train completes its movement and arrives safely clearing all the Back lock Tracks, Route can be released by proving front contacts of UYRs on the route instead of TSR back contact, Ref. fig.2.27 along with the concerned track circuits in energised condition.

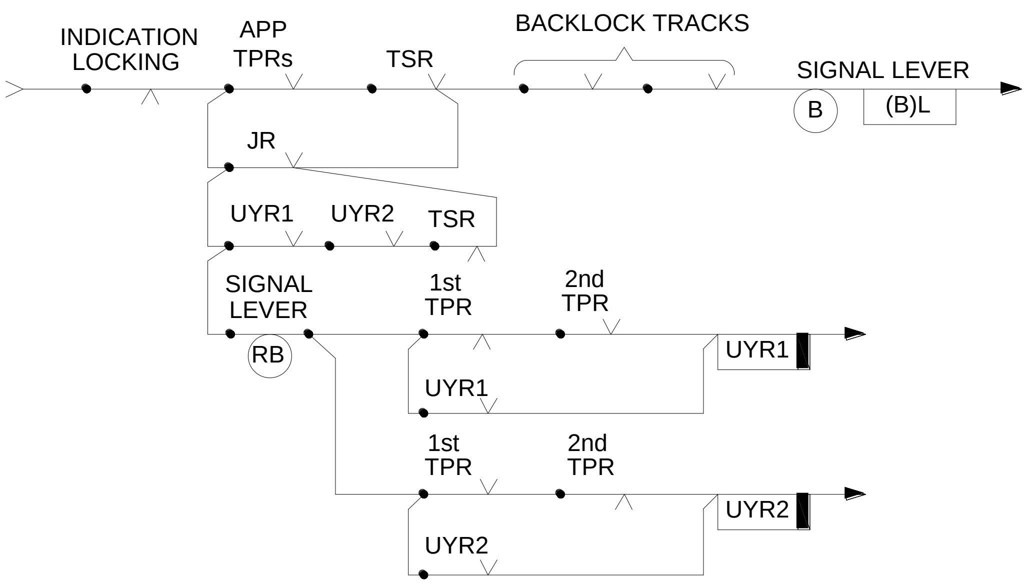


Fig: 2.27

Note: - *Improvised arrangement (for unidirectional movement) recommended is as follows:-*

(a) 1st Track ↓ + 2nd track↑ + UYR2 ↓ ⟶ UYR1 energizes & sticks.

(b) 1st Track ↑ + 2nd track↓ + UYR1↑ ⟶ UYR2 energizes & sticks.

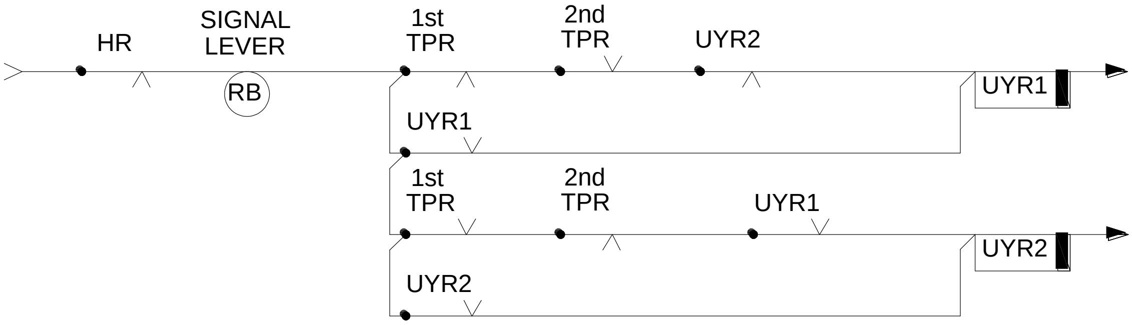


Fig: 2.28

Once the route is released (i.e. lever comes to normal by energising [B] lock or energizing ASR), all UYR's energized during train movement are expected to drop. Proper functioning of these relays is checked by proving back contacts of all UYR's in signal clearance circuits (HR).

In the modern installations, wherever possible, three Track circuits in succession are used in different combinations (Two Tracks occupied and one Track free) to energise UYRs. (Dealt in IRISET notes S12 & S13)

2.5 Sectional Route Release

The route locking explained above cannot be adopted for larger yards with more parallel movements; since the points cleared by the train cannot be made use of for other movement till the train clears the last pair of points, though it is safe to do so.

As such, a different type of route locking is adopted in which the arrangement is such that a train in clearing each section of the route, releases the locking affecting that section. Such locking is known as 'Sectional route release locking'.

This is defined in B.S.I Specification No. 719-4936 as 'Route locking so arranged that train in clearing each section of the route, release the locking affecting that section'.

In the layout Fig.2.29, if back locking (without Sectional Route Release) is adopted if lever 1 is reversed for a movement with points 2,3 and 4 in normal position, the lever No.1 can be put back to Normal only when the train clears all the tracks upto 5T. As a result, when train is on 3T or 4T, point No.2 cannot be used for some other movements. As such, in bigger yards, the 'Sectional route release locking' is adopted.

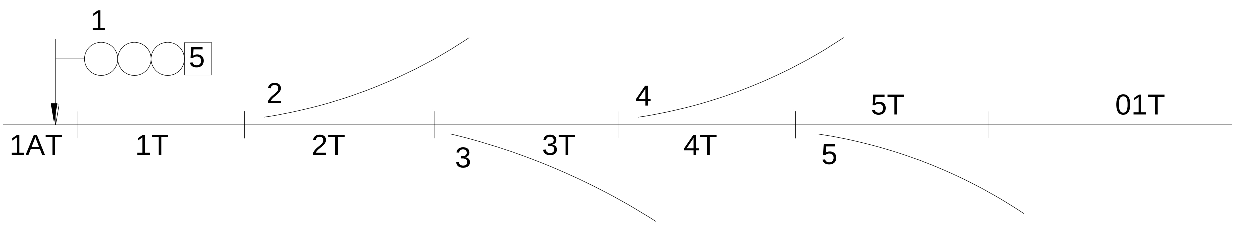


Fig: 2.29

When Sectional route release locking is adopted, the back locking is released, as soon as first point is cleared, so that the point can be used for other movements. In this case, when train clears 2T, the back locking is released as shown in Fig. 2.30.

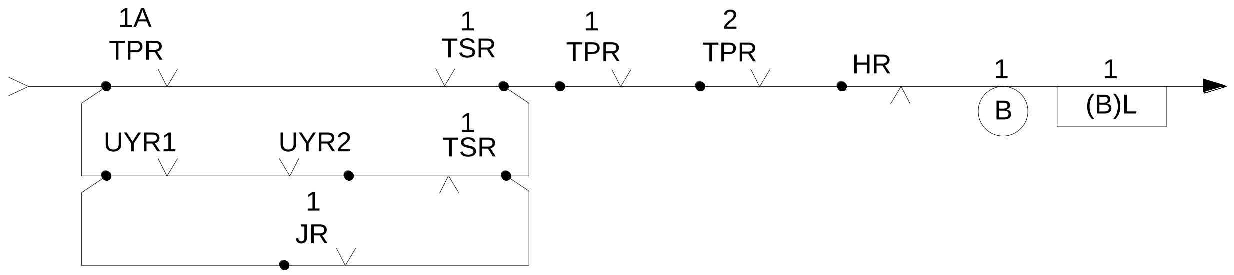


Fig: 2.30

When the signal lever is put back to normal all the point levers become free as far as mechanical interlocking is concerned. Lever no. 2 should be free for making other movements. However, point lever 3, 4 and 5 are to be kept locked since the train has yet to travel on these points. Out of these three points, point lever 3 is track locked, as such it cannot be operated. But point levers 4 and 5 are free in all respects. For holding these points, a relay called route lock stick relay (ULSR) is provided. Fig.2.31, 4/5 ULSR is provided for holding points 4 and 5. When signal lever 1 is operated to reverse, this relay drops and causes points 4 and 5 to be locked electrically. When the train clears 2T and occupies 3T, the signal lever 1 is replaced to Normal. Even though lever 1 is replaced to normal, 4/5 ULSR cannot pick up as 3TPR contact is not available in 4/5 ULSR circuit, with the result, points 3, 4 and 5 are held.

When the train clears 3T point 3 becomes free which can be utilised for other movements. Since 4T is included in the 4/5 ULSR circuit, 4/5 ULSR cannot pick up. Points 4 and 5 still cannot be operated. When train clears 4T, 4/5 ULSR is energised and releases point 4 for further use, since the train is now on 5T point 5 cannot be operated as it is held by track locking. When train clears 5T, point 5 also becomes free.

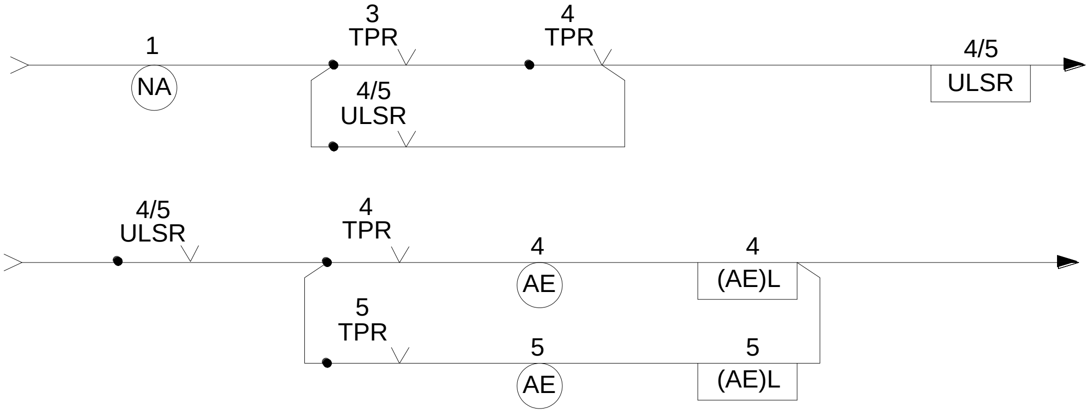


Fig: 2.31

It can be seen with this example, as the train clears each point section, the point in rear is released for simultaneous moves when points ahead re held till the train clears them in turn.

So far, it is seen how the route is released section by section when the signal is cleared with points 2, 3, 4, and 5 in normal position. If the signal is cleared for the other roads with either 2 reversed or 3 reversed, then also 4/5 ULSR may drop and cause points 4 and 5 to be locked. It is an accepted practice, that the points over which movements are not done should not be locked as it can be used for some other movements, where feasible, or it can be used for maintenance or testing purposes.

In this case points 4 and 5 should be kept free when signal is cleared with 2 or 3 reversed. This is achieved by bridging Normal contact of lever 1 in 4/5 ULSR circuit with reverse contact of 2 or 3 as the case may be Fig. 2.32. By providing such an arrangement, it is ensured that when lever 1 is operated with 2 or 3 reversed, 4/5 ULSR will not drop and hence, point 4 and 5 are free.

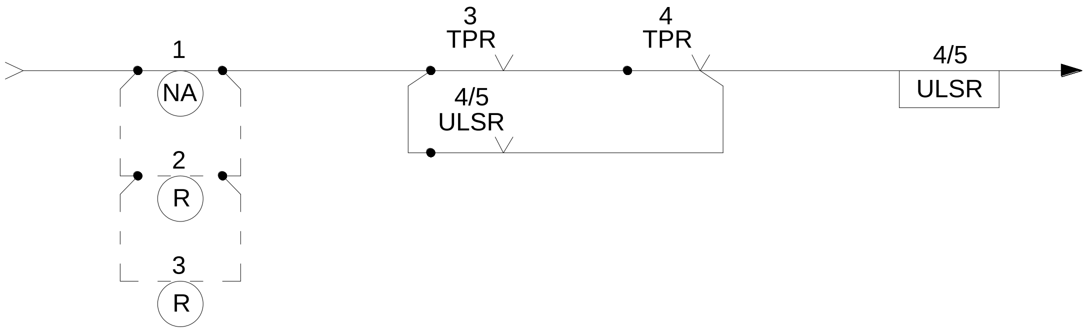


Fig: 2.32

From the circuits adopted for sectional Route Release, it can be seen that the back lock on the signal is released as soon as the train clears 2T and on 3T point number 3 is track locked and points 4 & 5 are held by the respective ULSR. Now that point 2 is free, the same may be operated to R for another movement while the points in advance i.e. 3, 4, 5 are held by track locking and ULSR.

But if 4/5 ULSR fails to drop when the signal is cleared for the train, then the full route will get released the moment the signal lever is normalized while the train is still negotiating the part of the route, as the points concerned (4 & 5) which should have been held by 4/5ULSR are now free. This is an unsafe condition and may lead to an accident. It is therefore necessary that before clearing a signal it shall be ensured that the concerned ULSRs have already de-energised and the points in the respective sub routes are locked electrically.

Separate ULSRs are to be used for movement in opposite directions as necessary. These ULSRs are called ULSRs (EAST) and ULSRs (WEST) according to direction of movement. In the latest installations they are designated as TRSR (Track Right Stick Relay) and TLSR (Track Left Stick Relay) depending upon whether the movement is from left to right or from right to left.

In Route Relay Interlocking installations, with bigger yards, the point zones are divided into various sub-routes and each sub-route is associated with directional relays. TRSR and TLSR for right and left ward movements over the points, when points in the sub-routes are required to be released for further movements in rear of a particular movement (Right/left) of the train. To check proper functioning of these relays,

(a) Before clearing any signal leading over the sub-route, its concerned directional relays are proved in de-energised condition in order to hold the points in that sub-route,

(b) It is preferred to prove opposite directional relays of sub-routes in energised condition, to ensure a movement in conflicting direction is not initiated.

CHAPTER 3: SELECTION TABLE / CONTROL TABLE

3.1 Selection Table / Control Table

This table gives details of various signals, the movement permitted, various conditions to be fulfilled electrically before taking OFF a signal and before releasing the route/overlap and also some special conditions. It comprises of many columns and furnishes details about various safety requirements, flexibility provided in the yard etc.

3.2 The Various Columns provided in the Selection Table are discussed below:

Selection Table can be divided into 2 major divisions,

(a) Columns controlling Route Releasing or Route Holding ((B) L or ASR circuits) Columns 5 & 6.

(b) Columns controlling signal clearance - columns 7 to 14 (HR/HHR/DR).

The details to be furnished in different columns are as follows:

Col.1 - Serial Number

Col.2 - Signal Number

Col.3. - Route

This column can be referred as

(i) Either Road 1, Road 2 etc., ii)up to next signal in advance (e.g. starters) or iii)to clear of the first opposing signal (e.g. shunts) or may be identified by an alphabet 1A,1B etc.

Col.4. Aspect of Signal

This means OFF aspect of the signal. Each OFF aspect may be dealt separately viz., HG, HG+UG, HHG, DG etc.

Col.5. Approach Locked by:

This column provides the conditions to be satisfied for cancelling the movement (for both Approach and Dead Approach Locking). For providing approach locking, the length of the approach track circuit shall be adequate. It is therefore decided to have for

(i) Home signal (FSS) - Normal Breaking Distance (NBD) + Reaction Distance.(RD)

(ii) Starters - Berthing Tracks

(iii) Shunts - The tracks from which train is expected to start

Otherwise, it shall be mentioned with 60/120 sec. time delay as the case may be.

It may be noted that for a run through movement, the approach locking for main line starter will be effective from the first stop signal in rear, when signals are controlled by a centralised agency.

Time delay mentioned ensures, the movement cannot be cancelled unless the specified time delay is elapsed when

(a) Train is on approach track, in case of approach locking

Or

(b) When movement to be cancelled in case of Dead Approach locking.

Col.6. Back locked by:

All signals except calling-on signal will have to be given this condition, by proving track circuits up to the last point track in the route excluding the berthing tracks. For calling on signal since, no track circuit is proved, the route release can be effected after a time delay irrespective of the condition of the track circuits.

Col.7.Controlled by Tracks:

Various conditions to be proved for clearing signals in this column are explained vide 1.2 (c)

Col.8. Controlled by aspect of signal ahead:

This column provides the necessary Red lamp protection as explained vide Para 1.2. (r) The conditions to be proved are,

For Home Signal to main line - the aspect of respective main line starter if controlled by same agency (controlled by slot).

For all Starter Signals - the respective intermediate starter/ LSS ahead.

However proving the aspect of signal ahead is not required for calling-on signal, home signal onto loop line, shunt signal and last stop signal.

Col.9. Controlled by Crank handle *zone:*

This column provides various groups of crank handle to be proved. The minimum number of crank handles to be provided on single line is 2 and the same on double line is 3. It may also be noted that the crank handle pertaining to isolation points (though not on the route) shall be indicated. Please refer para 4.1 of this notes for more details.

***Note: -** Crank handle interlocking is applicable to motor operated points only.*

Col.10. & 11 Locks and Detects Points:

The various conditions to be proved in these columns are explained vide Para 1.2.(a)

Col.12 Locks Signals:

The various conditions under which signals to lock each other are explained vide Para 1.2.(g).

Col.13.Other Controls:

Normally the selection table/control table is drawn with respect to the place of operation. If a signal is controlled by other agencies, other than the place of operation, those controls are to be specified in this column, to ensure before clearing the signal.

They are:-

(a) Slot (if any)

(b) Block Control

(c) LC Gate (if any)

(d) Locally operated points (if any).

(e) Plungers in the case of trains dealt from track circuit to non track circuited lines or goods lines.

Col.14. Remarks:

This column meant for any other conditions to be fulfilled before clearing a signal and not covered by any of the columns above.

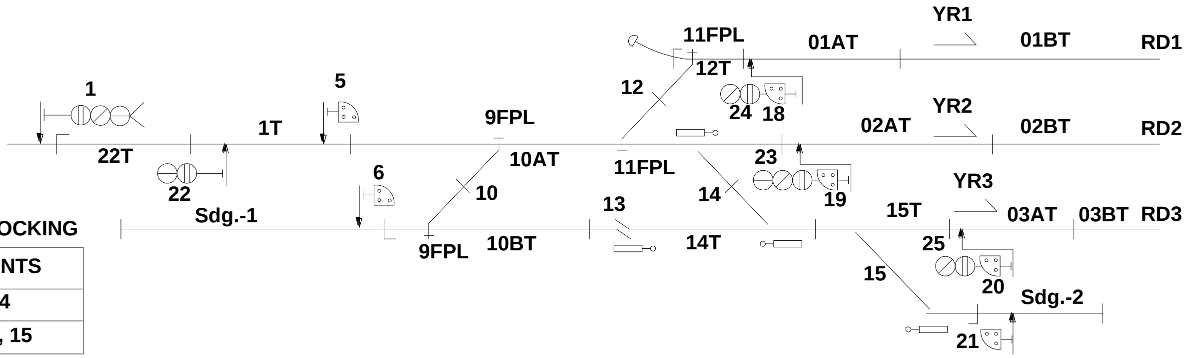
They are

(a) Signal with junction type route indicator for straight line All UHRs & UECR↓
Diversion Lines - Concerned UHR↑ UECR↑

(b) Calling on signal

The required time delay to be specified for clearing calling on signal after occupation of respective calling on track, and written as ‘Clears after 120 seconds of the calling on track occupied’

This column can also be used to indicate the reckoning of adequate distance. For example: Overlap reckoned short of LC Gate, Overlap reckoned short of fouling points, zero adequate distance etc.



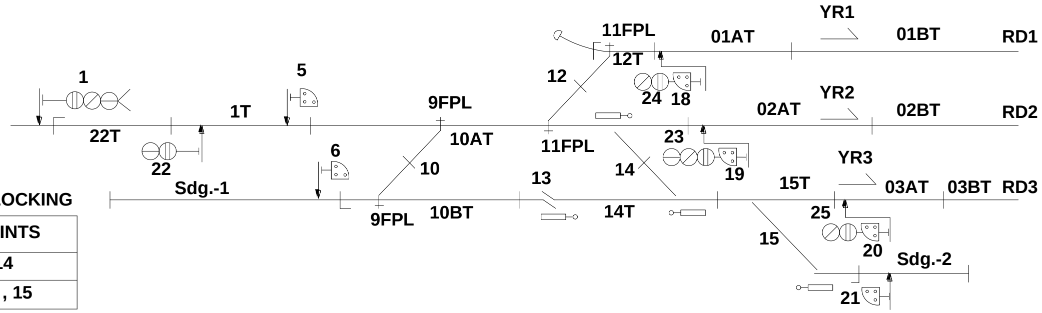
CRANK HANDLE INTERLOCKING

ZONE	POINTS
1	14
2	13 , 15

Fig. 3.1

TABLE OF CONTROL FOR FIG. 3.1

S No	SIG No	ROUTE	ASPECT	APPROCHED LOCK BY	BACK LOCKED BY	CONTROLLED BY			LOCK AND DETECTS POINT		LOCKS SIGNAL	OTHER CONTROLS	REMARK
						TRACK	ASPECT OF SIG AHEAD	CRANK HANDLE ZONE	NORMAL	REVERSE			
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1	RD1	Y^{R1}	DA (120 sec)	22T,1T,10AT,12T	22T,1T,10AT,12T, 01AT,01BT	-	1	10,14	12	5,18,22,24	$1YR_1\uparrow$	$1UYR_1\uparrow$ $1UECR\uparrow$
2	1	RD2	Y	DA(120 sec)	22T,1T,10AT	22T,1T,10AT,02AT ,02BT	-	1	10,12,14	-	5,19,22,23	$1YR_2\uparrow$	$1UHR_1\downarrow$,$1UHR_3\downarrow$, $1UECR\downarrow$
3	1	RD2	G	DA(120 sec)	22T,1T,10AT	22T,1T,10AT,02AT ,02BT	-	1	10,12,14	-	5,19,22,23	$1YR_2\uparrow$, $3DECR\uparrow$	$1UHR_1\downarrow$,$1UHR_3\downarrow$, $1UECR\downarrow$
4	1	RD3	Y^{R2}	DA(120 sec)	22T,1T,10AT, 14T,15T	22T,1T,10AT,15T, 14T,03AT,03BT	-	1,2	10,12, 13,15	14	5,20,22,25	$1YR_3\uparrow$	$1UHR3\uparrow$,$1UECR\uparrow$
5	5	RD1	OFF	1T (60 sec)	10AT,12T	10AT,12T	-	-	10	12	1,18,22,24	-	-
6	5	RD2	OFF	1T (60 sec)	10AT	10AT	-	1	10,12,14	-	1,19,22,23	-	-
7	5	RD3	OFF	1T (60 sec)	10AT,14T,15T	10AT,14T,15T	-	1,2	10,12,15	14	1,20,22,25		
8	5	SDGII	OFF	1T (60 sec)	10AT,14T,15T	10AT,14T,15T	-	1,2	10,12	14,15	21	-	-
9	6	RD1	OFF	DA (60sec)	10BT,10AT,12T	10BT,10AT,10T	-	-	-	10,12	18	-	-
10	6	RD2	OFF	DA (60sec)	10BT,10AT,	10BT,10AT	-	1	12,14	10	19	-	-
11	6	RD3	OFF	DA (60sec)	10BT,14T,15T	10BT,14T,15T	-	1,2	10,14,15	13	20	-	-
12	6	SDGII	OFF	DA (60sec)	10BT,14T,15T	10BT,14T,15T	-	1,2	10,14	13,15	21	-	-



CRANK HANDLE INTERLOCKING

ZONE	POINTS
1	14
2	13 , 15

S No	SIG No	ROUTE	ASPECT	APPROCHED LOCK BY	BACK LOCKED BY	CONTROLLED BY			LOCK AND DETECTS POINT		LOCKS SIGNAL	OTHER CONTROLS	REMARKS
						TRACK	ASPECT OF SIG. AHEAD	CRANK HANDLE ZONE	NORMAL	REVERSE			
1	2	3	4	5	6	7	8	9	10	11	12	13	14
13	18	TO CLEAR OFF 5	OFF	01AT,01BT (60sec)	12T,10AT	12T,10AT	-	-	10	12	1,5,22,24	-	-
14	18	TO CLEAR OFF 6	OFF	01AT,01BT (60sec)	12T,10AT,10BT	12T,10AT,10BT	-	-	-	12,10	6	-	-
15	19	TO CLEAR OFF 5	OFF	02AT,02BT (60sec)	10AT	10AT	-	1	14,12,10	-	1,5,22,23	-	-
16	19	TO CLEAR OFF 6	OFF	02AT,02BT (60sec)	10AT,10BT	10AT,10BT	-	1	14,12	10	6	-	-
17	20	TO CLEAR OFF 5	OFF	03AT,03BT (60sec)	14T,10AT,15T	14T,10AT,15T	-	1,2	15,12,10	14	1,5,22,25	-	-
18	20	TO CLEAR OFF 6	OFF	03AT,03BT (60sec)	14T,10bT,15T	14T,10BT,15T	-	1,2	15,1,10	13	6	-	-
19	21	M/L	OFF	DA (60sec)	15T,14T,10AT	15T,14T,10AT	-	1,2	10,12	14,15	5,22	-	-
20	21	SD-1	OFF	DA (60sec)	15T,14T,10BT	15T,14T,10BT	-	1,2	10,14	13,15	6	-	-
21	22	BLOCK SECTION	G	-	-	22T	-	-	15W14R	-	1,5,18,19, (20W14R)	L.C.OBTAINED	-
22	23	M/L	Y	02AT,02BT (60sec)	10AT	10AT,1T	22R/G	1	14,12, 10	-	1,5,19	-	-
23	23	M/L	G	02AT,02BT (60sec),ATR↑ *	10AT	10AT,1T	22G	1	14,12, 10	-	1,5,19	-	-
24	24	M/L	Y	01AT,01BT (60sec)	12T,10AT	12T,10AT,1T	22R/G	-	10,14	12	1,5,18	-	-
25	25	M/L	Y	03AT,03BT (60sec)	14T,10AT,15T	14T,10AT,1T, 15T	22R/G	1,2	15,13, 12,10	14	1,5,20	-	-

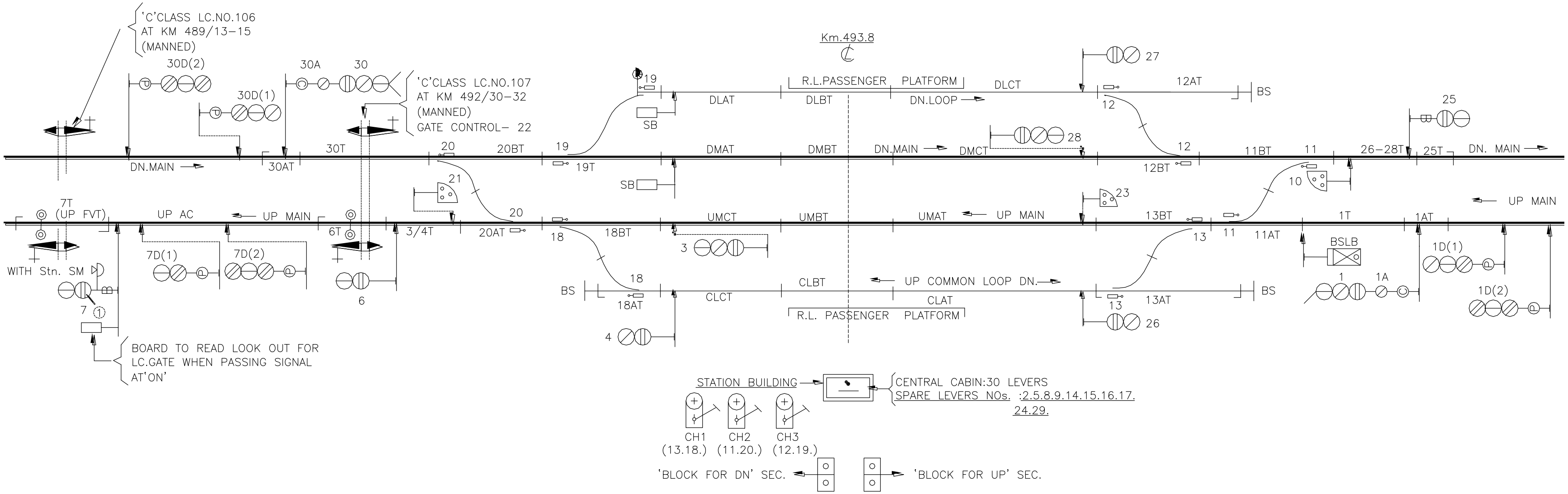

'C'CLASS LC.NO.106
AT KM 489/13-15
(MANNED)
30D(2)
30D(1)
30A
30
'C'CLASS LC.NO.107
AT KM 492/30-32
(MANNED)
GATE CONTROL- 22
Km.493.8
R.L.PASSENGER PLATFORM
DLCT
12AT
BS
27
25
DLAT
DLBT
DN.LOOP
SB
DN.MAIN
30AT
30T
20
20BT
19
19T
DMAT
DMBT
DN.MAIN
DMCT
28
12
12BT
11BT
11
26-28T
25T
DN. MAIN
7T
(UP FVT)
UP AC
UP MAIN
6T
3/4T
20AT
21
18
18BT
UMCT
UMBT
UMAT
UP MAIN
13BT
13
11AT
1T
1AT
UP MAIN
10
23
WITH Stn. SM
7D(1)
7D(2)
6
3
BSLB
1D(1)
1D(2)
1
1A
BS
18AT
CLCT
CLBT
UP COMMON LOOP DN.
CLAT
13AT
BS
26
R.L. PASSENGER PLATFORM
4
7
BOARD TO READ LOOK OUT FOR
LC.GATE WHEN PASSING SIGNAL
AT'ON'
STATION BUILDING
CENTRAL CABIN:30 LEVERS
SPARE LEVERS NOs. :2.5.8.9.14.15.16.17.
24.29.
CH1
(13.18.)
CH2
(11.20.)
CH3
(12.19.)
'BLOCK FOR DN' SEC.
'BLOCK FOR UP' SEC.

Fig No: 3.2

CONTROL TABLE (FOR LAYOUT in Fig 3.2)

SL. NO.	SIGNAL NO.	DESTINA-TION	LOCKS / DETECTS POINT						CONTROLLED BY TRACK CIRCUITS			OTHER CONTROLS IF ANY	APPROACH LOCKED BY TRACK CIRCUITS	BACK LOCKED BY TRACK CIRCUITS	LOCKS SIGNALS	SIGNAL ASPECT				REMARKS
			ROUTE		ISOLATION		OVERLAP													
			NOR	REV	NOR	REV	NOR.	REV.	ROUTE	OVERLAP	FOULING	CH, LXC, SDG SLOT, etc.				Y WITH ROUTE IF	Y IF	YY IF	G IF	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
1	1D(2)	1D(1)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1D(1) HG/ HHG/ DG	1D(1) DG/ HHG	DG CONTROLLED BY 1D(1) DG/HHG WITH POINT NO 13N
2	1D(1)	S1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 RG /HG/ DG	1 HG/ DG	1DG	
3	1	UP MAIN	11, 13	-	-	-	18, 20	-	1T,11AT, 13BT,UMT	18BT, 20AT, 3/4T	-	CH1,CH2	DEAD APPROACH	1T, 11AT, 13BT	1A,21	-	3 RG/H G/DG	-	3DG	TIME RTELESE 120 SEC
4	1	COMMON LOOP SET TO BS	11	13	-	-	18	-	1T,11AT, 13BT,13AT, CLT	18AT	-	CH1,CH2	DEAD APPROACH	1T, 11AT, 13BT, 13AT	1A,21	4 RG				TIME RTELESE 120 SEC 1UG REQUIRED
5	1	COMMON LOOP SET TO MAIN	11	13	-	-	20	18	1T,11AT, 13BT,13AT, CLT	18AT, 18BT, 20AT, 3/4T	-	CH1,CH2	DEAD APPROACH	1T, 11AT, 13BT, 13AT	1A,21	4 RG/ HG	-	-		TIME RTELESE 120 SEC 1UG REQUIRED
6	1A	UP MAIN	11, 13	-	-	-	-	-	1AT OCCUPIED	-	-	CH1,CH2	DEAD APPROACH	-	1,3,4,21 (30,30AW20R)	-	-	-	-	TIME RELEASE 240 SEC APPROACH CLEARED AFTER 120 SEC COGGN
7	1A	COMMON LOOP	11	13	-	-	-	-	1AT OCCUPIED	-	-	CH1,CH2	DEAD APPROACH	-	1,4,21, (30AW20R)	-	-	-	-	TIME RELEASE 240 SEC APPROACH CLEARED AFTER 120 SEC COGGN
8	3	UP MAIN	18, 20	-	-	-	-	-	18BT,20AT,3 /4T	-	-	CH1,CH2	UMT (1W13N)	18BT, 20AT	(1AW13N), 10W11R13N) ,21,23	-	6RG/ DG	-	6DG	TIME RLEASE 120 SEC DG CONTROLLED BY 6DG
9	4	UP MAIN	20	18	-	-	-	-	18AT,18BT,2 0AT, 3/4T	-	-	CH1,CH2	CLT	18AT, 18BT, 20AT	A, (10W11R), 21,26	-	6RG/ DG	-	-	TIME RELESE 120 SEC
10	6	7D(2)	20	-	-	-	-	-	6T, UP ACPR	-	-	CH2,22LX	-	-	21	-	-	-	7D(2) HHG/ HG	-
11	7D(2)	7D(1)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7D(1) HG	7D(1) HG/ DG	DG CONTROLLED BY 7D(1) DG
12	7D(1)	7 UP IBS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7 RG/ DG	-	7DG	DG CONTROLLED BY 7 DG
13	7	UP MAIN	-	-	-	-	-	-	7T	-	-	-	-	-	-	-	-	-	-	CONTROLLED BY UP SIDE BLOCK INSTRUMENT

SELECTION TABLE / CONTROL TABLE

SL. NO.	SIGNAL NO.	DESTINA-TION	LOCKS / DETECTS POINT: ROUTE NOR	LOCKS / DETECTS POINT: ROUTE REV	ISOLATION NOR	ISOLATION REV	OVERLAP NOR.	OVERLAP REV.	CONTROLLED BY TRACK CIRCUITS: ROUTE	CONTROLLED BY TRACK CIRCUITS: OVERLAP	CONTROLLED BY TRACK CIRCUITS: FOULING	OTHER CONTROLS IF ANY: CH, LXC, SDG SLOT, etc.	APPROACH LOCKED BY TRACK CIRCUITS	BACK LOCKED BY TRACK CIRCUITS	LOCKS SIGNALS	SIGNAL ASPECT: Y WITH ROUTE IF	SIGNAL ASPECT: Y IF	SIGNAL ASPECT: YY IF	SIGNAL ASPECT: G IF	REMARKS
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
14	10	DN LOOP	11	12	-	-	-	-	11BT,12BT,12AT	-	-	CH1,CH3	26-28T	11BT, 12BT, 12AT	25,27,30, (30AW20N)	-	-	-	-	TIME RELEASE 120 SEC
15	10	DN MAIN	11, 12	-	-	-	-	-	11BT,12BT	-	-	CH1,CH3	26-28T	11BT, 12BT	25,28,30,30A	-	-	-	-	TIME RELEASE 120 SEC
16	10	UP MAIN	13	11	-	-	-	-	11BT,11AT,13BT	-	-	CH1,CH2	26-28T	11BT, 11AT, 13BT	3,4,23,25, (21W18N) (30AW19R12R), (30,30AW19N)	-	-	-	-	TIME RELEASE 120 SEC
17	10	COMMON LOOP	-	11, 13	-	-	-	-	11BT,11AT,13BT,13AT	-	-	CH1,CH2	26-28T	11BT, 11AT, 13BT, 13AT	4,25,26, (21W18R), (30AW19R12R), (30,30AW19N)	-	-	-	-	TIME RELEASE 120 SEC
18	21	UP MAIN	20, 18	-	-	-	-	-	20AT,18BT	-	-	CH1,CH2	3/4T	20AT, 18BT	1,1A,3,6,26, (10W11R13N)	-	-	-	-	TIME RELEASE 120 SEC
19	21	COMMON LOOP	20	18	-	-	-	-	20AT,18BT,18AT	-	-	CH1,CH2	3/4T	20AT, 18BT, 18AT	1,1A,4,6,26, (10W11R13R)	-	-	-	-	TIME RELEASE 120 SEC
20	23	DN MAIN	13	11	-	-	-	-	13BT,11AT,11BT	-	-	CH1,CH2	UMT	13BT, 11AT, 11BT	3,10,25, (30AW20N19N) (30AW19R12R)	-	-	-	-	TIME RELEASE 120 SEC
21	25	DN MAIN	-	-	-	-	-	-	25T	-	-	-	-	-	10,23	-	-	-	-	CONTROLLED BY DN SIDE BLOCK INSTRUMENT
22	26	DN MAIN	-	10, 13	12	-	-	-	13AT,13BT,11AT,11BT, 26-28T	-	-	CH1,CH2,CH3	CLT	13AT, 13BT, 11AT, 11BT,	4,10,21, (30AW19N)	-	25 RG/ DG	-	-	TIME RELEASE 120 SEC
23	27	DN MAIN	11	12	-	-	-	-	12AT,12BT,11BT, 26-28T	-	-	CH2,CH3	DLT	12AT, 12BT, 11BT	10, (30AW20N)	-	25 RG/ DG	-		TIME RELEASE 120 SEC
24	28	DN MAIN	11, 12	-	-	-	-	-	12BT,11BT,26-28T	-	-	CH2,CH3	DMT (30W19N20N)	12BT, 11BT	10, (30AW19N20N)	-	25 RG/ DG	-	25 DG	DG CONTROLLED BY 25 DG TIME RELEASE 120 SEC
25	30	DN LOOP SET TO BS	20	19	-	-	12	-	30T,20BT, 19T,DLT	12AT	-	CH2,CH3, 22LX	DEAD APPROACH	30T, 20BT, 19T	(10W11N), 30A	27 RG	-	-	-	30 UG REQUIRED TIME RELEASE 120 SEC
26	30	DN LOOP SET TO MAIN LINE	20	19	-	-	11	12	30T,20BT, 19T,DLT	12AT, 12BT, 11BT, 26-28T	-	CH2,CH3, 22LX	DEAD APPROACH	30T, 20BT, 19T	10,30A	27 RG/ HG	-	-	-	30UG REQUIRED TIME RELEASE 120 SEC

SL. NO.	SIGNAL NO.	DESTINA-TION	LOCKS / DETECTS POINT: ROUTE NOR	ROUTE REV	ISOLATION NOR	ISOLATION REV	OVERLAP NOR.	OVERLAP REV.	CONTROLLED BY TRACK CIRCUITS: ROUTE	OVERLAP	FOULING	OTHER CONTROLS IF ANY: CH, LXC, SDG SLOT, etc.	APPROACH LOCKED BY TRACK CIRCUITS	BACK LOCKED BY TRACK CIRCUITS	LOCKS SIGNALS	SIGNAL ASPECT: Y WITH ROUTE IF	Y IF	YY IF	G IF	REMARKS
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
27	30	DN MAIN	19, 20	-	-	-	11, 12	-	30T,20BT, 19T,DMT	12BT, 11BT, 26-28T	-	CH2,CH3, 22LX	DEAD APPROACH	30T, 20BT, 19T	10,30A	-	28 RG/ HG/ DG	-	28 DG	TIME RELEASE 120 SEC
28	30	COMMON LOOP SET TO BS	-	20, 18	19	-	13	-	30T,20BT, 20AT,18BT,18AT,CLT	13AT	-	CH1,CH2, CH3,22LX	DEAD APPROACH	30T, 20BT, 20AT, 18BT, 18AT,	1A,30A, (10W11Ror12N)	26 RG	-	-	-	30UG REQUIRED TIME RELEASE 120 SEC
29	30	COMMON LOOP SET TO MAIN	-	20, 18	19	-	-	13, 11	30T,20BT, 20AT,18BT,18AT,CLT	13AT, 13BT, 11AT, 11BT, 26-28T	-	CH1,CH2, CH3,22LX	DEAD APPROACH	30T, 20BT, 20AT, 18BT, 18AT	10,30A	26 RG/ HG	-	-	-	30UG REQUIRED TIME RELEASE 120 SEC
30	30A	DN LOOP	20	19	-	-	-	-	30AT OCCUPIED	-	-	CH2,CH3, 22LX	DEAD APPROACH	-	(10W11Nor12R), (23W12R),27,30	-	-	-	-	TIME RELESE 240 SEC APP CLEARED AFTER 120 SEC COGGN
31	30A	DN MAIN	20, 19	-	-	-	-	-	30AT OCCUPIED	-	-	CH2,CH3, 22LX	DEAD APPROACH	-	10,23,26, 27, 28,30	-	-	-	-	TIME RELESE 240 SEC APP CLEARED AFTER 120 SEC COGGN
32	30A	COMMON LOOP	-	20, 18	19	-	-	-	30AT OCCUPIED	-	-	CH1,CH2, CH3, 22LX	DEAD APPROACH	-	1A,26,30, (10W11Ror12N)	-	-	-	-	TIME RELESE 240 SEC APP CLEARED AFTER 120 SEC COGGN
33	30D(2)	30D(1)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30D(1) /HG /HHG /DG	30D(1) / DG / HHG	DG CONTROLLED BY 30D(1) DG/HHG WITH POINT 19N 20N
34	30D(1)	S30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30 RG /HG /DG	30 HG /DG	30 DG	

CHAPTER 4: CRANK HANDLE, SIDING CONTROL CIRCUITS AND CALLING ON SIGNAL

4.1 Crank Handle Interlocking

Where points are operated by point machines, crank handles are provided to facilitate operation of points manually in case of failure. The manual operation of points after a signalled move has been given may endanger the train. Therefore it is necessary that the crankhandle is interlocked with signals suitably.

It is not possible to provide crank handle interlocking for every point individually. At the same time it is not proper to have only one crank handle common for all the points also. Therefore points are grouped to achieve optimum flexibility. This is explained in IRISET notes S12.

Crank handle interlocking is done as follows:

(a) Whenever a signaled move is given it shall not be possible to release the crank handle which is kept locked inside an electrical key transmitter (HKT/RKT/EKT)or in a special relay (KLCR) meant for this purpose.

(b) When the crank handle is OUT it shall not be possible to clear any signal concerned

For the above purposes, the crank handle is normally kept locked in an EKT/RKT/HKT and this condition enables the crank handle Relay (CHLR, CHR) to be energized. The crank handle gets locked, when the key fitted to it is inserted in the EKT/KLCR and turned.

When the key is extracted the relay drops and hence the signals interlocked with it cannot be taken off. To ensure that CHLR drops before the actual extraction of the key/crank handle the CHLR circuit is modified. When the economizer push is pressed for extracting the crank handle, it breaks the supply to CHLR and CHLR drops. Unless CHLR drops extraction of crank handle is not possible.

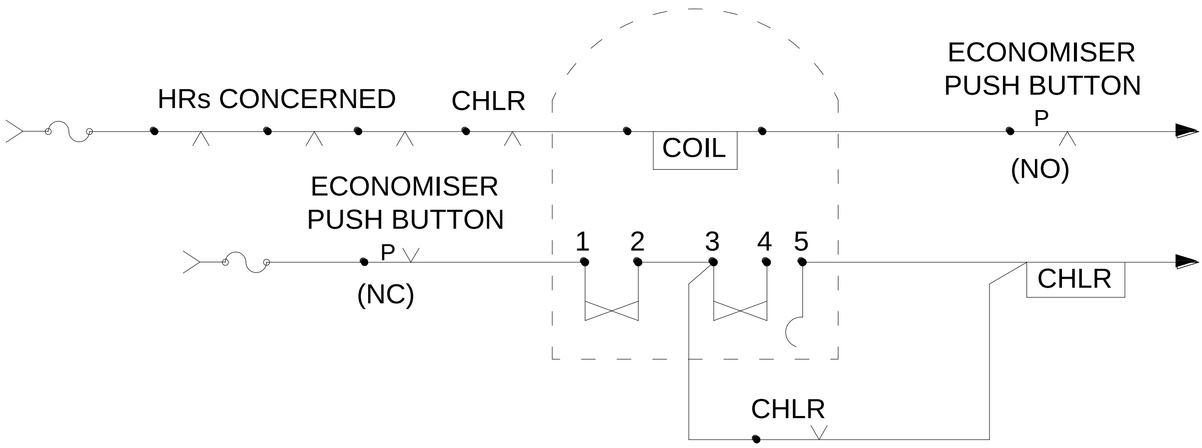


Fig: 4.1

4.2 SIDING CONTROL

Sidings are provided at the stations to:

(a) detach vehicles from the rake formation and stable the same for loading/unloading or to attend to the defects noticed and also

(b) To stable the tower wagon / tamping machine / ballast train etc.

Siding points may either be operated from the cabin/panel directly or operated locally but controlled by cabin/panel.

Operation of siding points directly from the cabin/panel is resorted to, only if the movements over these points are frequent. In such cases these points are interlocked directly as done in other running points and also these sidings may be provided with shunt signals to control the movements.

Where there are no frequent movements over the siding then these points are operated locally, but controlled from the cabin/panel. The siding points remain in locked position and the same can be released only when there is no signaled movement over it.

Siding points are operated from a Ground Lever frame situated adjacent to the respective siding point. Ground lever frame can be released only when the concerned E type key either physically brought from the, cabin or transmitted electrically and is inserted in the Ground Lever. E type key at the cabin Is extracted after reversing the siding control lever/knob/ button in case of relay interlocking which will be possible only when the signal levers/controls concerned are normal and other interlocking are favourable and safe.

Siding points interlocking where achieved through electrical transmission of the key of E type lock/RKT, following arrangements are provided:

A pair of electrical key transmitters is provided; one at the cabin and the other at the siding. The key at the siding remains locked in the EKT, once inserted and turned. The siding key in and locked together with the Ground frame Normal are proved in the siding NPR circuit and NPR is proved in the signal clearance circuits concerned(HR circuit).

Thus these signals cannot be taken if the key has been transmitted to the siding for the local operation of the same as NPR drops, once the key is extracted.

To reduce the time taken for the shunting movements over the siding point, the key is kept locked in the EKT kept inside a location box adjacent to the siding. EKT is energized through a relay, Siding YR which is controlled from the cabin/panel.

Siding YR can be energized only when:

(i) The signals concerned are at ON

(ii) Respective siding control lever/switch is reversed.

When siding YR energizes, free indications at the BKT appears and the siding key is released by pressing the economizer push. The siding key thus extracted is inserted in the Ground frame and siding point is operated. After the completion of the shunting movements over the siding point, the Ground frame is normalized and the key is taken out, inserted in EKT and turned.

When the key is turned a relay Siding NPR picks up at the cabin/panel. The signals concerned can be taken off only when the siding NPR is energized.

CONTROL OF SIDING THRO EKT. AT SITE

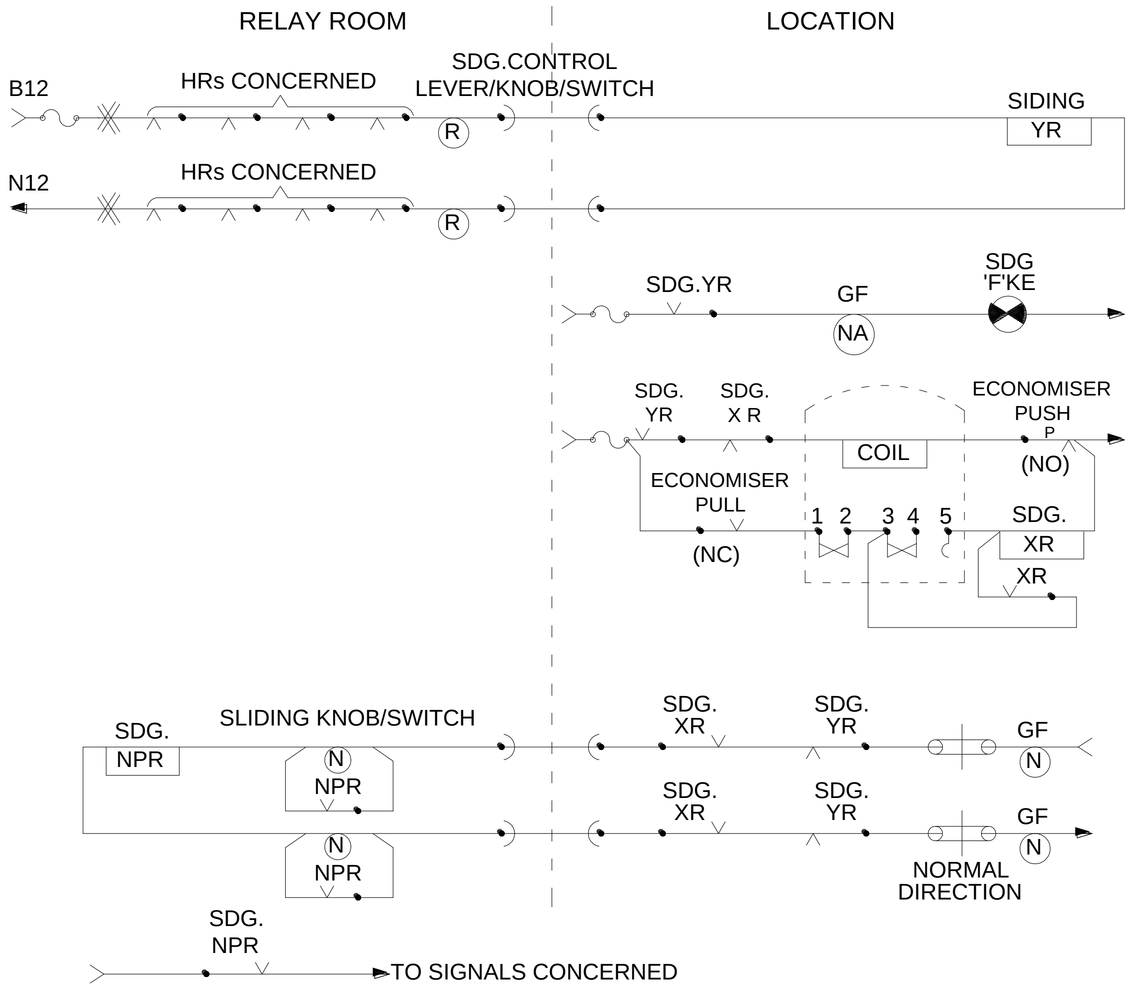


Fig : 4.2

CONTROL OF SIDING BY PHYSICAL TRANSMISSION OF KEY

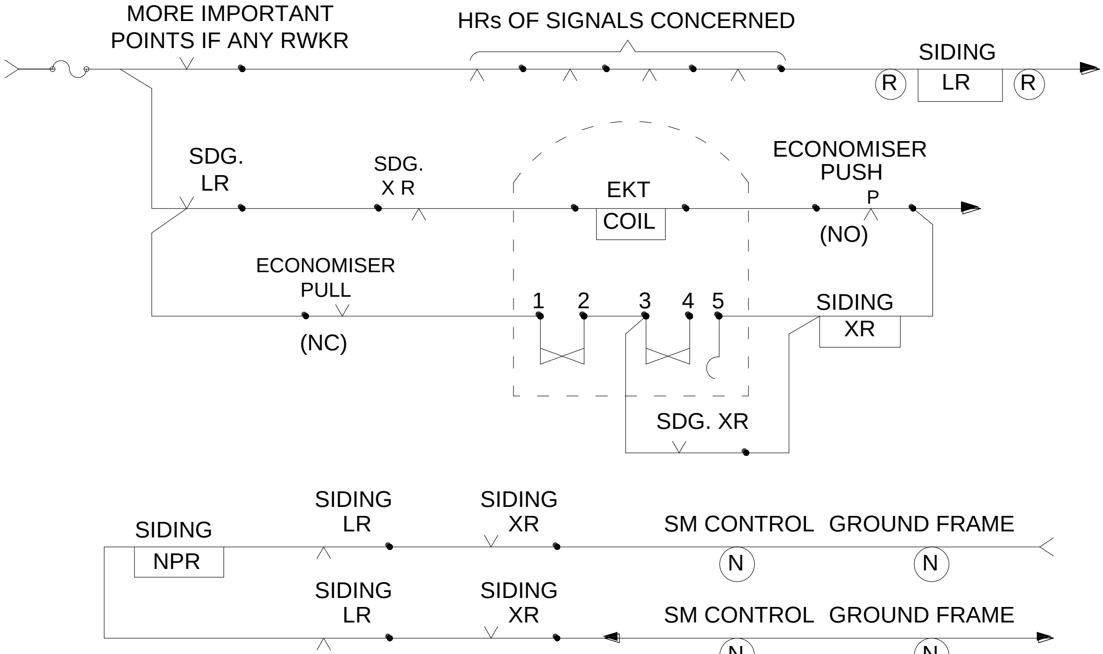


Fig : 4.3

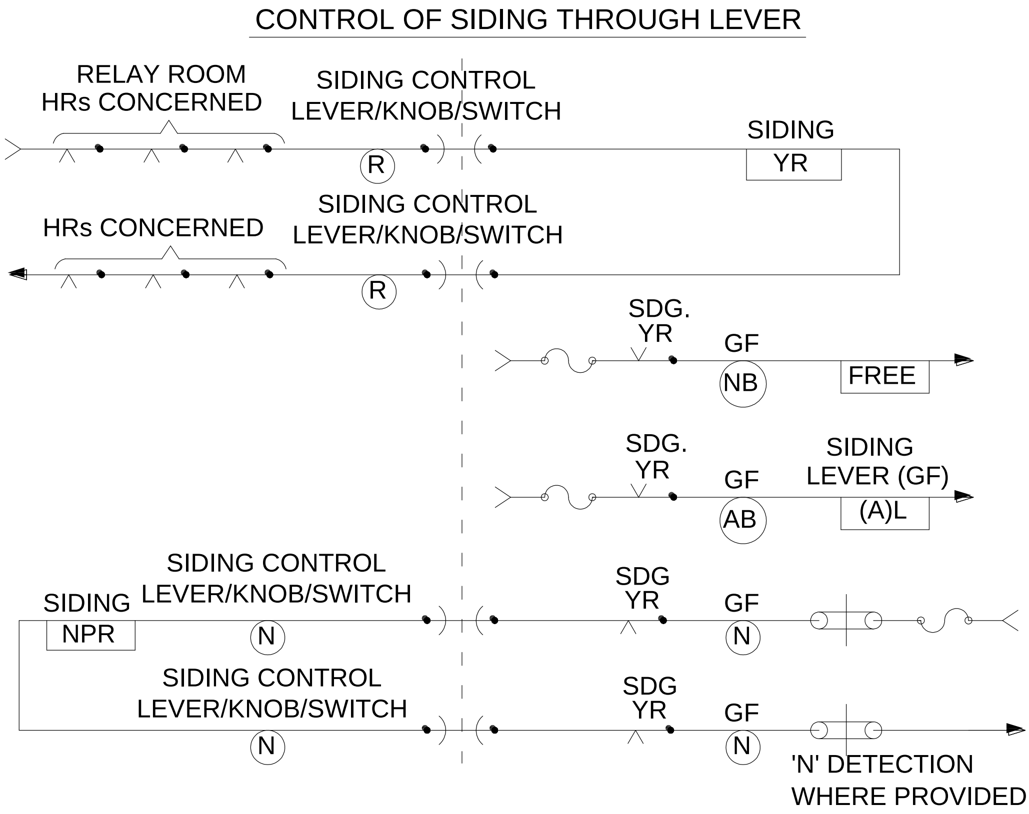


Fig: 4.4

4.3 CALLING ON SIGNAL

Calling on Signal: It is a subsidiary signal which can be fixed below any stop signal except LSS & Automatic Signal. It can't be provided on a post by itself. Calling on signal is taken off under any of the following conditions.

(a) To receive a train on an occupied line.

(b) When the main signal above it, can't be taken off due to

(i) Failure of track circuit in advance

(ii) Failure of points in overlap.

(iii) Signal in advance is blank

(iv) Failure of route indicator

Calling on signal can however be taken off only when the train has come to a stop at the foot of the signal.

Before taking off the calling on signal, the following conditions are to be fulfilled:-

(a) All points in the route including isolation are correctly set and locked.

(b) Calling on track is occupied.

(c) Crank Handles of the power operated points if any, are IN and locked.

(d) Signal in advance is not taken off

(e) Conflicting signals are at ON

(f) LC Gate in the route is closed and locked against the road traffic.

(g) Train has come to a halt at the foot of the signal. This is ensured by a time delay circuit which is initiated after ensuring that the train has come on the calling on track.

(h) Respective slot is received from the other agency (applicable to end panels/cabins). For the same route separate slots shall be given/obtained for the main signal as well as the calling on signal. On Double Line though points and track circuits in Overlap are not proved, separate slot is required for ensuring the interlocking of conflicting signals.

(i) Cross protection is provided to prevent energization of calling on HR by a foreign feed.

(j) Relevant control switch/button (COGGN) operated together with the main signal lever already in pulled condition

In case of automatic calling on HR circuit, calling on track circuit occupied status, completed predetermined time delay, the first track circuit in advance is clear and TSR↑ are proved. Calling on signal cannot be taken OFF if the signal above is exhibiting an OFF aspect. Therefore, it is necessary that the HR of signal above is proved in de-energized position.

In a lever frame although separate levers are not provided for controlling calling on signals, separate knob/switch or button is provided above the respective signal lever controlling the stop signal below which it is fixed. The operator is supposed to set the route for the movement intended, reverse the signal lever concerned and after ensuring that the train has come to a stop at the foot of the signal (by the respective calling on TPR↓ in case of closed track circuits and calling on TPR↑ in case of open track circuit shall initiate the time delay by operating the calling on signal knob/button (COGGN).

After the predetermined time delay the calling on signal can clear.

Calling on signal once cleared can be replaced to ON the moment the train clears the calling on track circuit or when the switch/lever concerned has been normalized, where the first track circuit in advance is not proved.

In automatic signalling sections, where there is a possibility of a second train also coming on the calling on track circuit passing the signal (automatic signal) in rear at ON; the calling on signal shall be replaced to ON the moment the first train passes it. For this purpose the first track circuit immediately in advance and the TSR concerned are proved in the calling on HR circuit.

* * *

CHAPTER 5: INDICATION CIRCUITS

5.1 TRACK CIRCUIT INDICATION CIRCUITS

The modern signalling has been developed on the basis of the track circuit in which the simple circuit is having inherent safety features and being the fundamental signalling circuit.

It fulfills all the requirements of a vital circuit by operating on closed circuit principle and fails only on safe side. These track circuits are used to indicate the presence of a train in a given portion of the track. To give a continuous indication to the operator in cabin regarding the presence of train in the area controlled by him, the back contact of the track repeating relays are used as shown in Fig. 5.1.

Fig: 5.1

For each track circuit on the illuminated diagram two lamps are provided to display the occupied status of track. In case of AC Track Circuits, it is preferable to give the track indications through the track repeating relays, as the AC Track relays sometimes fail to make the back contacts.

Additional track indications are made available on the illuminated diagram provided in the cabins with lever frame to indicate the clear condition of the track circuits concerned. These white indications are made available on the panel provided with relay interlocking and in Electro mechanical installations where the interlocking is achieved through relays, only when a signaled move is given i.e. normally when there is no signalled move given over the track circuit, no indication is given, though the track circuit is clear. White light appears only when the route is locked for a signaled move.

Track red indication appears when the track circuit has been occupied or failed, irrespective of whether the signaled move is given or not.

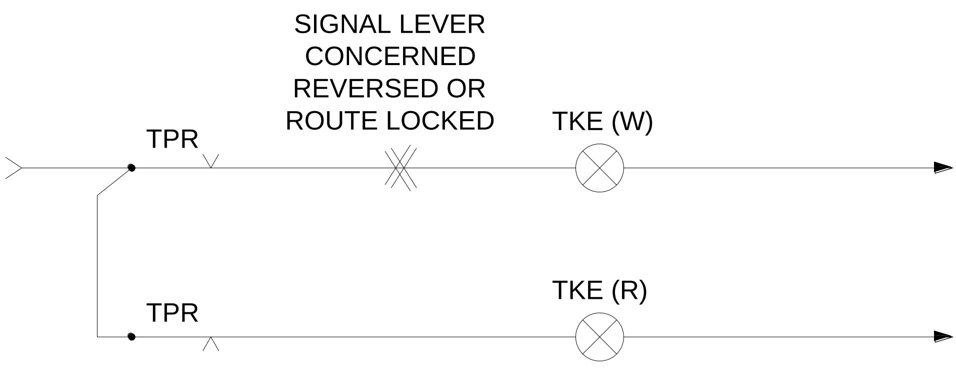


Fig: 5.2

5.2 There are three methods by which track indications can be provided in the Cabin/Panel.

5.2.1 Spot Light Type

The indications of track circuit are given by providing two bulbs at the ends of the track circuit boundaries on the illuminated diagram. Berthing Track circuits may be provided with four bulbs, since the length of track circuit is more.

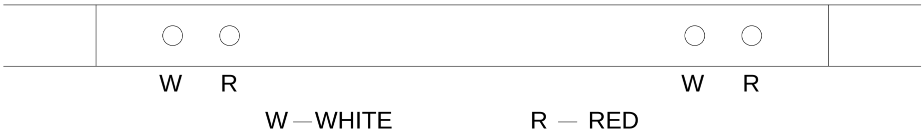


Fig: 5.3

Spot lights are provided for track circuits in cabin which are provided with illumination diagram above the lever frame, station equipped with SM's control slide Instrument for controlling points and signals and in level crossing gate in the block section.

5.2.2 Strip Light Type

The indication of track circuits is given by lighting strip in the illuminated diagram. These strips are provided with opaque front pieces and the indication bulbs are provided behind the opaque front pieces. As soon as the bulbs are lit the entire strip is illuminated and a number of strips arranged side by side can indicate the entire length of track circuit.

Fig: 5.4

Strip light indicators are provided on all panels of panel Interlocking and Route Relay Interlocking installations for track indications, junction type route indications, block arrow indications, point indications (example Domino panel), Axle Counter indications etc. These strip light indications may be arranged with either white or red colors by a strip/film kept in one of the grooves.

5.2.3 Luminous Indicators

These are provided in the cabins above the respective levers in main lever frame and also at ground frames, at level crossing gates, sidings, shunting necks, etc.

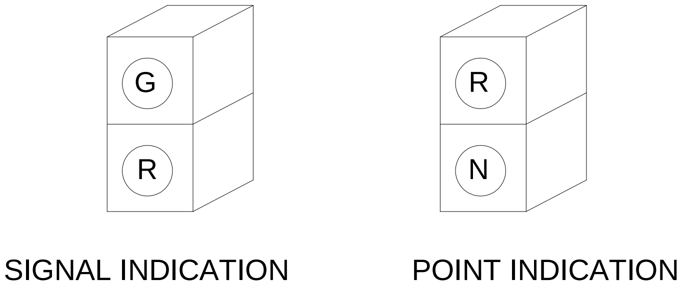


Fig: 5.5

These indicators are provided in an enclosed box and are of two types i)Stencil type with white light and ii)with different colors to repeat the aspects of signals. Stencil type is normally used for point indications, 'Free' indication & shunt signal indications.

5.3 Signal Indication Circuits

Normally aspect of signals is repeated individually in the cabin. When signals are controlled by levers, these indications are either provided above lever frame (luminous indicators) or in an illuminated diagram, to repeat the aspect of the signals controlled by that lever. These indications are repeated by different methods known as voltage drop method, current transformer method and Lamp checking relay method. These three methods are already discussed in detail in IRISET notes S10.

In case of signals controlled by slides/knobs/buttons, the aspects are repeated at the geographical location of the signal in the track diagram. These indications are taken through the respective lamp proving relay front contacts as shown in Fig 5.6 or by using 'I' type indication transformer, where proving of signal aspects is not mandatory in controlling any other circuits.

In some of the new signaling installations, flashing indications are also provided to indicate the fusing of lamps, so that they can be easily noticed and attended to, immediately.

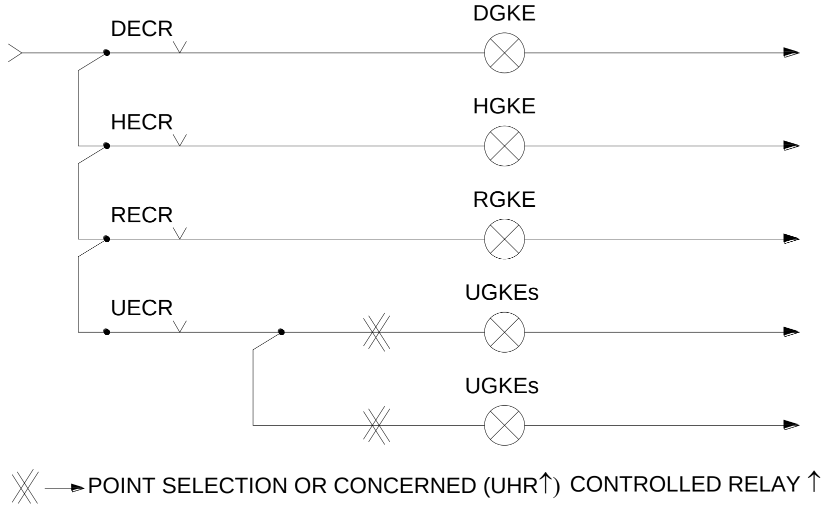


Fig: 5.6

Further, in siemen's system where common OFF aspect green indication is provided, for all OFF aspects viz. HG, HHG & DG. Flashing green indicates that the bulb which ought to have been lit is fused and another most restrictive aspect is lit through the cascading arrangement.

5.4 Point Indication Circuits

5.4.1 Luminous Indicators

To enable the operator to know the correct setting of points in the route, stencil type route indicators are normally provided above the lever controlling the point. These indications are given by the illumination of a stencil having a letter N when the points are lying in Normal and a letter R when the points are lying in Reverse. These indications are given through the normal/reverse contacts of point indication relays. (Fig 5.7) In addition F indication is also made available, to indicate that the points are free electrically. When provided above the respective point lever, an economizer push switch is also given to save energy.

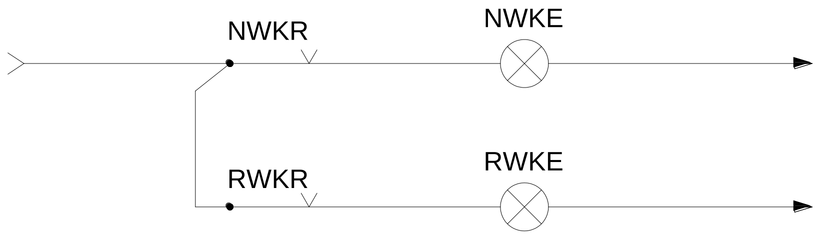


Fig: 5.7

5.4.2 Spot Light Indicators

Spot light indicators are provided on illuminated diagrams in the cabins or at stations, above the SM's slide instrument from where points and signals are operated. Spot light indications are also provided on the panel above the point knob concerned. Normal indication is given by a green light and reverse indication by yellow light, while white light indicates the electrically free condition of the point and red light indicates points are engaged in a route/track circuit concerned has failed/occupied.

5.4.3 Strip Light Indications

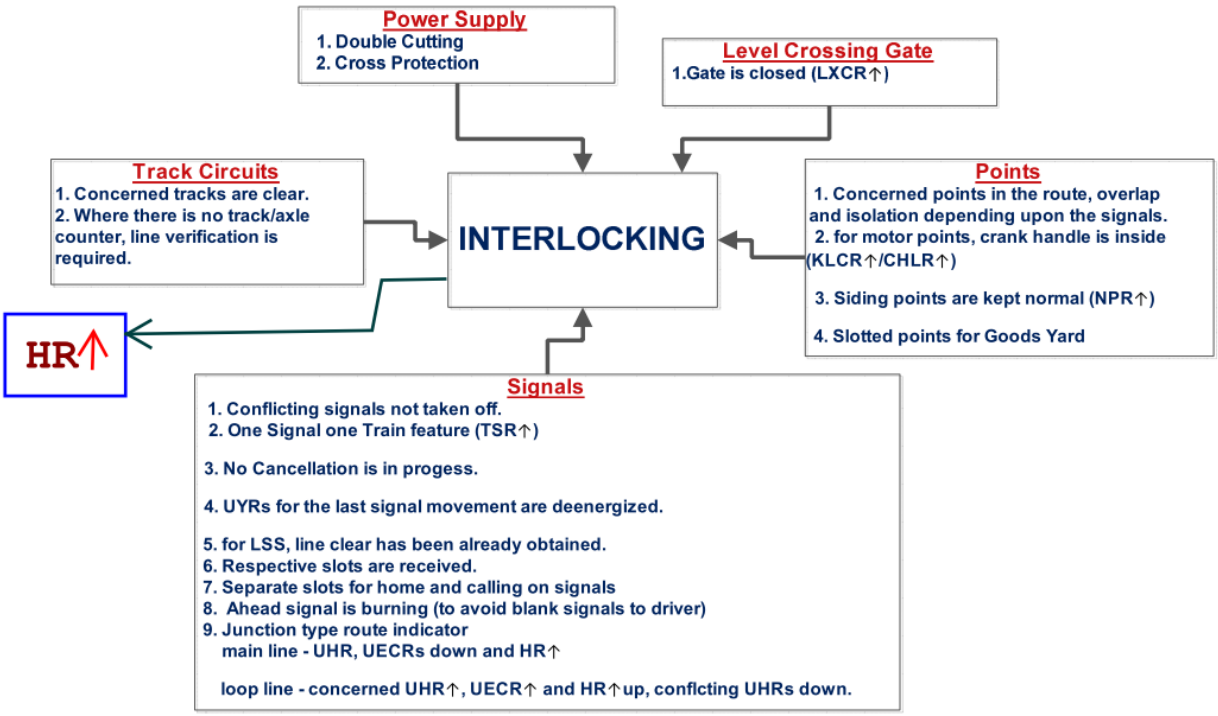
Strip light indications are provided on the track diagram of the panel at the exact location of the point. Two strip lights are used for indicating the condition of the point.

These strips with white light indicate the correct setting of the point and the red indication appears when the point track concerned has failed or occupied. In some of the new signalling installations, flashing indication is provided to indicate that the Points are being operated or failed.

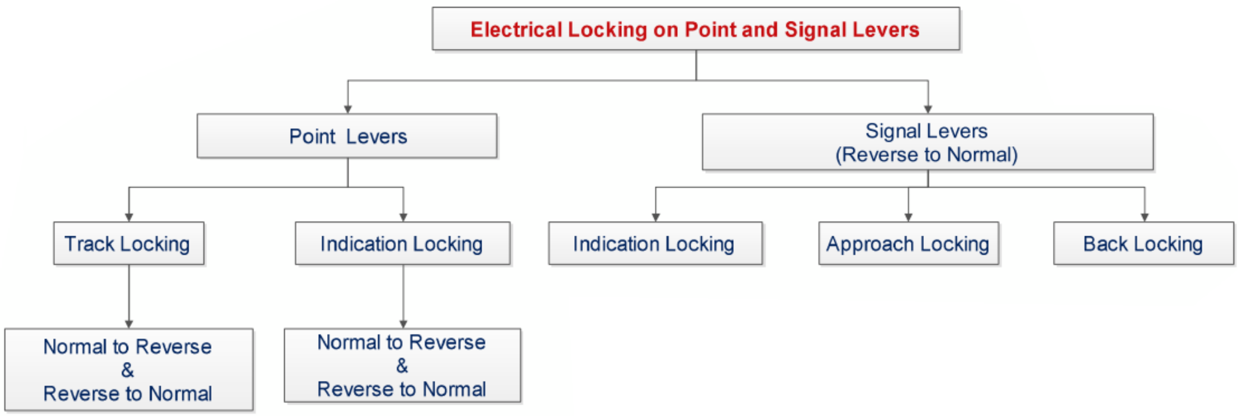
CHAPTER 6: PRACTICE

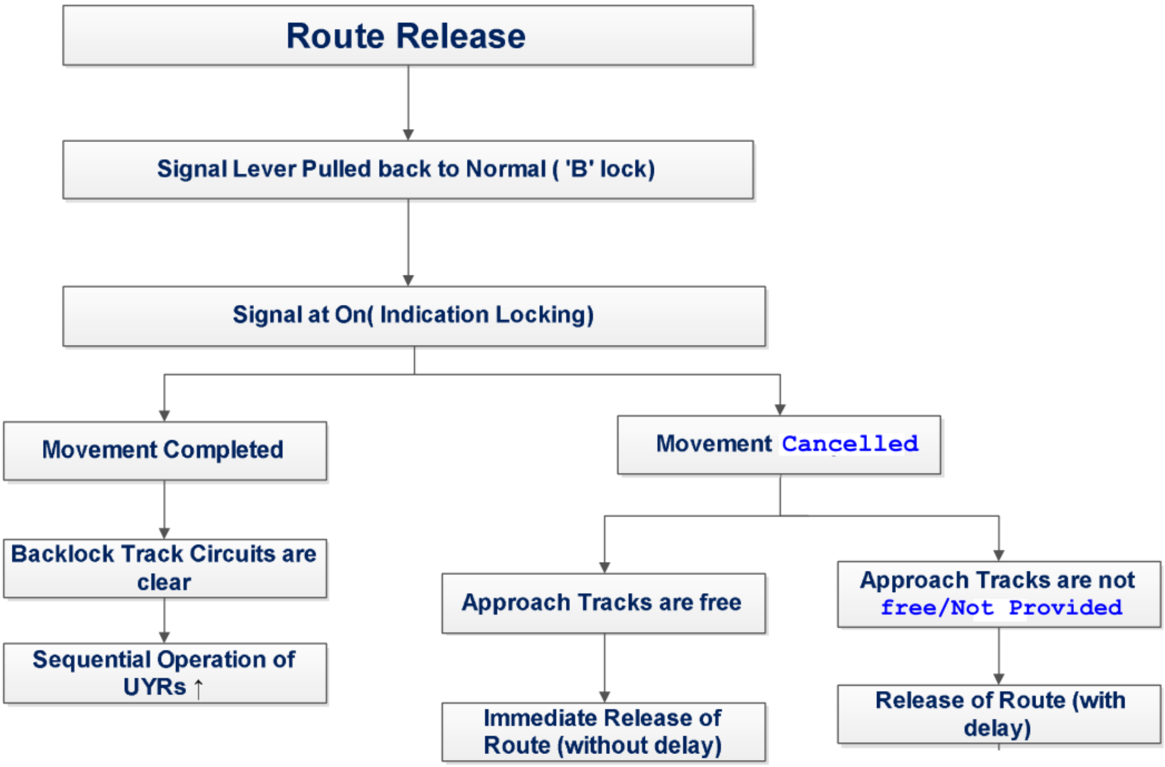
6.0 EASY ANALYSATION OF IMPORTANT CONCEPTS

Conditions to be proved for clearing a signal (HR↑)



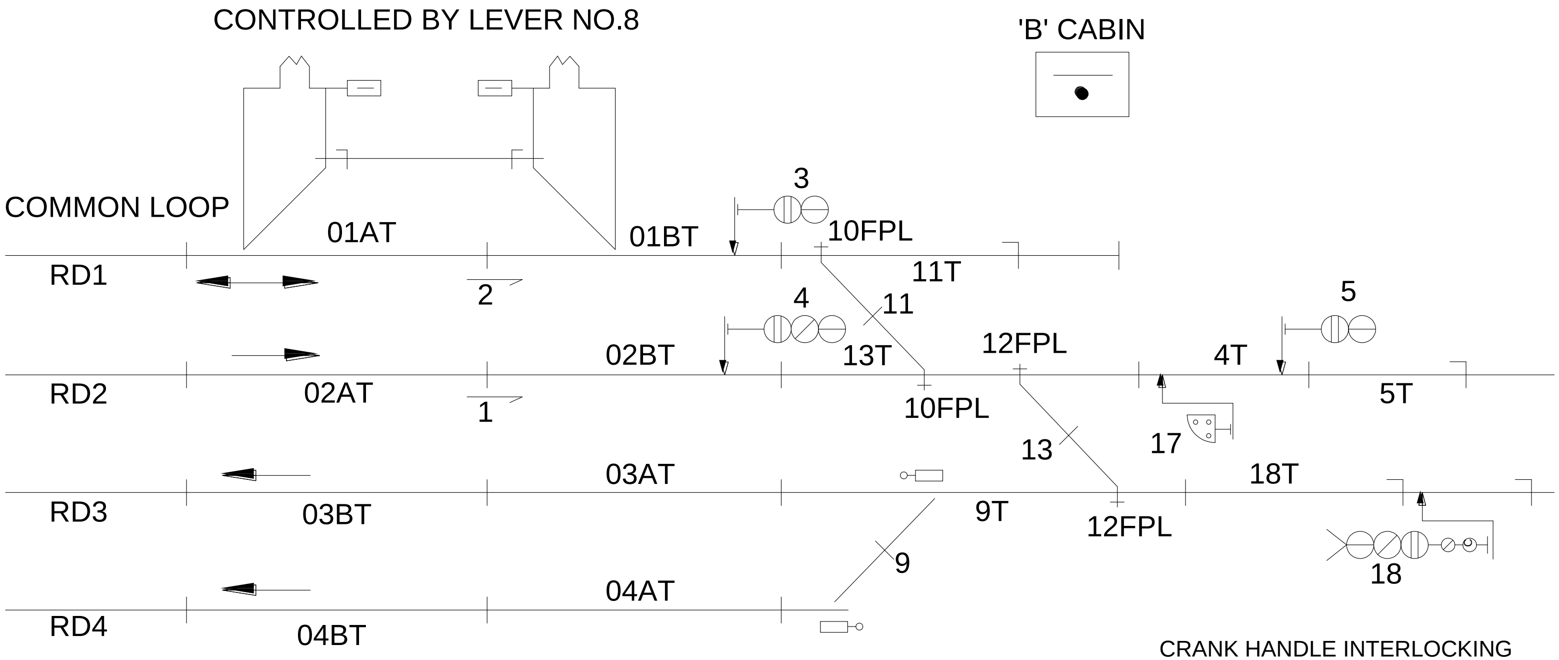
Authorized operation, SMR↑




Route Release
Signal Lever Pulled back to Normal ('B' lock)
Signal at On(Indication Locking)
Movement Completed
Movement Cancelled
Backlock Track Circuits are clear
Sequential Operation of UYRs ↑
Approach Tracks are free
Approach Tracks are not free/Not Provided
Immediate Release of Route (without delay)
Release of Route (with delay)

6.1 Selection Circuit Practice

Based on the discussion in the earlier sections, it becomes necessary to have a combined view of various vital circuits used in a installation. The following is an example of a double line yard with Electro Mechanical signaling installation. The necessary Control Table and vital Selection circuits are given for reference.



CRANK HANDLE INTERLOCKING

ZONE	POINTS
1	9

✳ SEPERATE SLOT SHALL BE GIVEN FOR CALLING ON SIGNAL.WHICH WILL BE INITIATED BY PRESSING THE CALLING ON BUTTON/OPERATION. THE SWITCH PROVIDED ABOVE THE CONCERNED SLOT LEVER.

Fig No: 6.1

CONTROL TABLE (DOUBLE LINE)

S No	SIGNAL No	ROUTE	ASPECT	APPROACH LOCKED BY	BACK LOCKED BY	CONTROLLED BY: TRACK	CONTROLLED BY: ASPECT OF SIGNAL AHEAD	CONTROLLED BY: C.H ZONE	LOCK & DETECTS POINTS: NORMAL	LOCK & DETECTS POINTS: REVERSE	LOCKS SIGNALS	OTHER CONTROLS	REMARKS
1	3	M/L	Y	01AT,01BT (60 sec)	11T,13T	11T,13T, 4T	5R/G	-	13	11	17	8NPR↑	
2	4	M/L	Y	02AT,02BT (120 sec)	13T	13T,4T	5R/G	-	11,13	-	17		
3	4	M/L	G	02AT,02BT (120 sec)	13	13T,4T	5G	-	11,13	-	17		
4	5	Block Section	G	-	-	5T	-	-	13	-	17	8NPR↑, 15YR↑ A Cabin	Controlled by Block inst. 15LCPR↑
5	17	RD 1	OFF	4T (60 sec)	13T,11T	13T,11T	-	-	13	11	5,3	8NPR↑	
6	17	RD 2	OFF	4T (60 sec)	13T	13T	-	-	13,11	-	5,4		
7	18	RD 1	YR1	DA (120 sec)	18T,9T,13T,11T	18T,9T, 13T,11T, 01BT,01AT	-	9CHLR	9	13,11	C 18	8NPR↑ 18YR$_1$↑ A Cabin	Provided with Jn type Route R.I. 18UHR$_1$↑, 18UECR↑
8	18	RD 2	Y	DA (120 sec)	18T,9T	18T,9T, 03AT,03BT	-	9CHLR	13,9	-	C18	18YR$_3$↑ A Cabin	18UHR$_1$↓, 18UHR$_4$↓, 18UECR↓
9	18	RD 3	G	DA (120 sec)	18T,9T	18T,9T, 03AT,03BT	-	9CHLR	13,9	-	C18	18YR$_3$↑, A Cabin 18DR↑	18UHR$_1$↓, 18UHR$_4$↓, 18UECR↓
10	18	RD4	YR1	DA (120 sec)	18T,9T	18T,9T, 04AT,04BT		9CHLR	13	9	C18	18YR$_4$↑ A Cabin	Provided with Jn type Route R.I. 18UHR$_4$↑, 18UECR
11	C 18	RD 1	OFF	DA (120 sec)	-	C18T Occupied	-	9CHLR	9	13,11	18	8NPR↑, C18YR$_1$↑ A Cabin	Clear after 120 sec of the Train occupied calling-on track C18BT.
12	C 18	RD 2	OFF	DA (120 sec)	-	C18T Occupied	-	9CHLR	13,9	-	18	C18YR$_3$↑ A Cabin	
13	C 18	RD 3	OFF	DA (120 sec)	-	C18T Occupied	-	9CHLR	13	9	18	C18YR$_4$↑ A Cabin	

UHR, HR CIRCUITS OF HOME SIGNAL

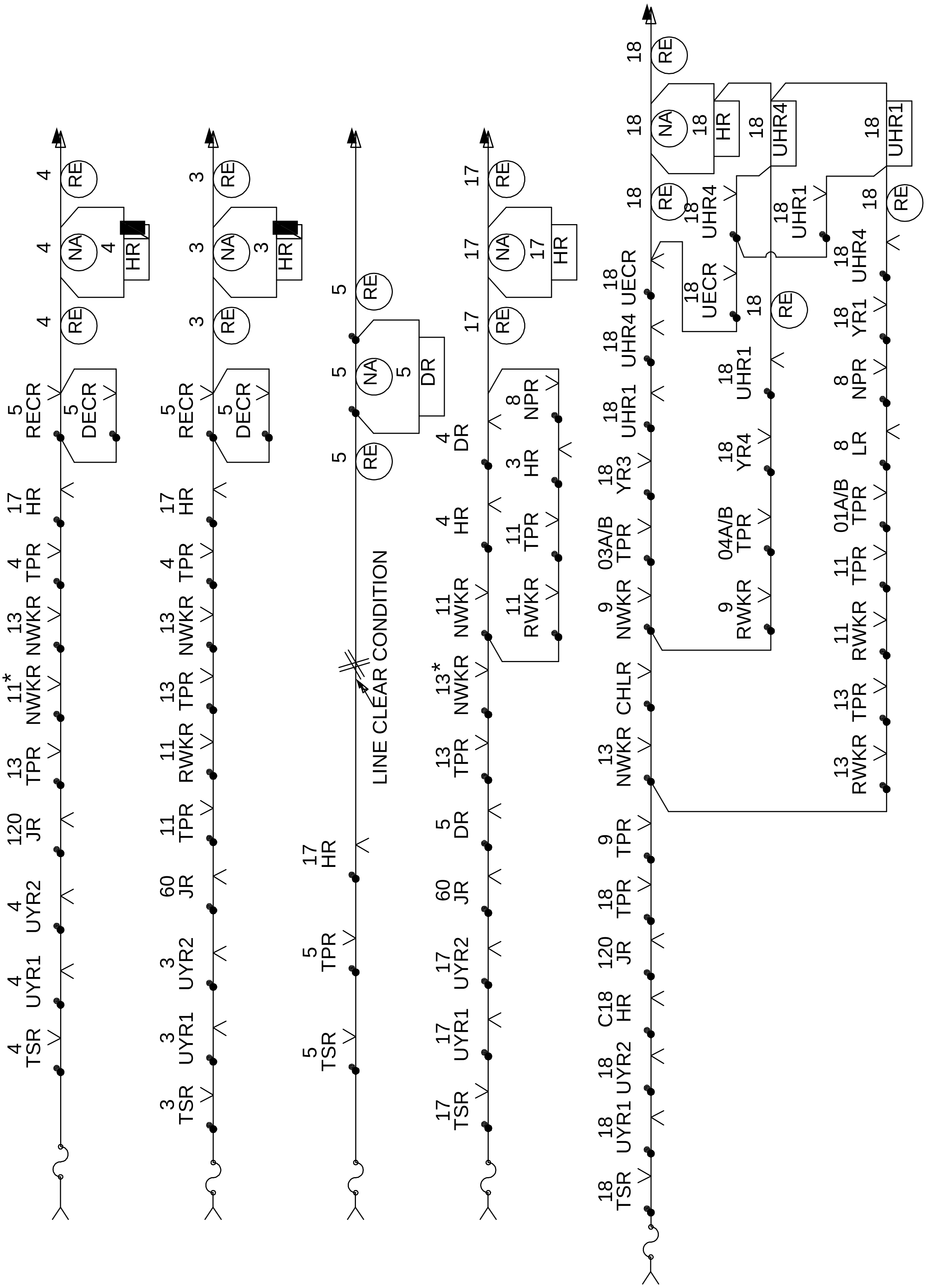


Fig No: 6.2

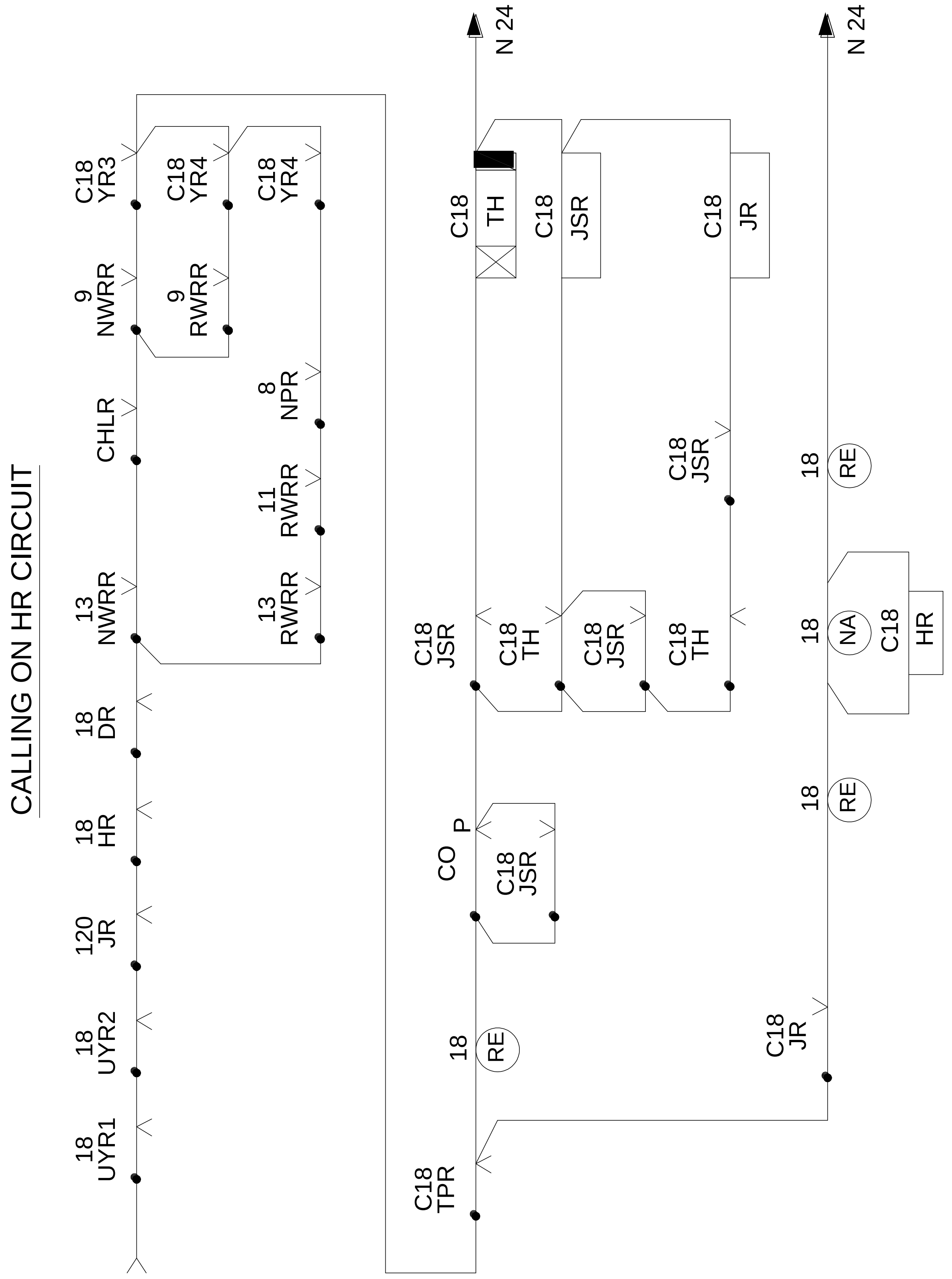
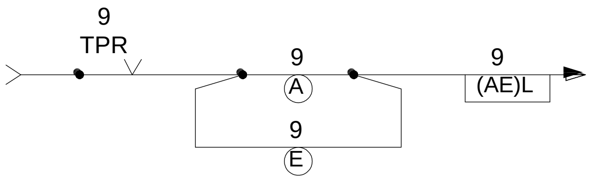
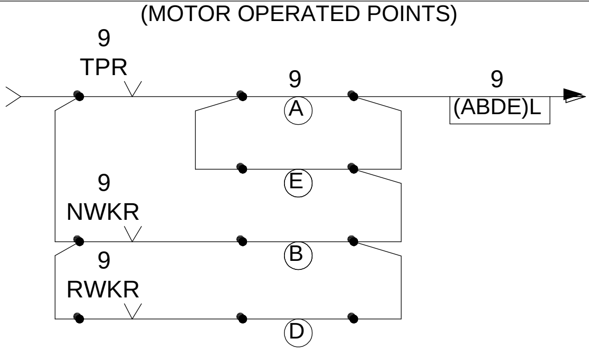

CALLING ON HR CIRCUIT
C18 YR3
9 NWRR
CHLR
13 NWRR
18 DR
18 HR
120 JR
18 UYR2
18 UYR1
C18 YR4
9 RWRR
C18 YR4
8 NPR
11 RWRR
13 RWRR
N 24
C18 TH
C18 JSR
C18 JR
C18 JSR
C18 JSR
C18 TH
C18 JSR
C18 TH
CO P
C18 JSR
18 RE
C18 TPR
N 24
18 RE
18 NA
C18 HR
18 RE
C18 JR

Fig No: 6.3

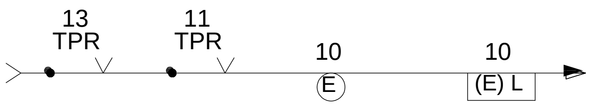
TRACK LOCKING CIRCUIT ON POINTS.9



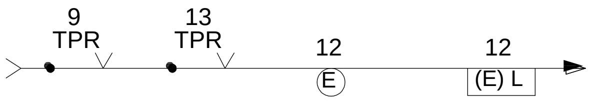
TRACK AND INDICATION LOCKING CIRCUIT ON POINTS.9
(MOTOR OPERATED POINTS)



TRACK LOCKING CIRCUIT ON POINTS.11
(PROVIDED ON LOCK LEVER.10)



TRACK LOCKING CIRCUIT ON POINTS.13
(PROVIDED ON LOCK LEVER 12)



(B) L CIRCUIT ON SIGNAL LEVER NO.3

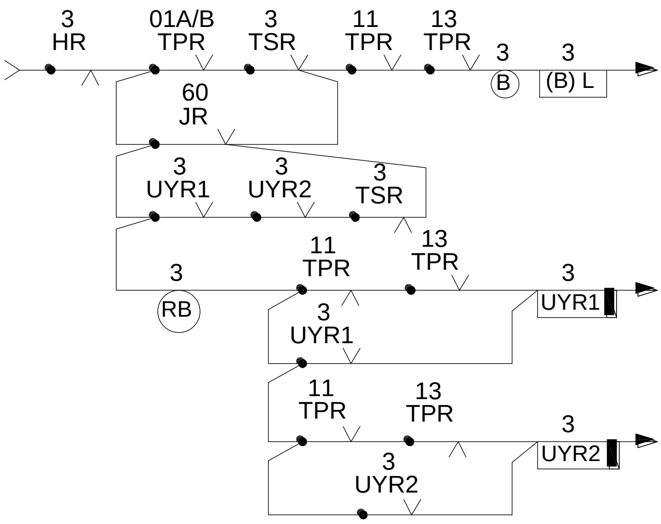


Fig No: 6.4

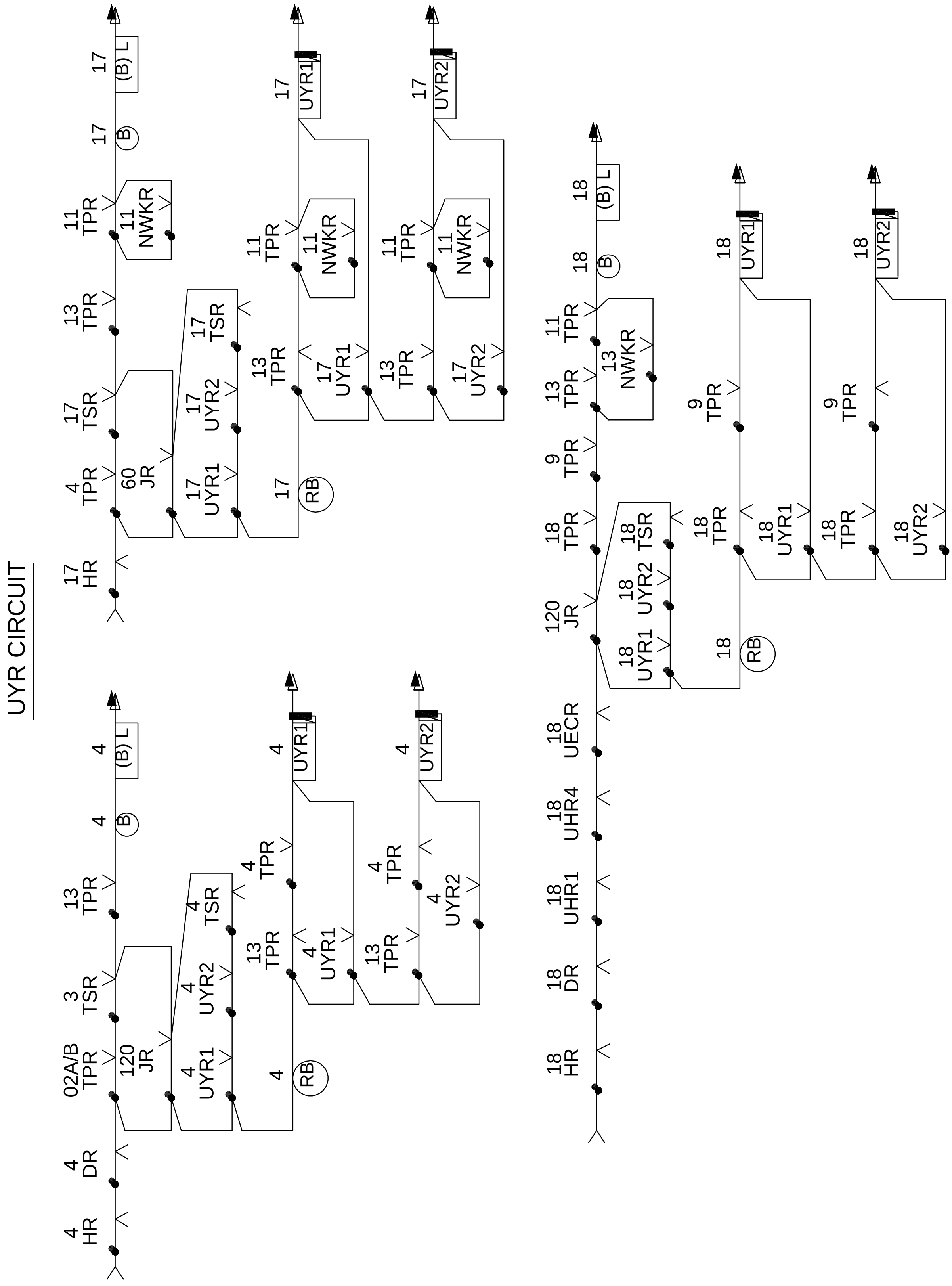


Fig No: 6.5

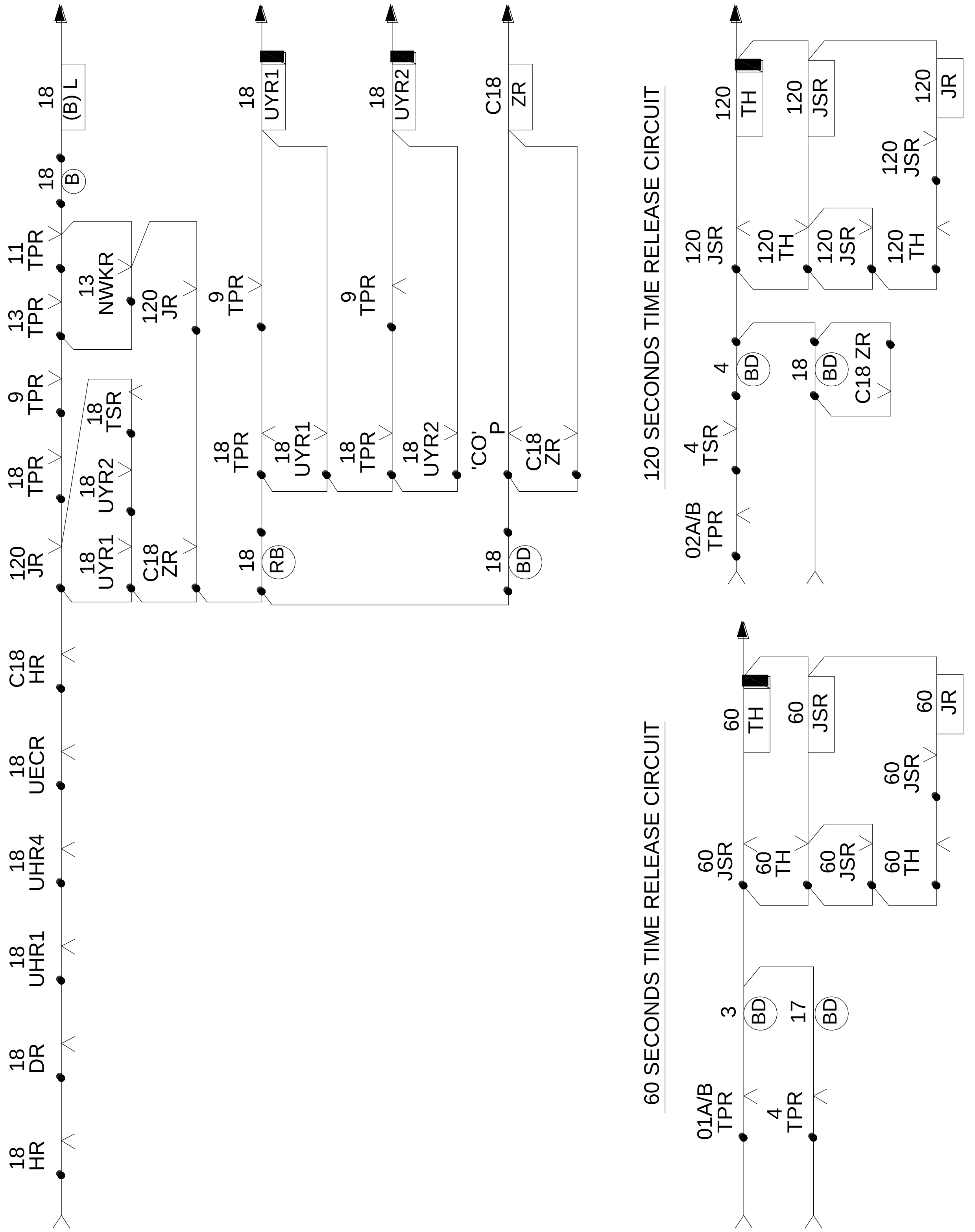

120 SECONDS TIME RELEASE CIRCUIT
60 SECONDS TIME RELEASE CIRCUIT

Fig No: 6.6

7. REVIEW QUESTIONS

CHAPTER 1

Subjective questions

1. Write down the point to be considered in designing signal control circuit.

Objective Questions

State True or False

1. Point in Isolation need not to be proved in calling on HR circuit (T/F)
2. CHLR Relay proves closing and locking of LC Gate (T/F)
3. Berthing Track must be proved in the shunt signal HR circuit (T/F)
4. Point in Isolation are not required to be proved in HR circuit of shunt signal (T/F)
5. The signal and Shunt signal below it are conflicting signal in same direction (T/F)
6. The Replacement of Track circuit must be proved in the calling HR circuit (T/F)
7. TSR Relay achieves one slot one train principle (T/F)
8. There can be common TSR for more than one signal (T/F)
9. For single with multi lamp route indicator lighting of route prier to main aspect is not necessary (T/F)
10. Junction type route indicator lit for main line aspect also (T/F)

CHAPTER 2

Subjective questions

1. Write a shot notes on
   (i) Track Locking
   (ii) Indication Locking
   (iii) Approach Locking
   (iv) Back Locking
   (v) Section route Release
2. Write down the function and purpose of sequential proving Relay

Objective Questions

State True or False

1. Indication Locking Performs the function of Lock Bar (T/F)
2. The Track Locking is effective on ‘A’ and ‘E’ Position of Signal Lever (T/F)
3. Infringement of fouling can be proved with the help of Track Locking (T/F)
4. Indication Locking on Signal Lever is effective on ‘A’ and ‘B’ Position (T/F)
5. Indication Locking is effective on ‘B’ Position while signal goes from Normal to Reverse (T/F)
6. If Colour light signal is controlled by Lever than Indication Locking must be proved on that Lever (T/F)
7. Approach Locking is effective on ‘B’ position of Signal Lever and Provided to prevent manipulation of route when the train as cross the signal (T/F)

8. All the Track circuits including Berthing Track and Track circuits starting from signal upto the last point Zone must be proved in Back Locking (T/F)
9. ULSR Relay is used to achieve section route Release (T/F)
10. If The siding shunt signal is taken to OFF then it can be normalised without time delay (T/F)
11. Approach Locking and Back Locking is effective on 'B' position of Signal Lever (T/F)
12. Normal Position of sequential Relays is drop (T/F)
13. Sequential is used to prove in particular direction (T/F)
14. In home signal HR circuit route release relays dropped position must be proved (T/F)
15. In home signal HR circuit calling on signal below home signal not operated position must be proved (T/F)

CHAPTER 3

Subjective questions

1. Prepare the selection Table for the shunt signal 21, signal 29, and signal 1 to Road 3.

Objective Questions

State True or False

1. The Back Lock and controlled by track circuits for shunt signals are same (T/F)
2. Aspect of the signal ahead in control table is useful in providing Red Lamp protection (T/F)
3. For Main Line Home signal all the tracks from single up to the Main line starter or Approach Track circuits (T/F)
4. For Home single with Dead Approach Locking the time delay recommend is 60 sec (T/F)
5. The Calling on Track circuit of home signal can be used as Approach lock Track circuit (T/F)
6. The Berthing Track circuits are Back lock Track circuits for starter signal (T/F)

CHAPTER 4

Subjective questions

1. Draw the CHLR circuit and explain why it is required.
2. Draw the NPR circuit (Siding control circuit).

CHAPTER 6

Subjective questions

1. Draw the Approach Locking and Back Locking for the signal Number 3.
2. Draw the HR circuit for single Number 18.
3. Draw the indication circuit and Track Locking circuit for Point Number 9.
4. Draw the sequential Relay circuit for single Number 17.
5. Prepare selection table for single Number 18 to Road 1 (common Loop).