

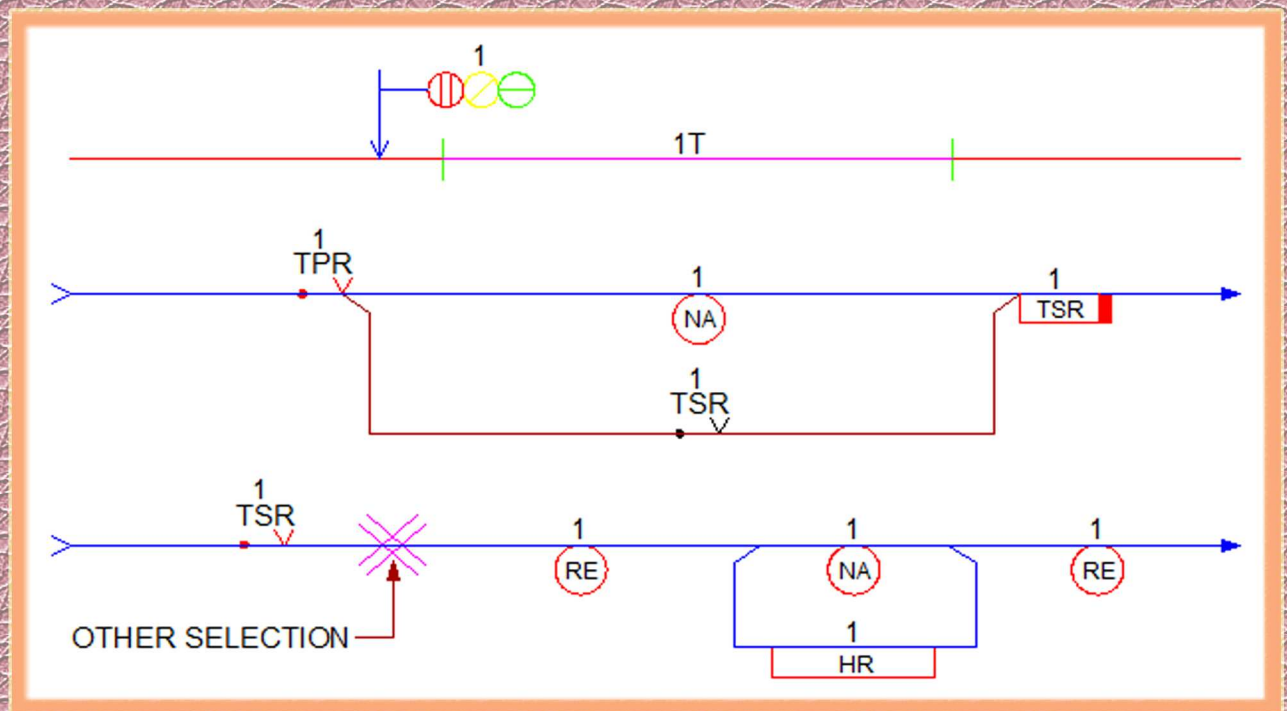
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IRISET

S 11

CONTROL TABLES AND SELECTION CIRCUITS



Indian Railways Institute of
Signal Engineering and Telecommunications

SECUNDERABAD - 500 017

S-11

CONTROL TABLES & SELECTION CIRCUITS

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**INDIAN RAILWAYS INSTITUTE OF
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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 Indicators 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 or secondary 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. 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 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 concerned points 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
 - On single line OR On double line
 - Points in Route & in Isolation.
- (b) Wherever points are operated by point machine it shall be ensured that the concerned crank handle/handles used for manual operation of point (locally) 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, concerned Berthing tracks and Overlap tracks.

(ii) For Starter signal

- Tracks upto next signal in advance in the route.

(iii) For Shunt signals

- Normally upto next opposing signal in the route. - b) In big yards, where intermediate shunts are there, the line is clear upto next intermediate shunt signal in advance.

Note: - In some of the existing yards, only one track circuit ahead of shunt signal concerned is proved (Signal replacing track). Berthing or Destination track circuits are not proved in clearing shunt signals, to enable clearing of shunt signal to an occupied line.

(iv) For Calling-on signal:

- To enable clearance of calling-on signal in case of 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 concerned '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.

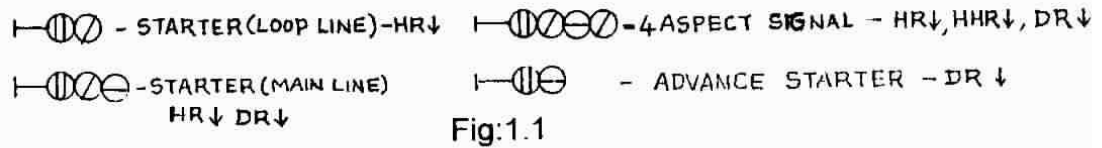
(v) Advance starter: One track circuit after the signal.

(d) In case of stations/yards where no track circuit or axle counter is provided on berthing tracks, to ensure these lines are free by the operator/SM concerned, a special arrangement is provided (i.e.). A plunger at an appropriate place is provided from where the traffic personnel can have a clear visibility of the entire stretch of the berthing track, who will press the plunger after ensuring that the line is free (not occupied).

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

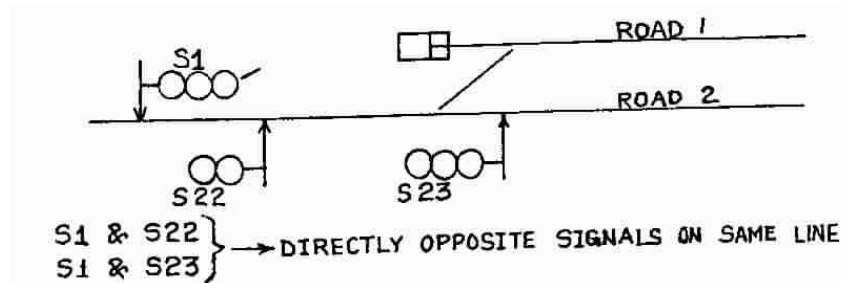
(f) In case of Goods yards where points are locally operated (either from a lever frame or from a ground frame) the points are correctly set by the yard master and a control is given to enable reception or dispatch as the case may be.

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

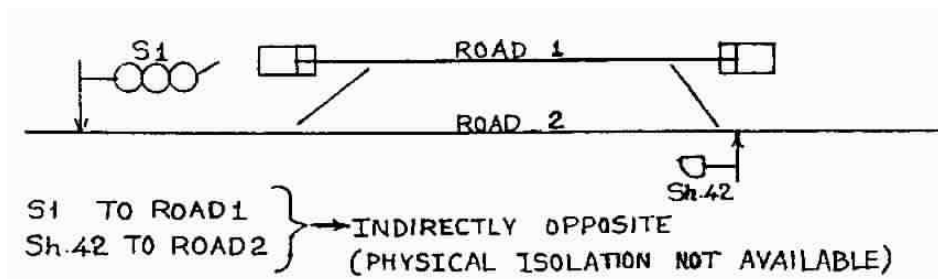


The conflicting signals can be of different types:

- (i) Directly opposite
Opposing signals on same line of the track

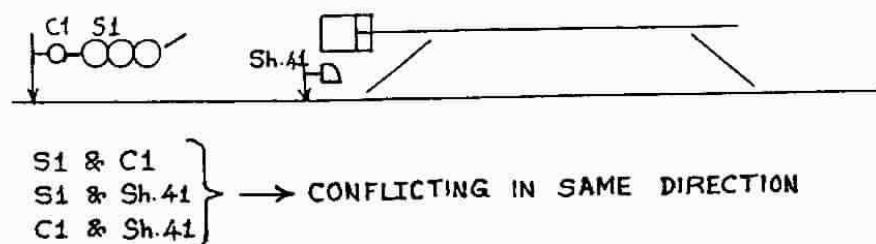


- (ii) Indirectly opposite (infringing in the Overlap zone)



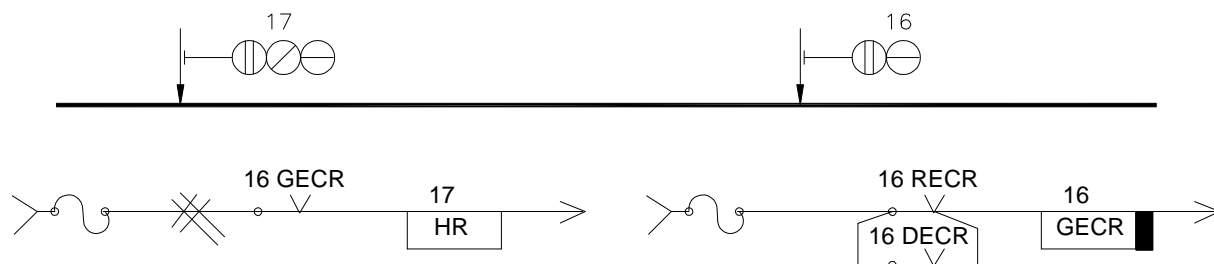
- (iii) Conflicting in the same direction

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



- (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 concerned timer circuit 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-energised 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 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 concerned controlling relay 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) In case of interlocked LC gate, if any, shall be ensured that it is closed and locked against 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 concerned signal lever/switch is reversed 'signal controlling relay (HR/HHR/DR/UHR'S) should not be energised. Circuit controller "R" Contact of the concerned signal lever 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 concerned signal control relay 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 para-1.8
- (r) Red Lamp Protection: - now days 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 S5J.

- (a) Points concerned locked electrically - concerned points lock relay - WLR's. ↓ (for motor operated points only)
- (b) Route set correctly - Route checking Relay - UCR↑
- (c) Route locked - Concerned ASR ↓
- (d) Overlap locked - OVSr.↓
- (e) Sub-routes if any - locked - Concerned directional relays, TRSR/TLsr's ↓
- (f) Conflicting moves not initiated over the subroutes opposite directional relays, TLsr/TRsr's↑
- (g) Conflicting Routes not initiated - Conflicting ASR's↑
- (h) Route initiated RR/SR. ↑

According to the different types of Signals, the concerned conditions 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 routes Fig: 1.7.

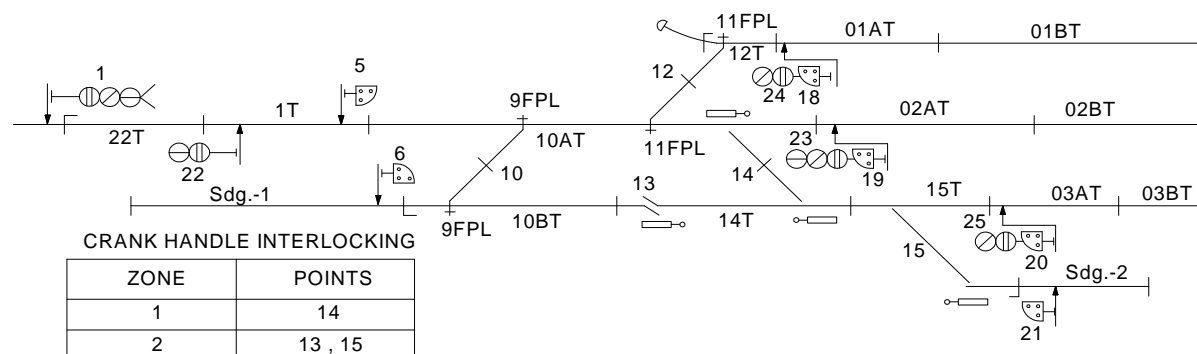


Fig.1.5

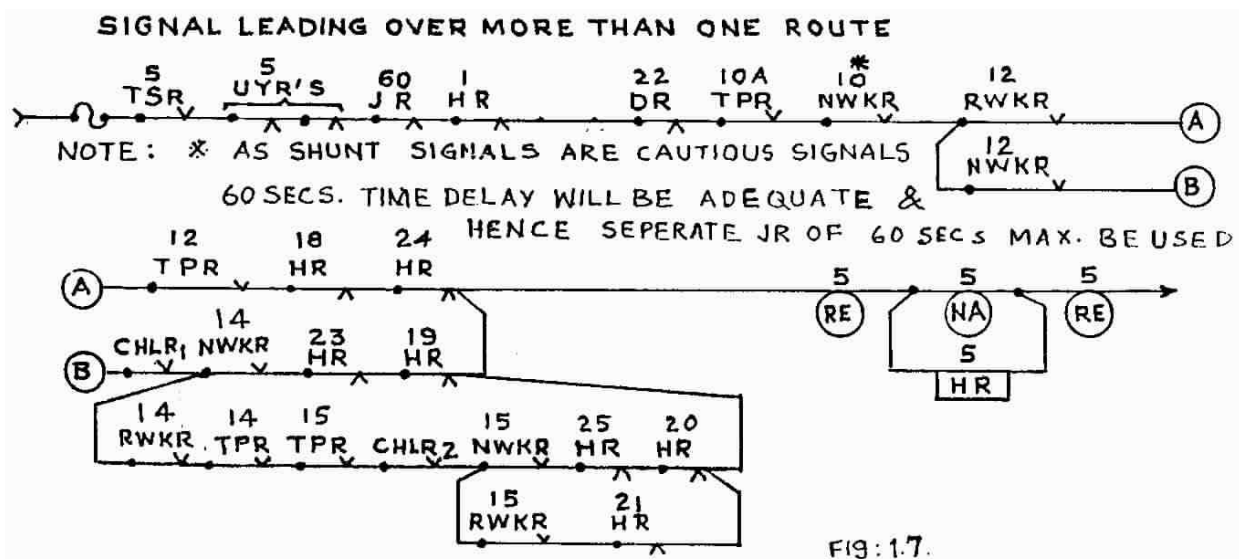
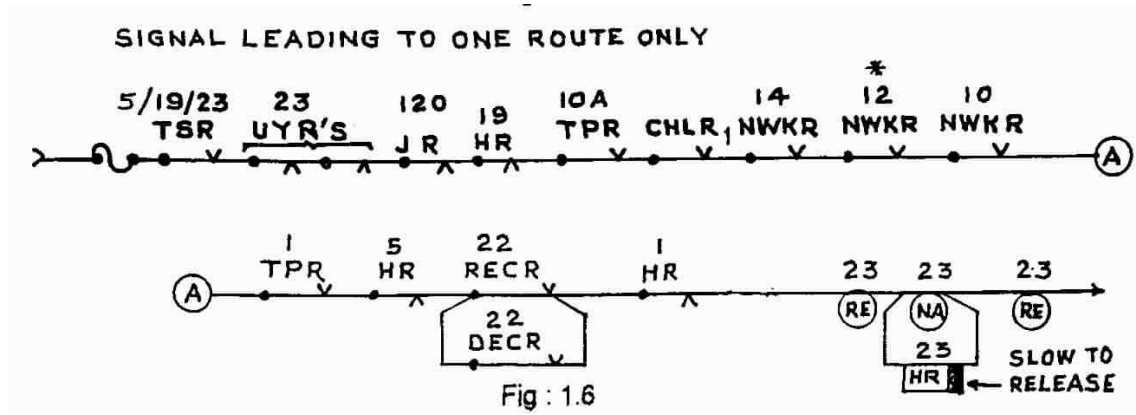


Fig: 1.7

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 (TSR/SR/LS circuit)

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 concerned signal levers. Once energised through normal position of the concerned signal levers, the stick relay holds through its own contact, bypassing the signal lever contacts. The TSR once dropped after the train past the signal and requires normalisation of all concerned signal levers so that TSR 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 a slow to pickup slow to drop relay (QSPA1 relay) the TSR need not be made slow to release.

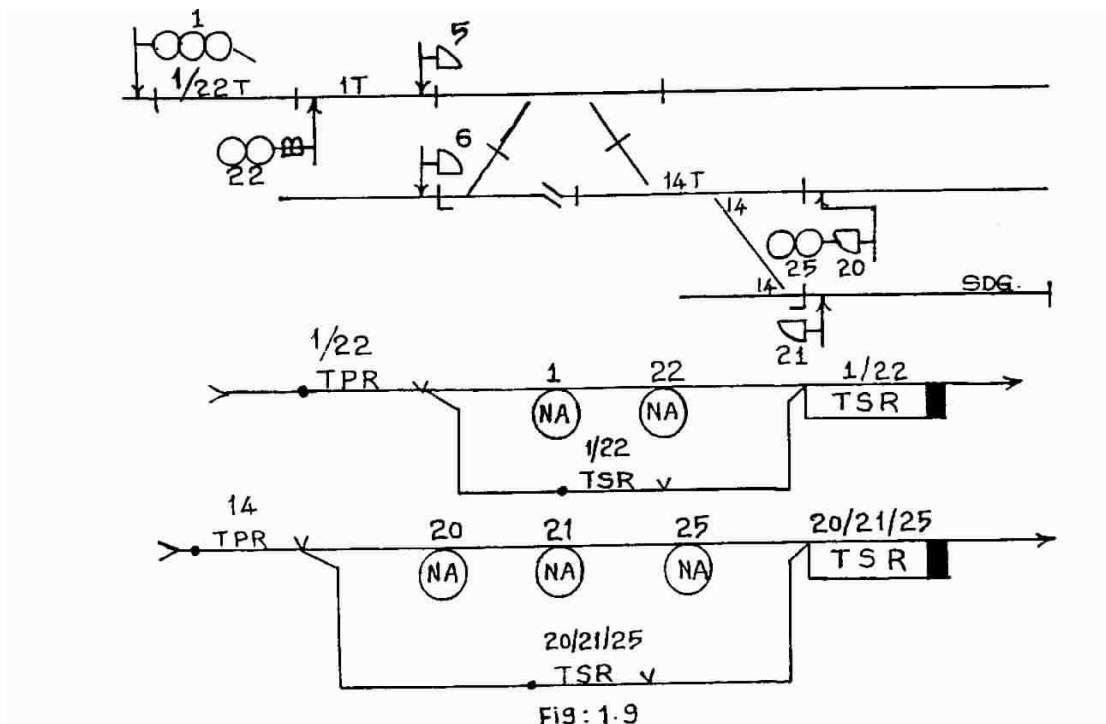
Common TSR for more than one Signal

Common TSR can be provided for

- (a) The signals which are of conflicting nature and
- (b) Having common controlling track circuit.

(ii) A starter signal and shunt below it;

(iii) Starter signals and shunt back.



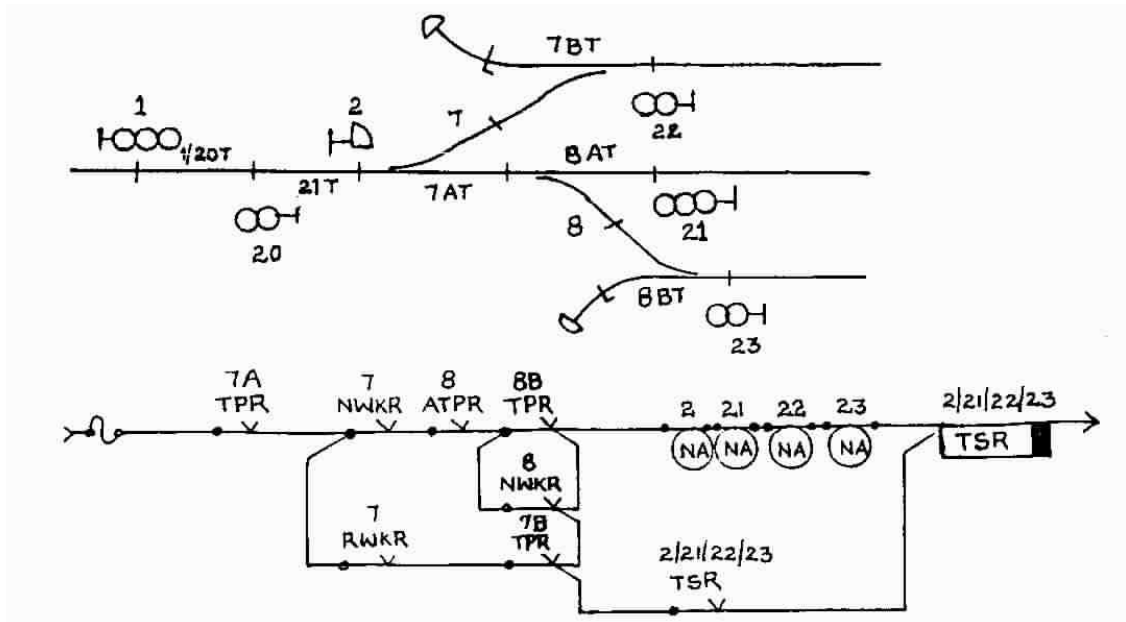


Fig. 1.10

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 IRISSET Notes S-20 and the requirements are as under:-

Each person giving slot shall ensure:-

- 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.
- With the given slot only one train can be dealt. (One slot-One train feature)
- 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 man at Cabin 'A' requires permission from station master, and permission from cabin man "B", that conditions are favourable to receive the trains with the signal no.1 to the nominated road.

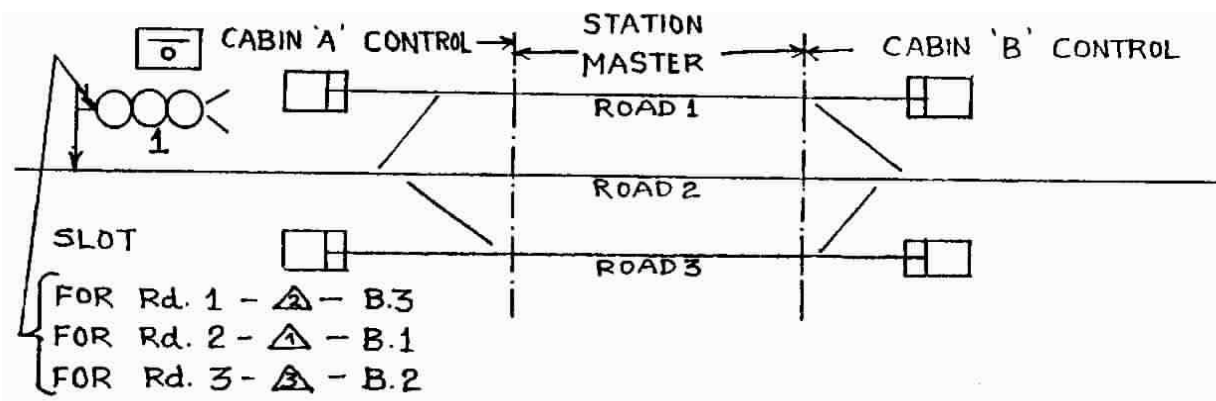


Fig. 1.11

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

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.

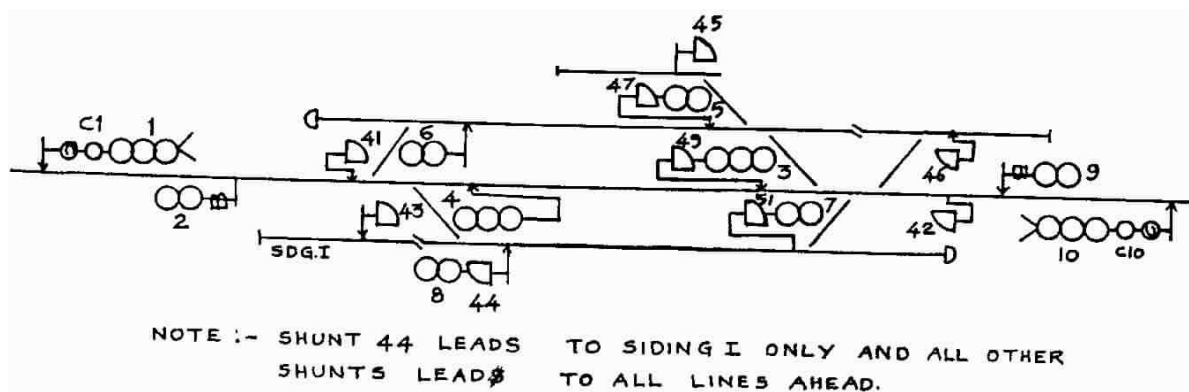


Fig. 1.12

* 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 does not require direct locking since it is achieved through points.

* 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 locks 41
- (d) 41 to Road 1 locks 5
- (e) 41 to Road 2 locks 3

- (f) 41 to Road 3 locks 7

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

- (a) 41 to Road 2 locks signals 3, 5, 7, 10, C10.
(b) 42 to Road 2 locks signals 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.

* 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 driver, 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 (major junctions) the above 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) Multilamp 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 driver). All lines ahead are indicated individually including main line, either by an alphabet (M = Mainline; B = Branch Line; G = Goods or S = Secunderabad; D = Delhi) or by the number.

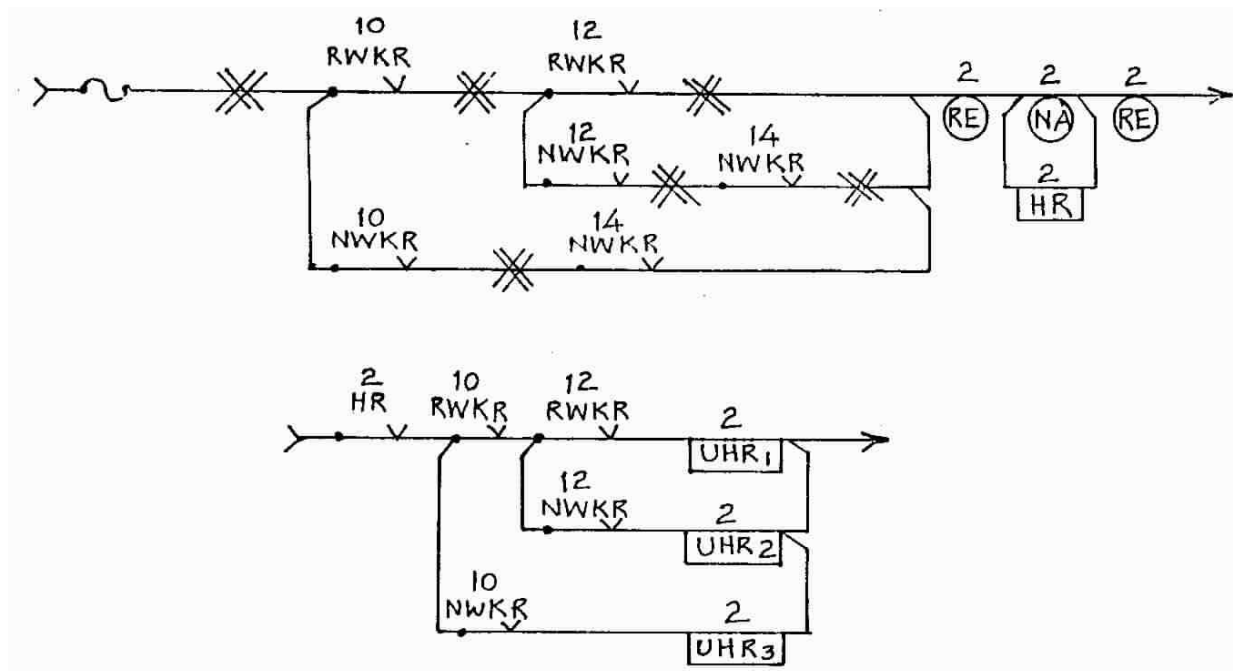
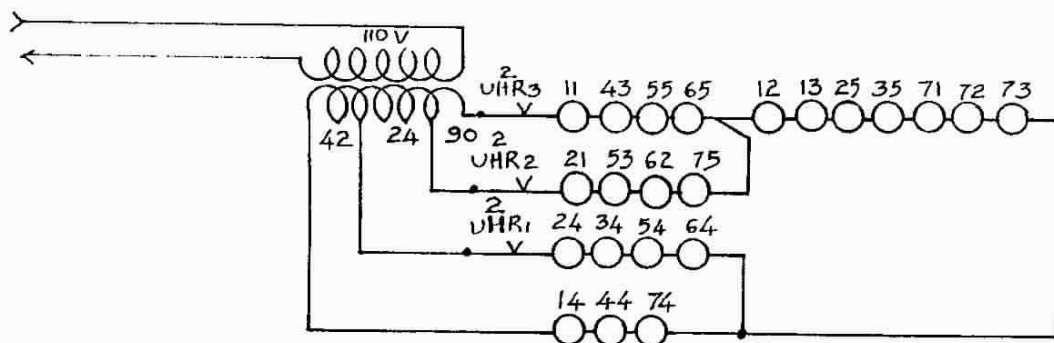
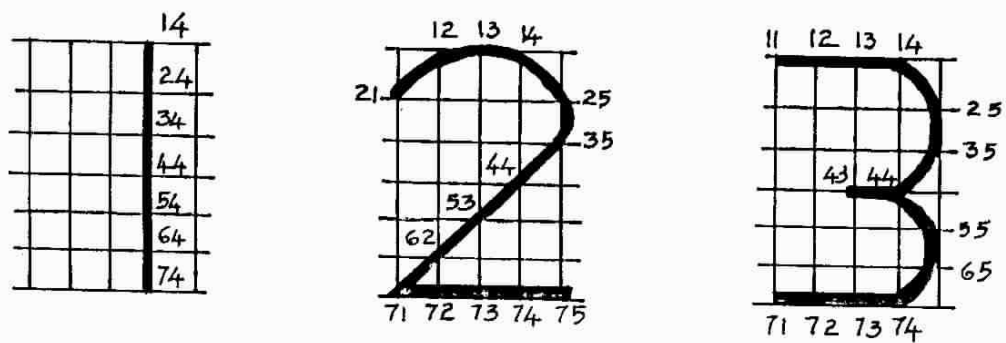


Fig: 1.14



WHEN LAMPS ARE CONNECTED IN SERIES

Fig: 1.15

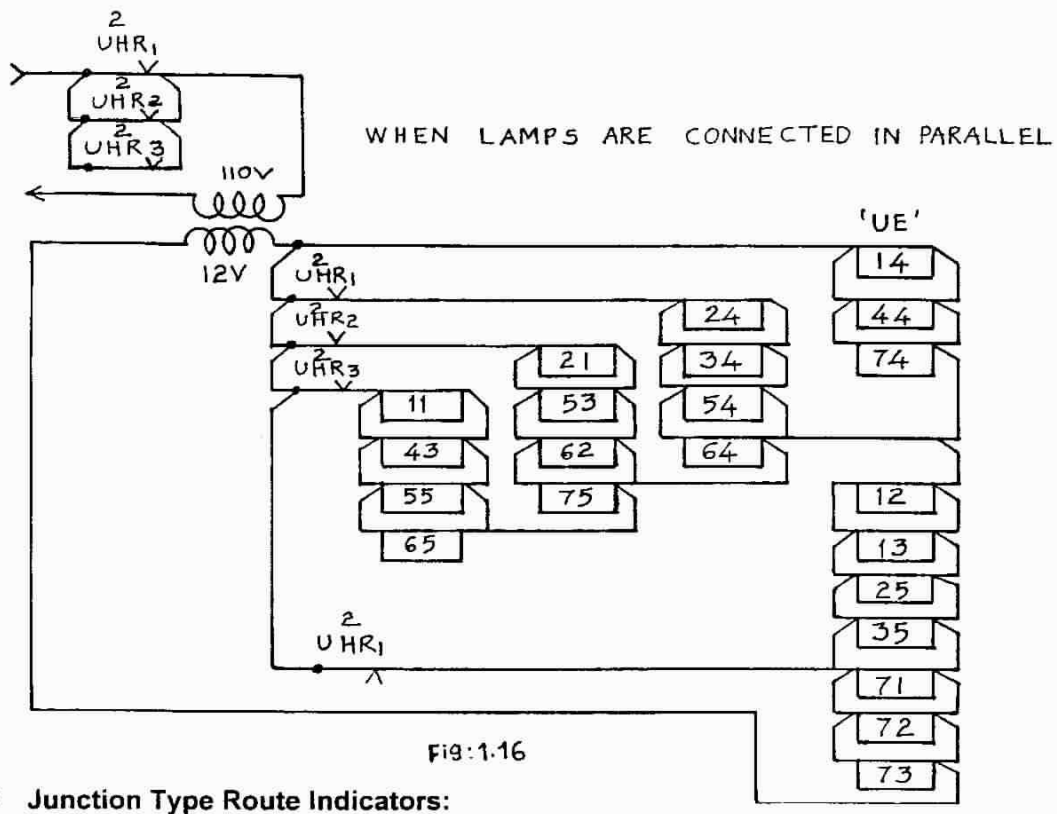


Fig.1.16

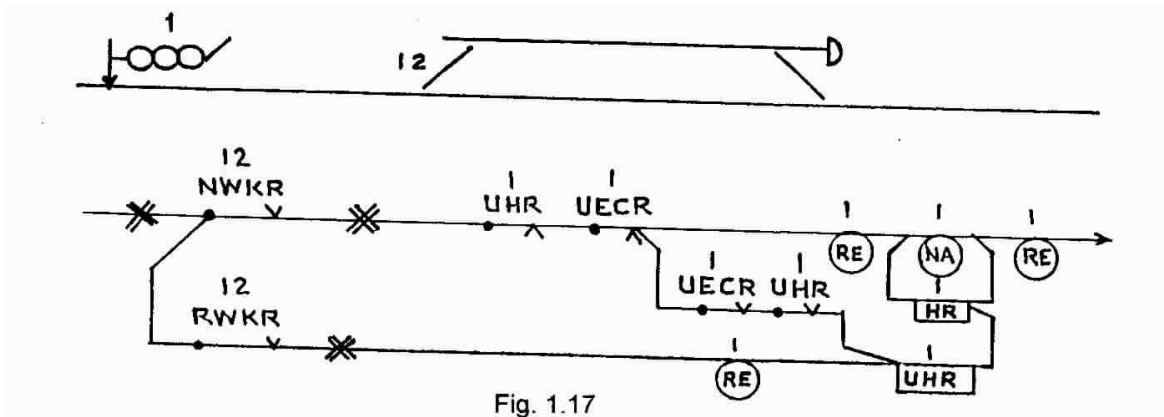
1.6.3 Junction Type Route Indicators

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.

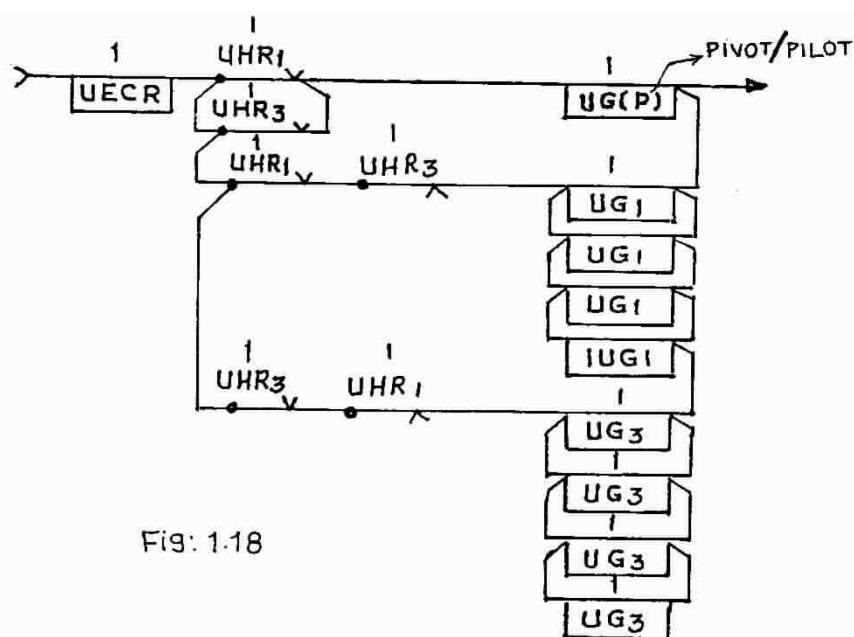
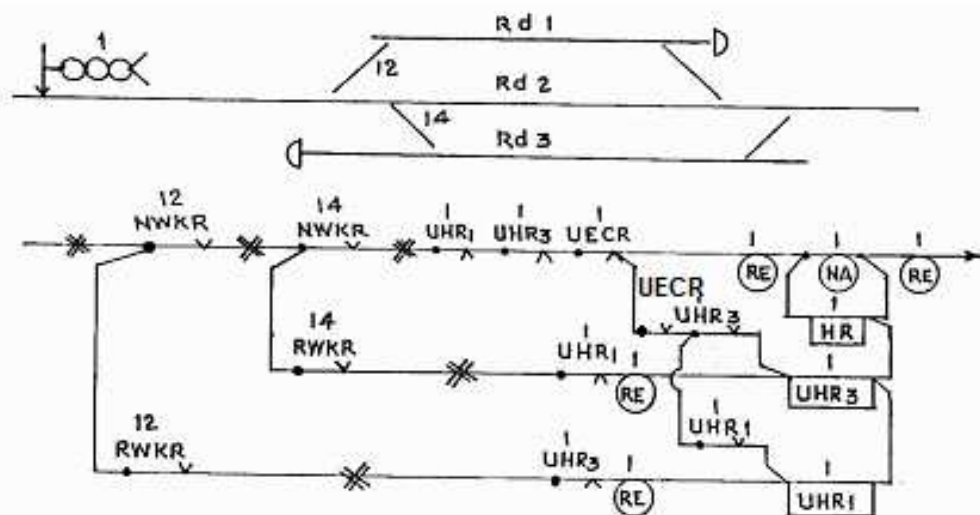
Circuit Arrangements of Junction type Route Indicators

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 driver 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 driver that he is being received on the straight route. As such, he may not reduce the speed as necessary to negotiate 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 so essential with other type of route indicators as they exhibit indication for the straight route also.

In junction type 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 as shown in Fig. 1.17



When more than one route are involved as shown in layout 2, repeat indications for different routes are provided by proving respective UHR contact along with the common UECR as shown in Fig. 1.7(b). 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.1.7(c). Point lever contacts or point detection relay contacts shall be proved in route indicator circuits.



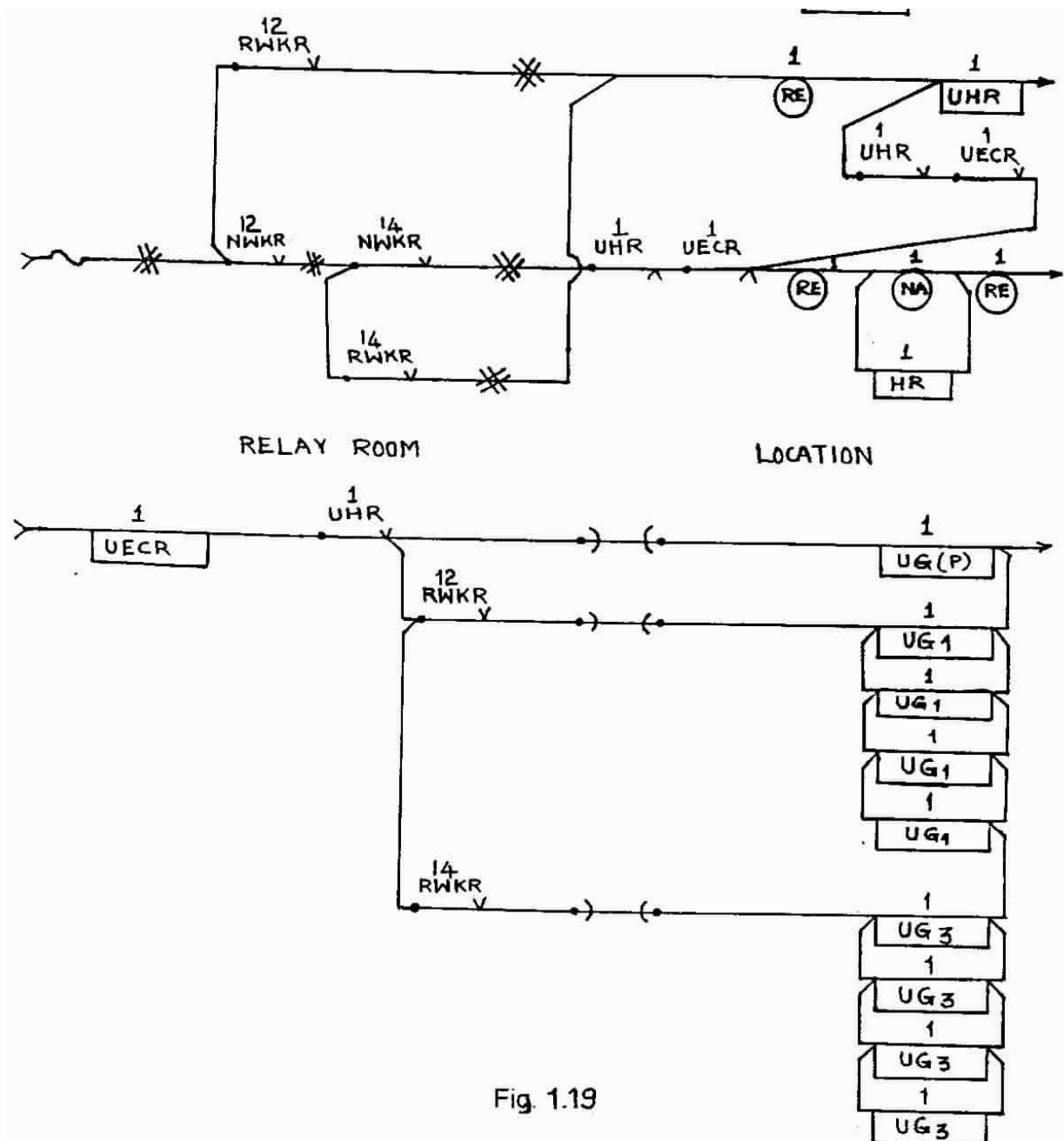


Fig. 1.19

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 AC 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.

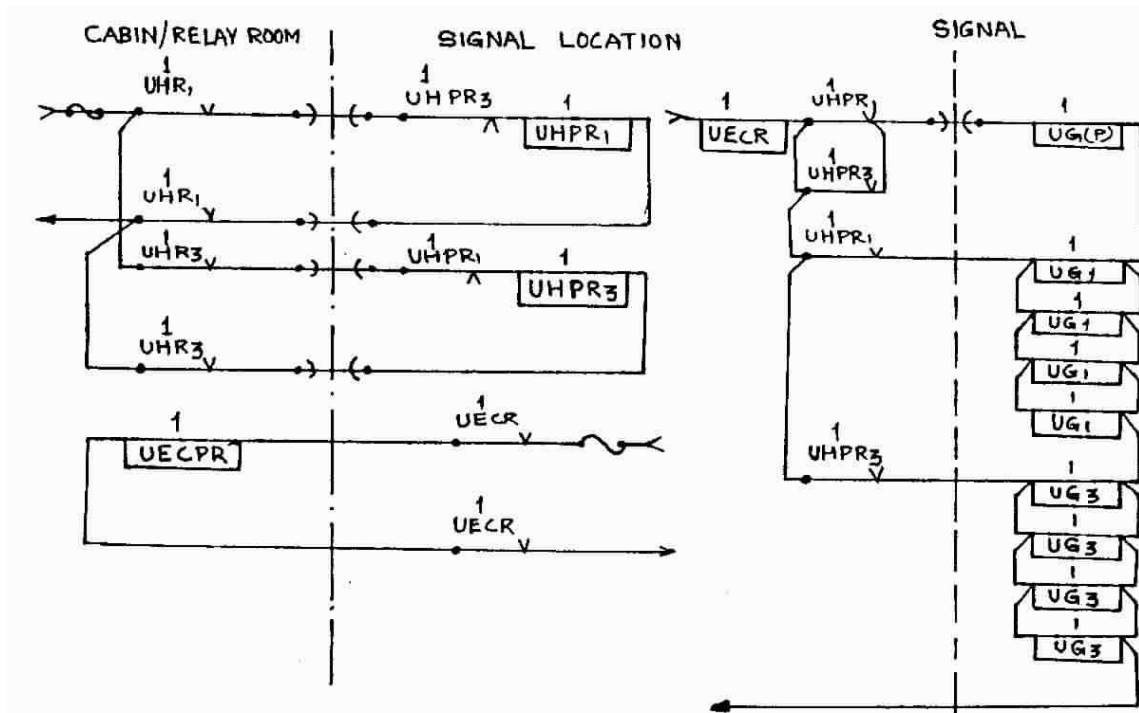


Fig. 1.20

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 concerned signal lever. 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 concerned signal lever have not been replaced to normal). If the TSR is made to pick up after the passage / 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.

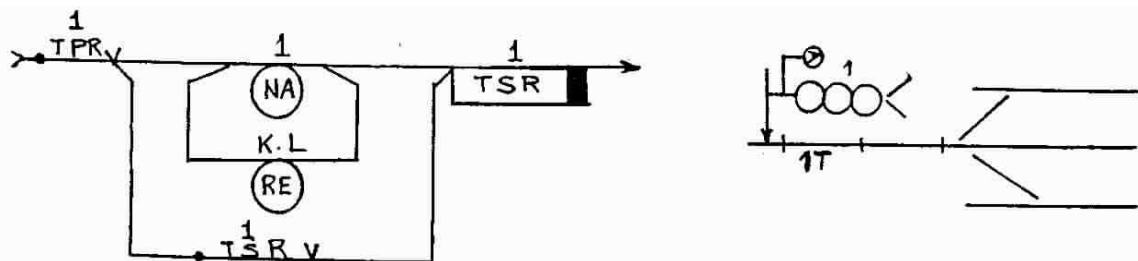


Fig.1.21

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 reclears 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. 1.9

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 are adopted. They are,

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

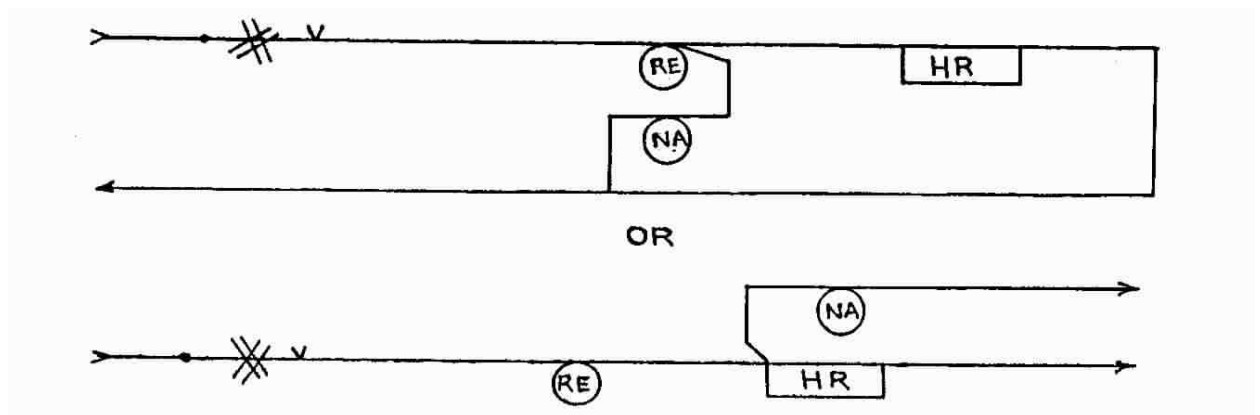


Fig: 1.23

- (b) By adopting double cutting (i.e.) by providing 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.

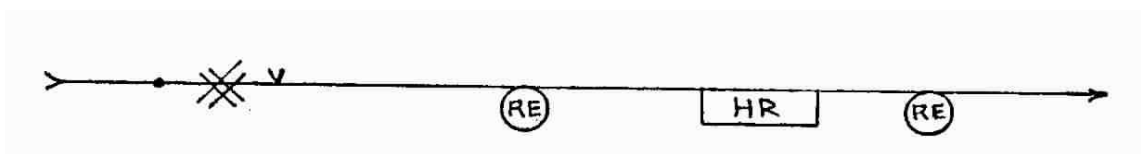


Fig: 1.24

SIGNAL CONTROL CIRCUITS

- (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.

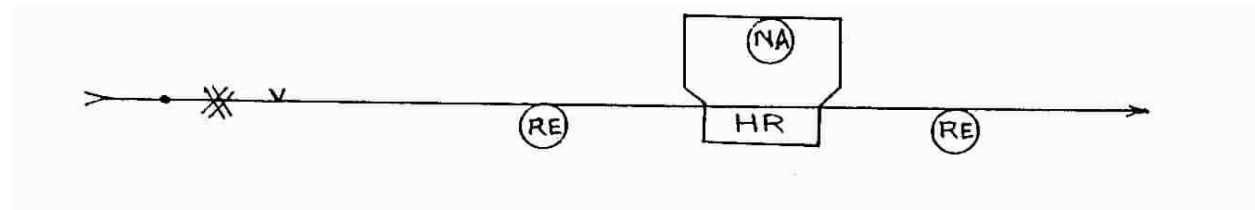


Fig :1.25

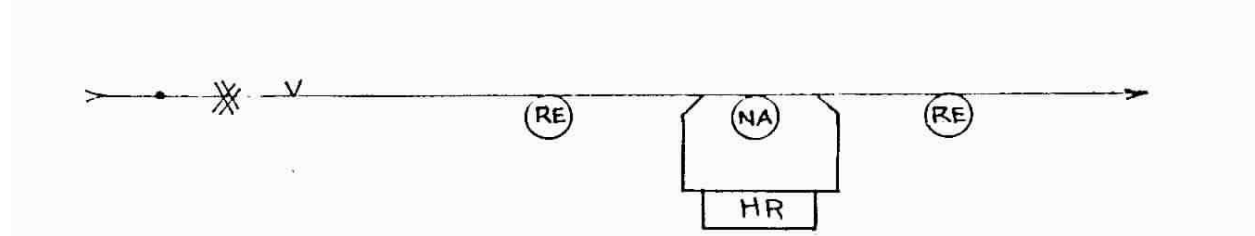


Fig: 1.26

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

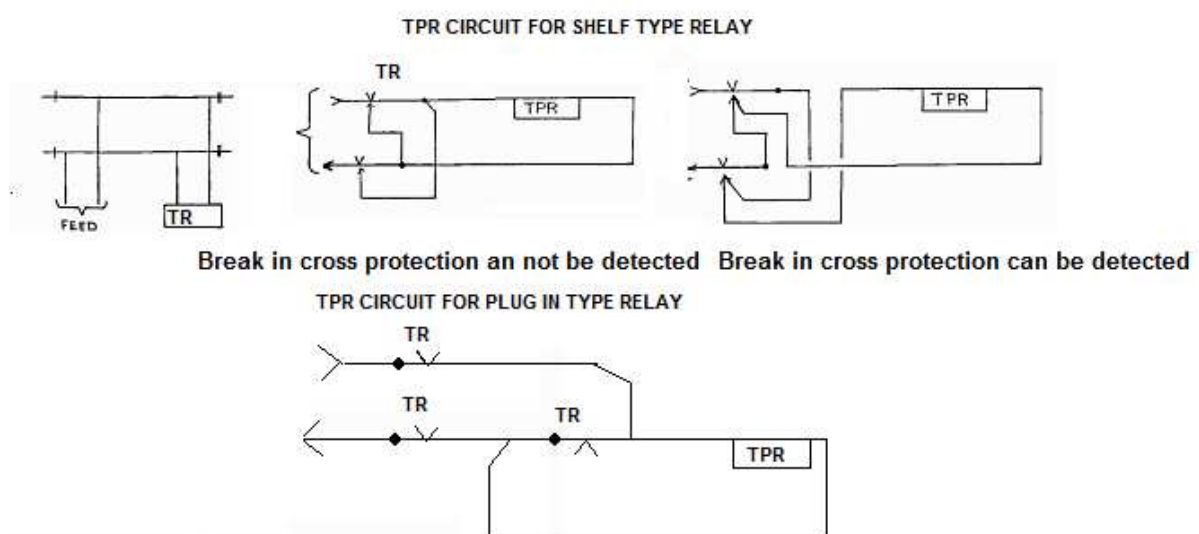


Fig: 1.27

CHAPTER - 2: ELECTRICAL LOCKINGS ON POINT & SIGNAL LEVERS

Topic covers 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 signalling, additional electric Lockings are provided on point and signal levers 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 entered
- (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 emergency OR otherwise then the signal can be put back to ON but lever cannot be taken to full normal position.

Some related paragraphs in SEM I

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.

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 securely 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 Electric Locking on Point Levers

(a) Track Locking:

Track locking is defined in B.S.I.Spec.No.719-1936 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 OR point lever
- (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 track circuit is occupied by train. 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.

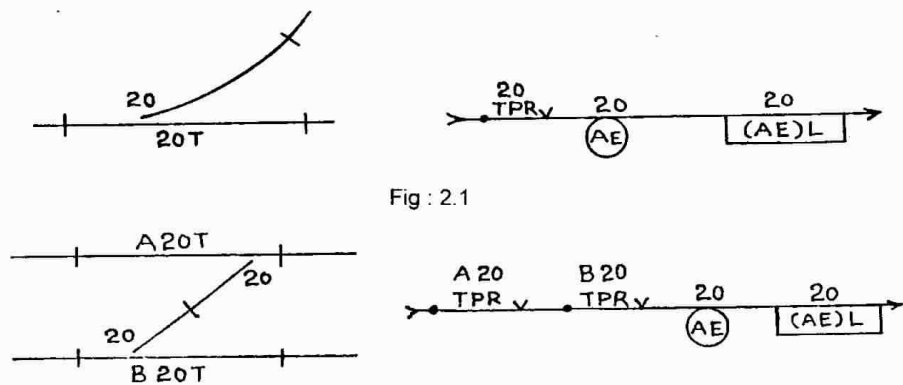


Fig: 2.2

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. (Three controlling Track circuits, in case of insufficient fouling protection) Fig : 2.2.

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 A20T 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.

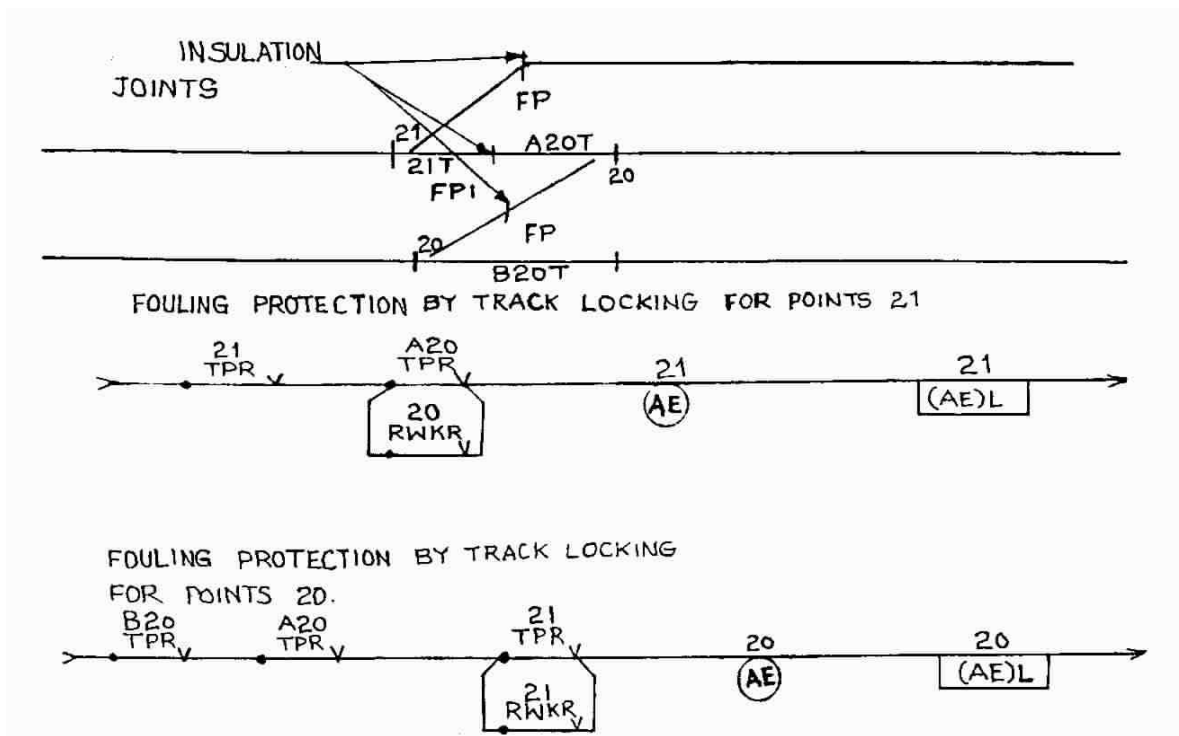


Fig: 2.3

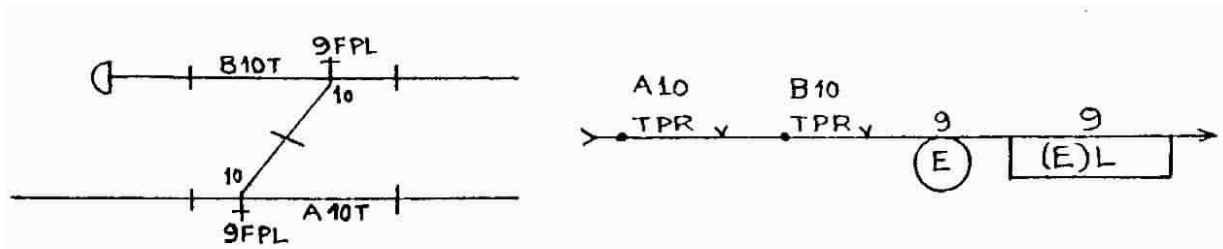


Fig : 2.4

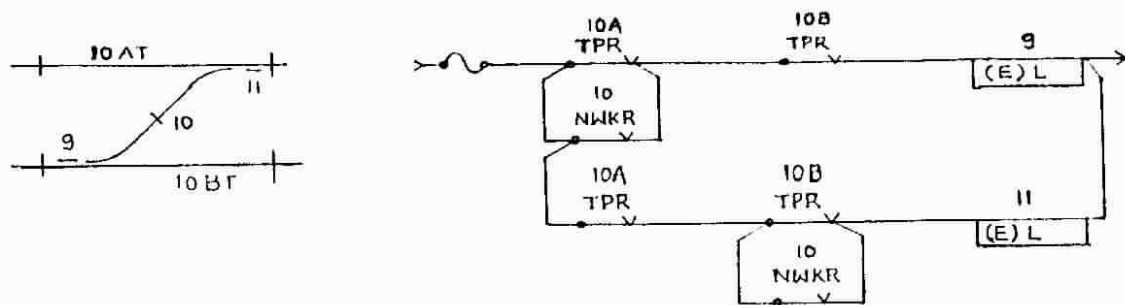


Fig: 2.5

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 OR point
- (ii) Signal lever controlling signal machine OR some time colour light signal.

Generally indication locking in relay interlocking applicable to signal and is achieved at route locking circuit level. (Refer ASR circuit in British relay interlocking Notes S5J)

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.

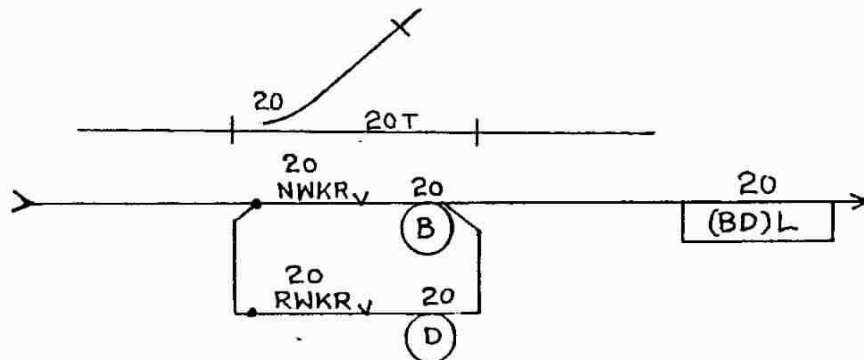


Fig: 2.6

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.

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.

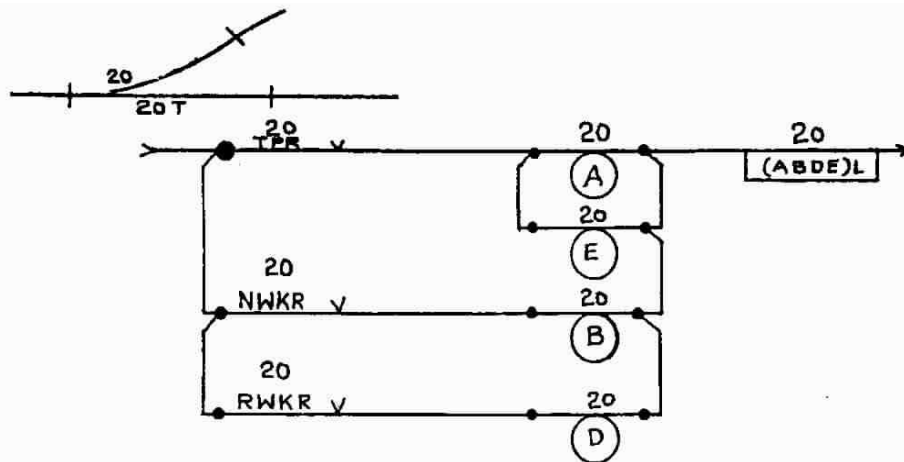


Fig: 2.7

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.

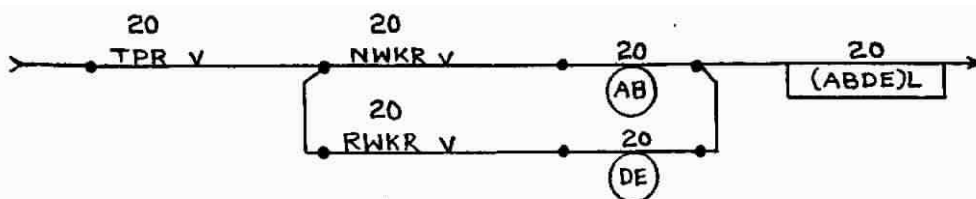


Fig: 2.8

Circuit 3 If two electric lever locks are used as shown below (for use of power frame etc.) The above said disadvantage can be eliminated. But this method is not economical.

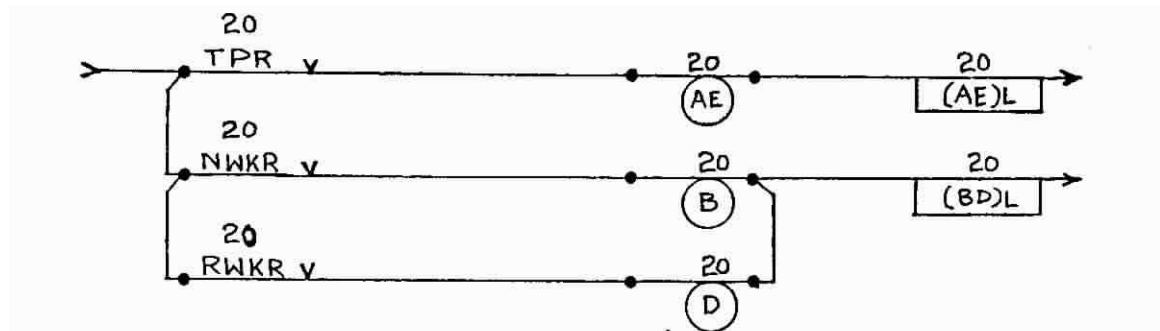


Fig: 2.9

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

2.3 Electric 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 00 to 50 of arm contact or by relays which proves 'ON' aspect of signals.

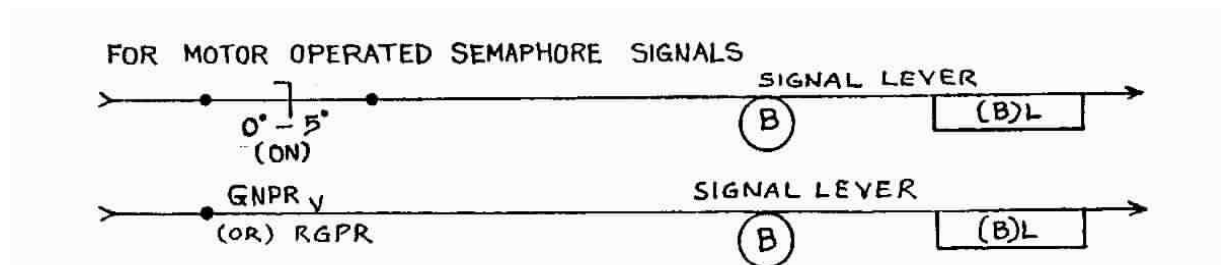


Fig: 2.10

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 Concerned HR↓
- (b) For 3 aspect Colour light signal Concerned HR ↓ & DR↓
- (c) For 4 aspect Colour light signal --- Concerned HR↓, HHR ↓ & DR↓.

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

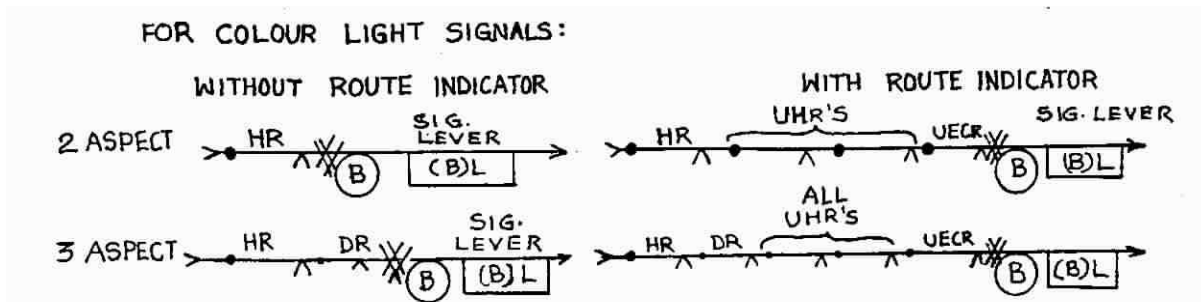


Fig: 2.11

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 signals (HECR, HHECR, DECR) may also be proved in de-energised condition e.g. HECR↓, HHECR↓, DECR↓.
- (b) For the First stop Signal (Home), not only the relays governing Home Signals 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-energised 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 conditions once signal to that route is taken to OFF and driver 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.

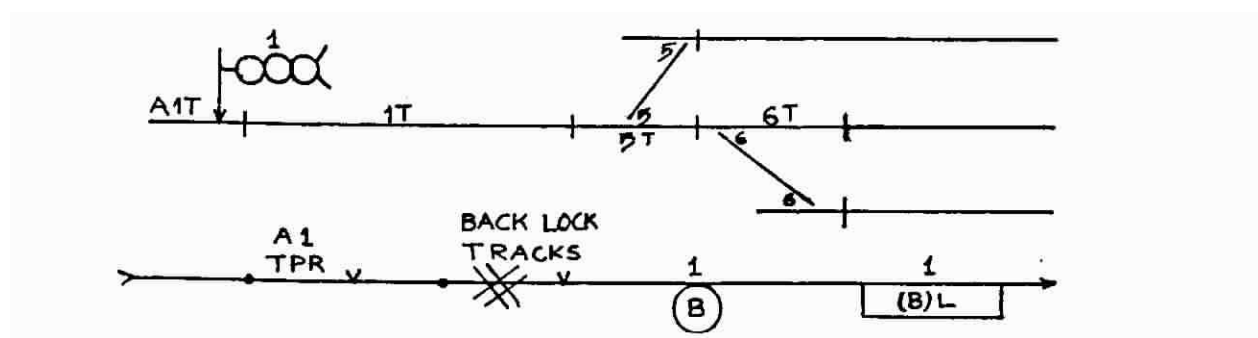


Fig: 2.12

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.

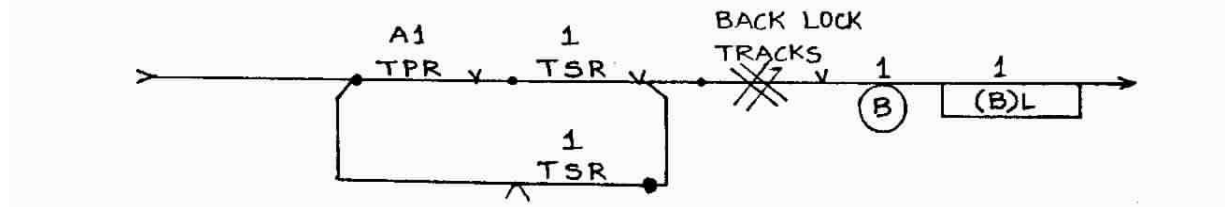


Fig: 2.13

When the first train passes the signal 1, 1 TSR 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 pre-mature 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 upto '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) by 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 (not passed the 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 pre-determined time lapse from the initiation of cancellation Fig. 2.14.

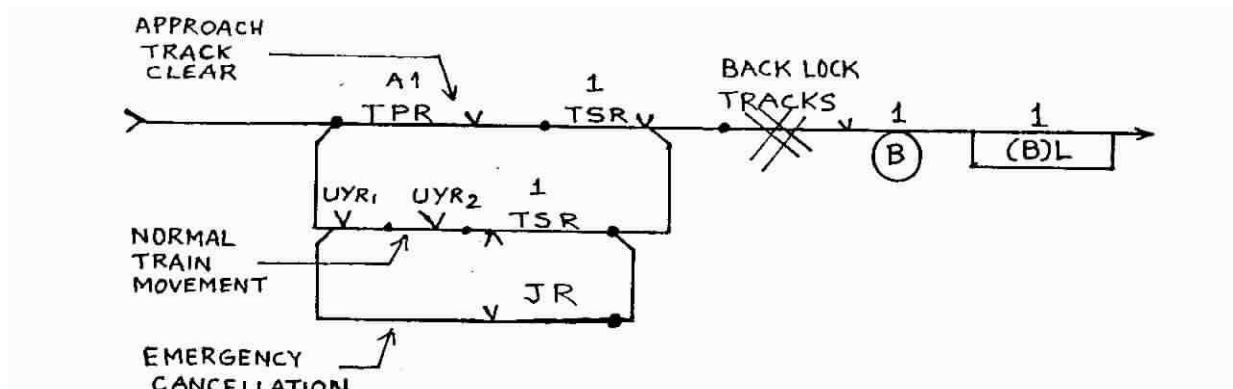


Fig: 2.14

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

- (a) Main Line Starter - 1 Km (BD) 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 (BD) in approach of signal.

But no approach track circuit is provided for home signal and 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 pre-determined time delay.

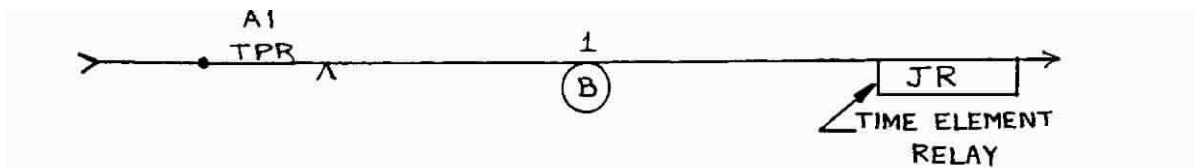


Fig: 2.15

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.

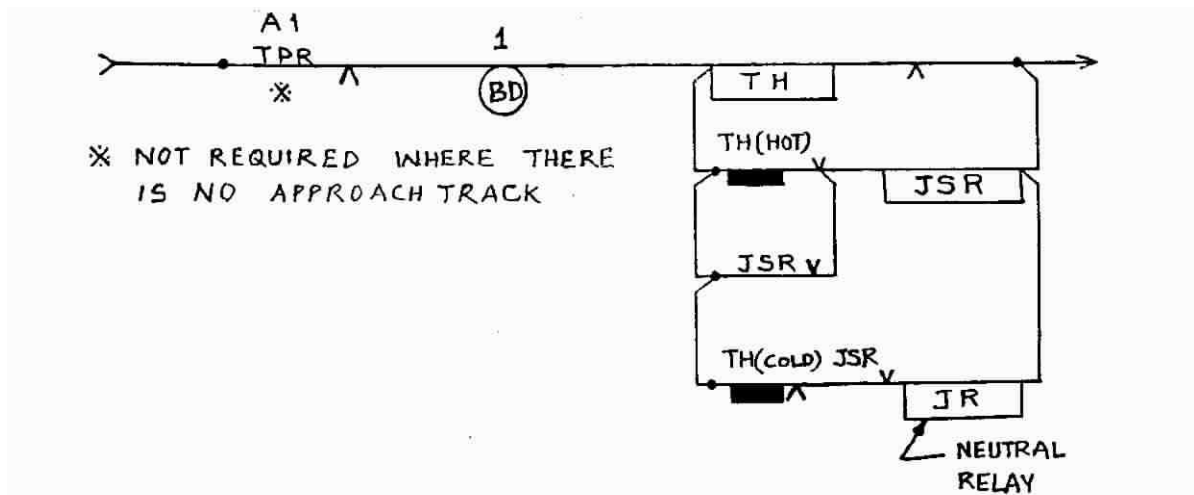


Fig: 2.16

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.

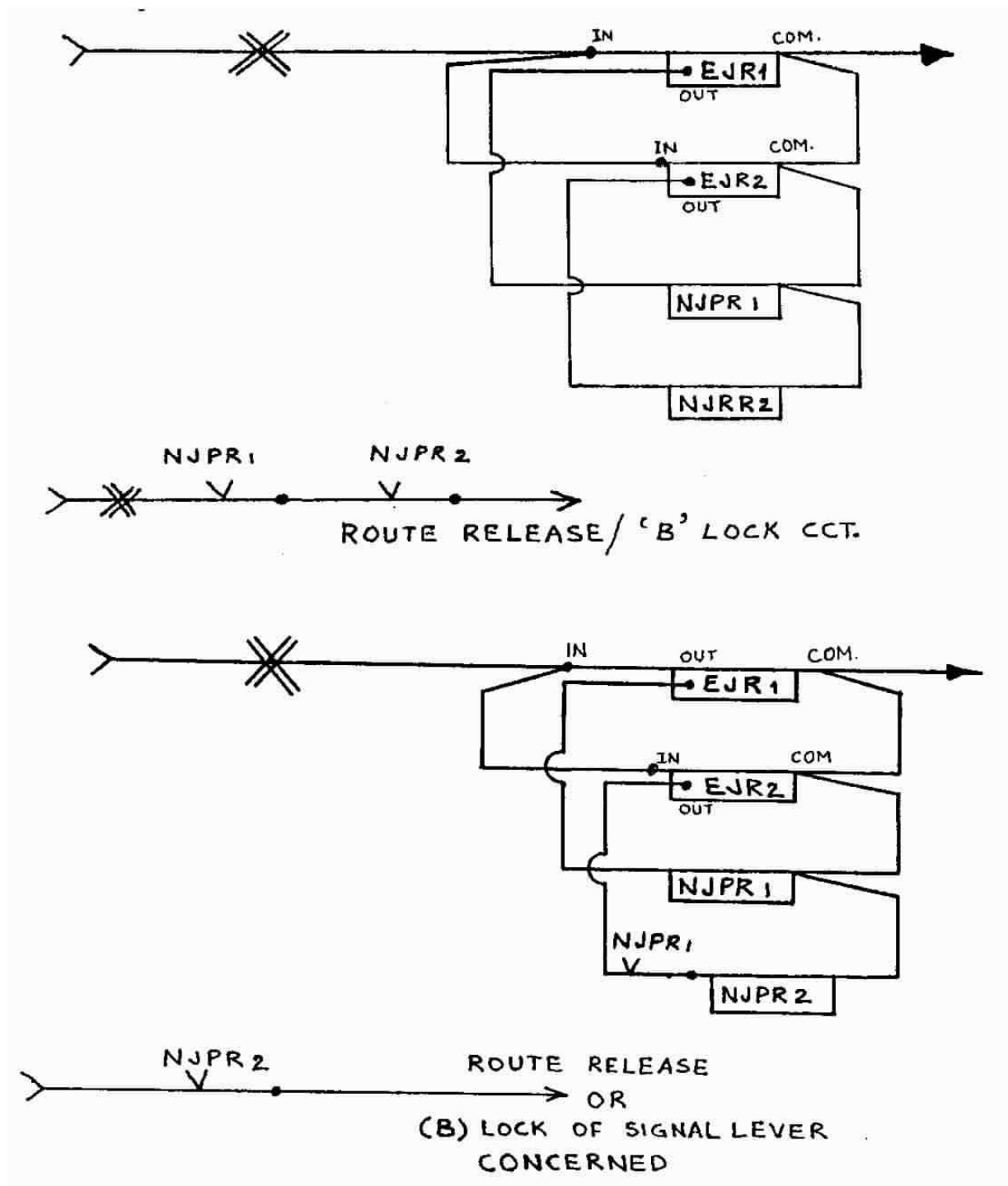


Fig: 2.17

Where electronic timers are used, they are worked in parallel and their outputs (contacts) 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 rough. One by using the contacts of both NJPR1 and NJPR2 in series to effect the time delay or prove NJPR1 \uparrow in NJPR2 and prove NJPR2 \uparrow 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.”

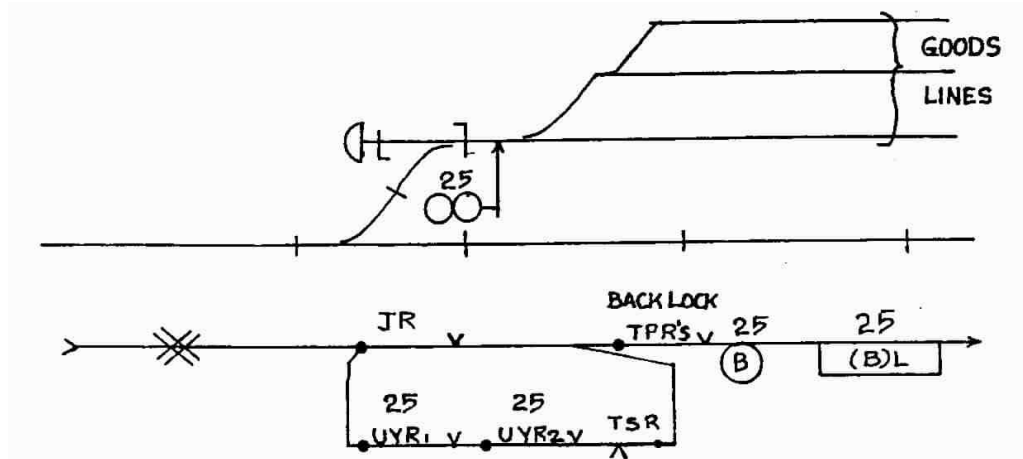


Fig: 2.18

From the Circuit it can be seen that once 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 lever man/cabinmen/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.

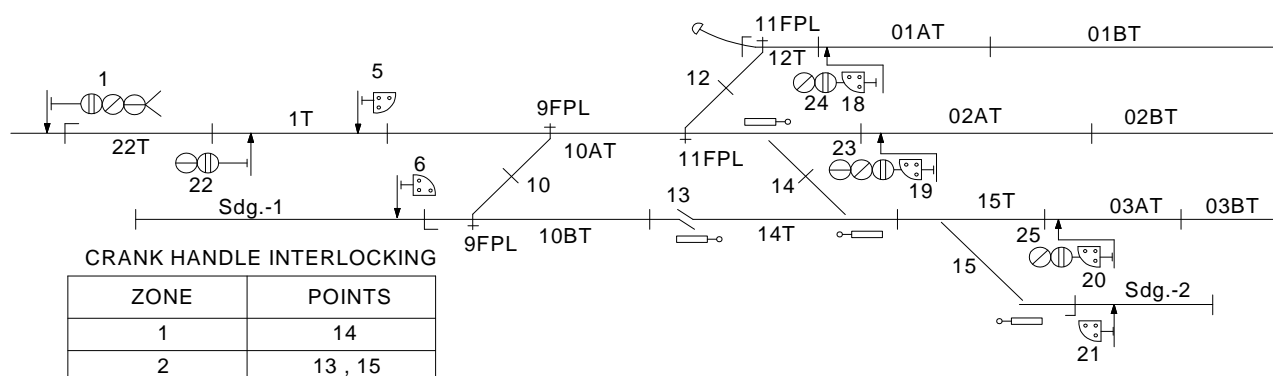


Fig: 2.19

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

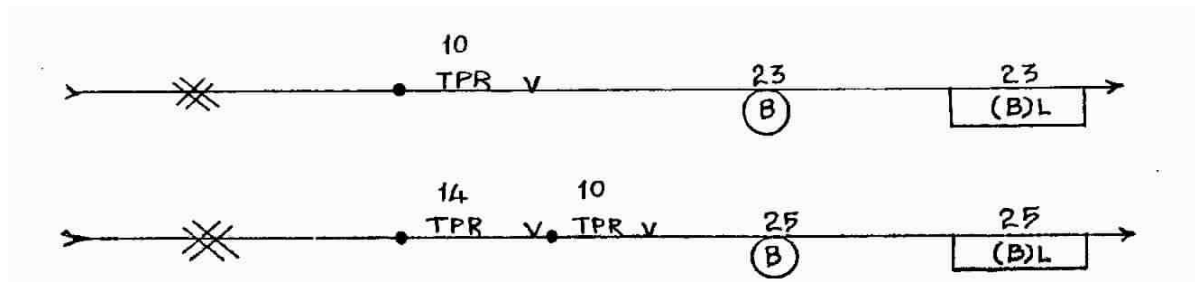


Fig : 2.20

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 & 10T 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.

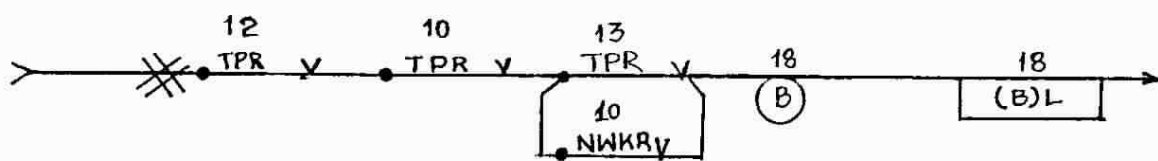


Fig: 2.21

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.

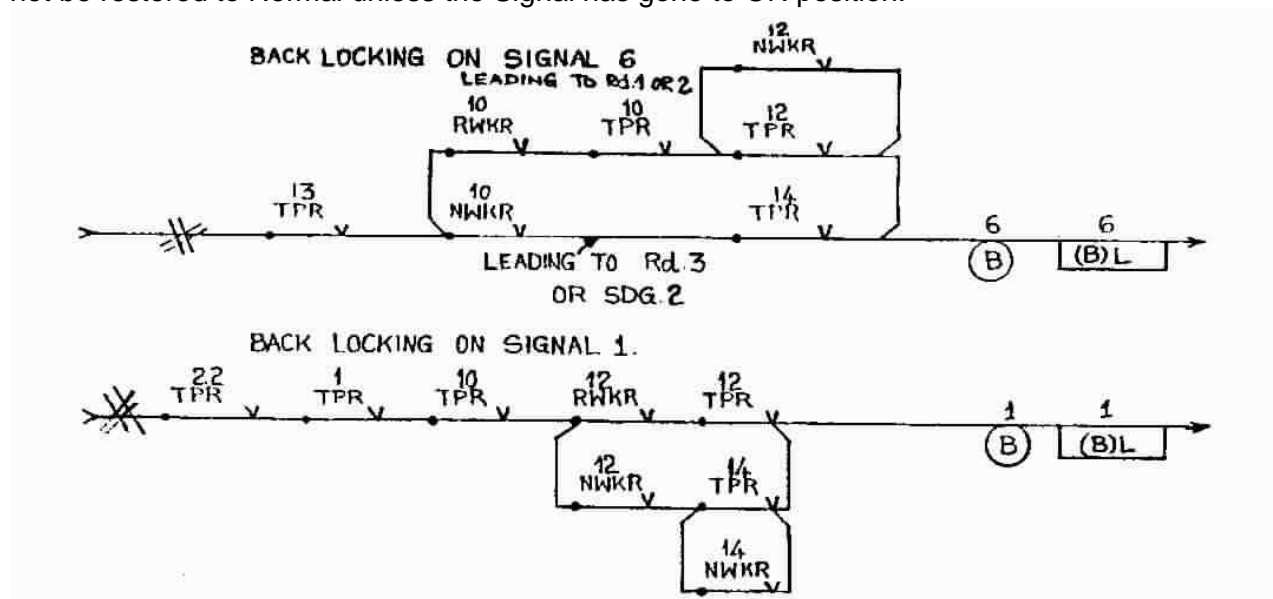


Fig: 2.22

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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.

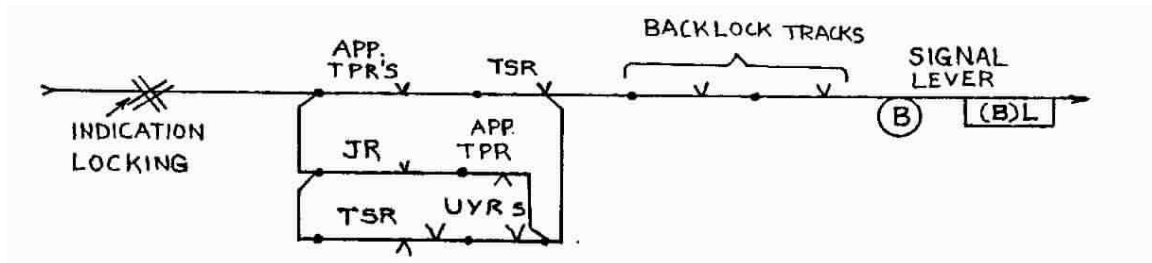


Fig: 2.24

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.

But, since TSR is controlled by only one Track Circuit in advance and if it fails momentarily and energises 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 “Pre-mature Route Release.”

To avoid Pre-mature Route Release, instead of relying on the, condition of only one Track Circuit we are required to consider minimum 2 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.) UYR's 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 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 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

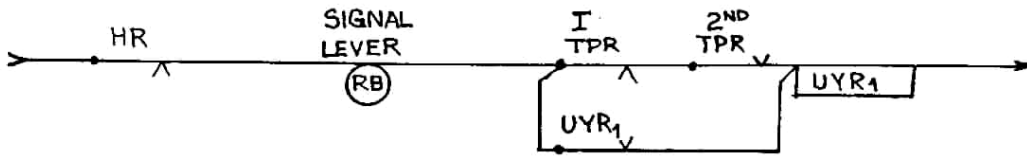


Fig: 2.25

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.

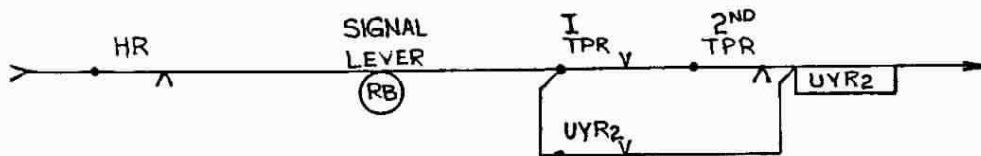


Fig: 2.26

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.

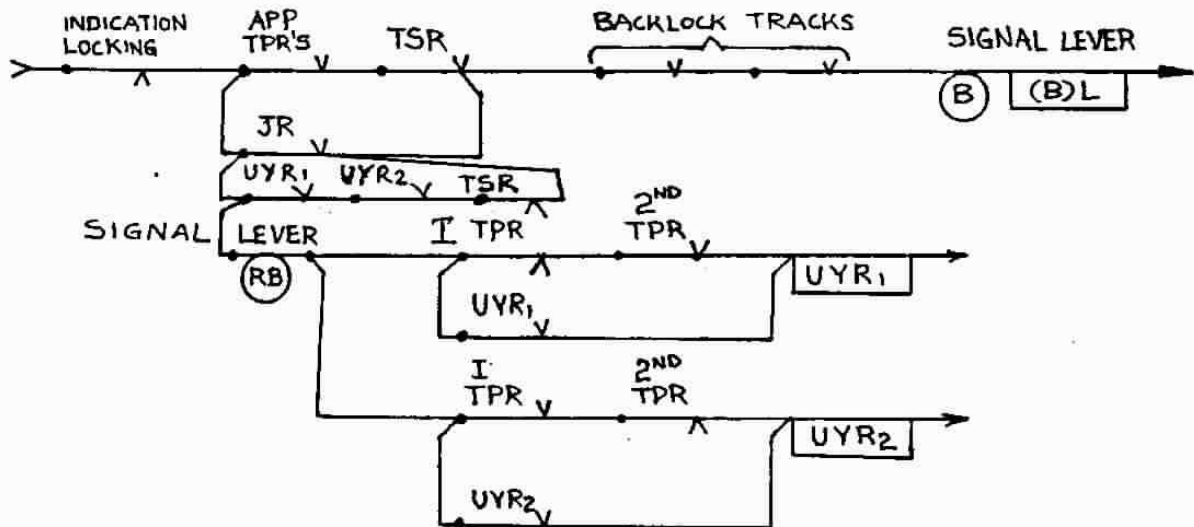


Fig: 2.27

Note: - Improvised arrangement recommended is as follows:-

- (a) 1st Track ↓ + 2nd track ↑ + UYR2 ↓ + POR ↑ + UYR1 energises & sticks
- (b) 1st Track ↑ + 2nd track ↓ + POR ↑ ----- UYR2 energises & sticks

ELECTRICAL LOCKING ON POINTS & SIGNAL LEVERS

In this method, not only the sequential performance of relays is monitored, but also the availability of stable power supply is ensured by proving POR (Power on relay) energised contact.

The circuit is shown in fig.2.28.

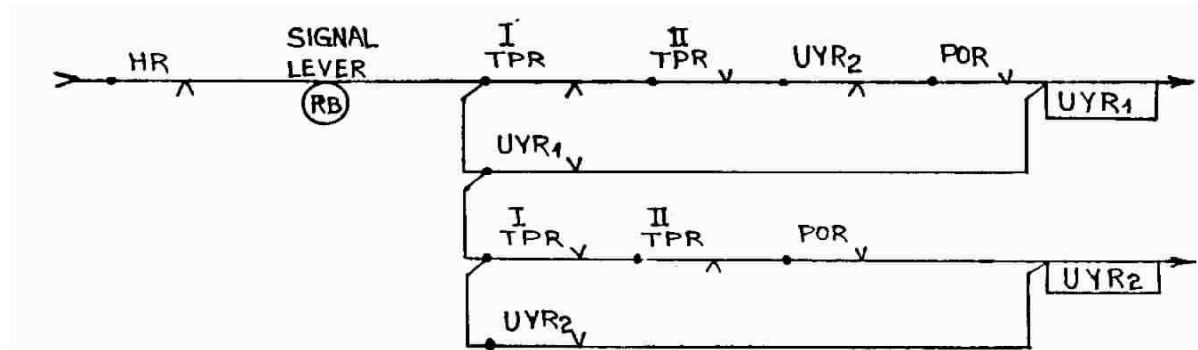


Fig: 2.28

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 are checked by proving back contacts of all UYR's in signal clearance circuits (HR).

In the modern installations, wherever possible, 3 Track circuits in succession are used in different combinations (2 Tracks occupied and one Track free) to energise UYR's. (Dealt in S12 & S14)

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, release 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 effecting 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.

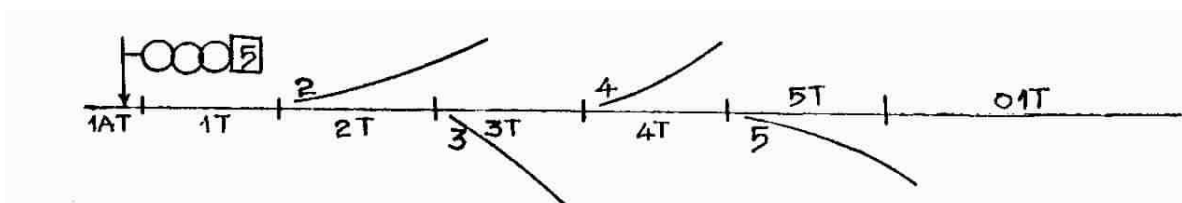


Fig: 2.29

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.

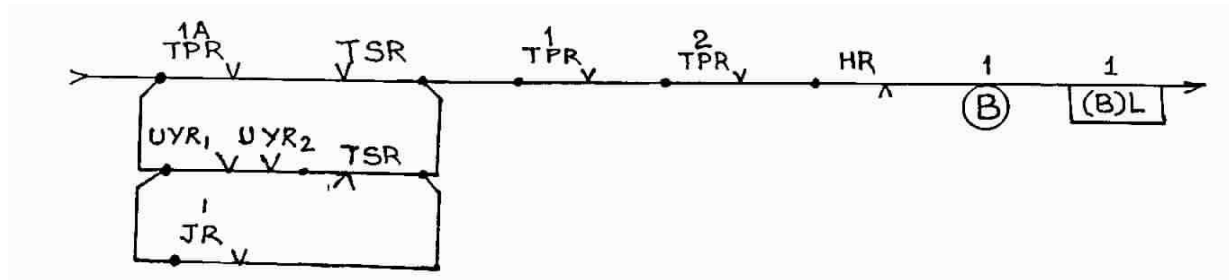


Fig: 2.30

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.

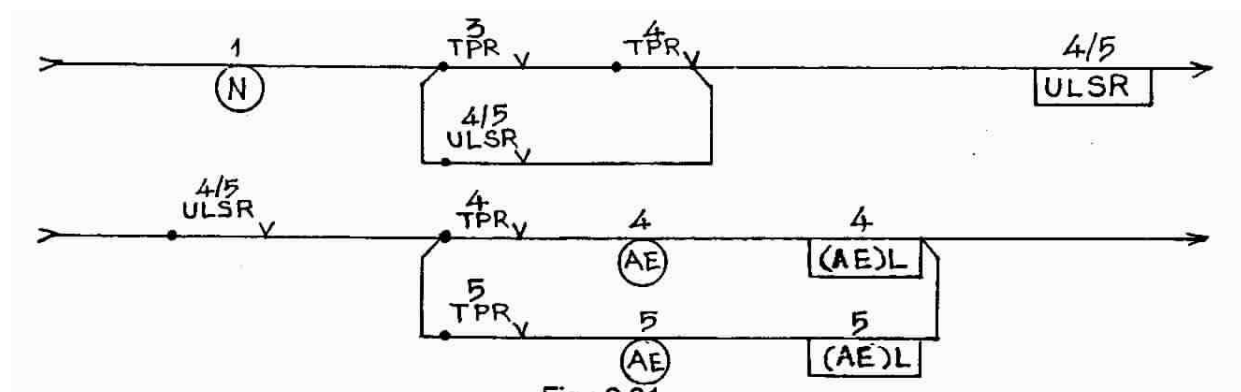


Fig: 2.31

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 are 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.

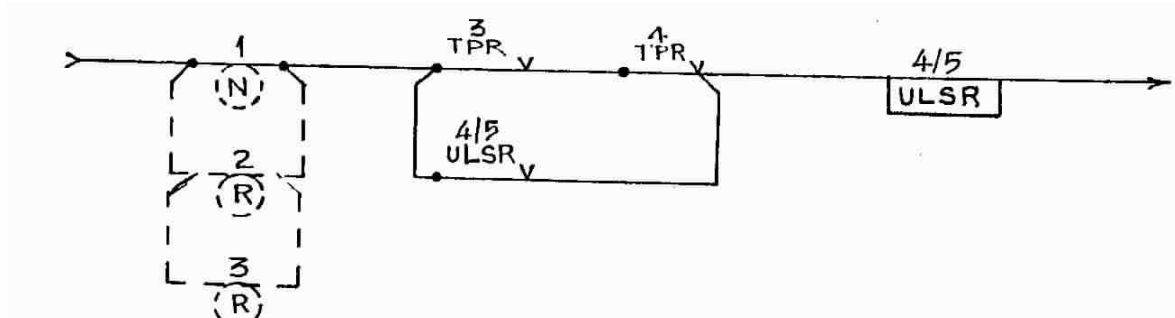


Fig: 2.32

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(in rear) 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 modern 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: TABLE OF CONTROL

3.1 Table of Selections/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 or 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.

TABLE OF CONTROL

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 S5H.3.I.(3)

Col.8. Controlled by aspect of signal ahead:

This column provides the necessary Red lamp protection as explained vide para 1.2.17. 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 1.2.1.

Col.12 Locks Signals:

The various conditions under which signals to lock each other are explained vide para 1.2.7.

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.
- (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 UHR's & 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 track occupied"

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

TABLE OF CONTROL

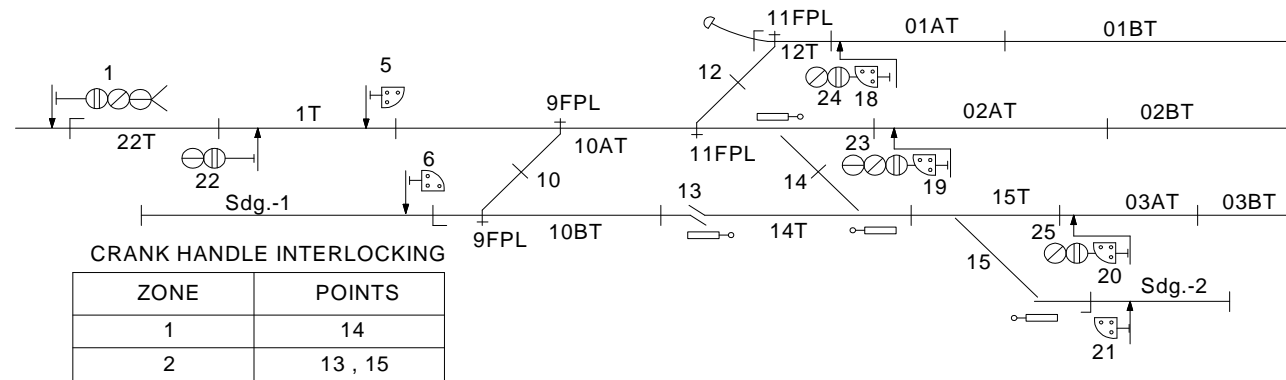
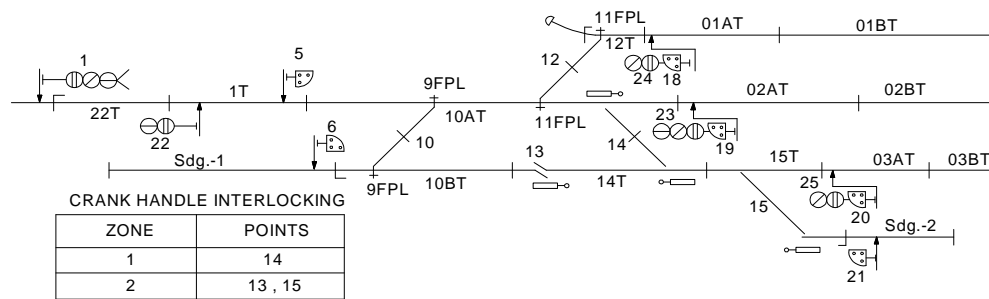


TABLE OF CONTROL

S No	SIG No	ROUTE	ASPECT	APPROCHED LOCK BY	BACK LOCKED BY	CONTROLLED BY			LOCK AND DETECTS POINT		LOCKS ROUTE/ SIGNAL	OTHER CONTROLS	REMARK
						TRACK	ASPECT OF SIG AHEAD	CRANK HANDLE ZONE	NORMAL	REVERSE			
1	1	Rd 1	YRI	DA (120 sec)	22T,1T,10AT,12T	22T,1T,10AT,12T, 01AT,01BT	-	1	10,14	12	5,18,22,24	1YR ₁ ↑	1UYR ₁ ↑ 1UECR↑
2	1	RD2	Y	DA(120 sec)	22T,1T,10AT	22T,1T,10AT,02AT ,02BT	-	1	10,12,14	-	5,19,22,23	1YR ₁ ↑	1UHR ₁ ↓,1UHR ₃ ↓, 1UECR↓
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 ↑,1DR↑	1UHR ₁ ↓,1UHR ₃ ↓, 1UECR↓
4	1	RD3	YR2	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 ↑	1UHR ₃ ↑,1UECR↑
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	-	-



S No	SIG No	ROUTE	ASPECT	APPROCHED LOCK BY	BACK LOCKED BY	CONTROLLED BY			LOCK AND DETECTS POINT		LOCKS ROUTE/SIGNAL	OTHER CONTROLS	REMARKS
						TRACK	ASPECT OF SIG. AHEAD	CRANK HANDLE ZONE	NORMAL	REVERSE			
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	-	-

Note: * ATR : Approach Track Relay , Pick up when all TC's up to Home Signal in rear are clear & R1-R2 Stands for Route to Rd-1 & Rd-3

IRISET



ZONE	POINT
Z1	13,18
Z2	11,20
Z3	12,19

ZONE	POINT
Z1	13,18
Z2	11,20
Z3	12,19

CONTROL TABLE (FOR LAYOUT in Fig 3.1)

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	LOCK ROUTES	SIGNAL ASPECT				REMARKS	
			ROUTE		ISOLATION		OVERLAP		ROUTE	OVERLAP	FOULING					Y WITH ROUTE IF	Y IF	YY IF	G IF		
			NOR	REV	NOR	REV	NOR	REV.													
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) ,21,2	-	6RG/ DG	-	6DG	TIME RELEASE 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), 21,2	-	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

TABLE OF CONTROL

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	LOCK ROUTES	SIGNAL ASPECT				REMARKS
			ROUTE		ISOLATION		OVERLAP		ROUTE	OVERLAP	FOULING					Y WITH ROUTE IF	Y IF	YY IF	G IF	
			NOR	REV	NOR	REV	NOR.	REV.												
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
13	7	UP MAIN	-	-	-	-	-	-	7T	-	-	-	-	-	-	-	-	-	-	CONTROLLED BY UP SIDE BLOCK INSTRUMENT
14	10	DN LOOP	11	12	-	-	-	-	11BT,12BT,1 2AT	-	-	CH1,CH3	26-28T	11BT, 12BT, 12AT	25,27,30, (30AW20N)	-	-	-	-	TIME RELEASE 120 SEC
15	10	DN MAIN	11, 1 2	-	-	-	-	-	11BT,12BT	-	-	CH1,CH3	26-28T	11BT, 12BT	25,28,30,30A	-	-	-	-	TIME RELEASE 120 SEC
16	10	UP MAIN	13	11	-	-	-	-	11BT,11AT,1 3BT	-	-	CH1,CH2	26-28T	11BT, 11AT, 13BT	4,23,25, (21W18N) (30AW19R12R), (30,30AW19N)	-	-	-	-	TIME RELEASE 120 SEC
17	10	COMMON LOOP	-	11, 13	-	-	-	-	11BT,11AT,1 3BT,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,1 8AT	-	-	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,1 1BT	-	-	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,1 1AT,11BT, 26-28T	-	-	CH1,CH2,C H3	CLT	13AT, 13BT, 11AT, 11BT,	4,10,21, (30AW19N)	-	25 RG/ DG	-	-	TIME RELEASE 120 SEC
23	27	DN MAIN	11	12	-	-	-	-	12AT,12BT,1 1BT, 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,2 6-28T	-	-	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	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

TABLE OF SELECTION- DOUBLE LINE STATION

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	LOCK ROUTES	SIGNAL ASPECT				REMARKS
			ROUTE		ISOLATION		OVERLAP		ROUTE	OVERLAP	FOULING					Y WITH ROUTE IF	Y IF	YY IF	G IF	
			NOR	REV	NOR	REV	NOR.	REV.												
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,1 8AT,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,1 8AT,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 crank handle 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 S5J.

Crank handle interlocking is done as follows:

- (a) Whenever a signalled move is given it will 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 will not be possible to
 - (i) Operate the points from cabin.
 - (ii) Clear any concerned signal.

For the above purposes, the crank handle is normally kept locked in an EKT/RKT/HKT and this condition (crank handle in and locked) 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.

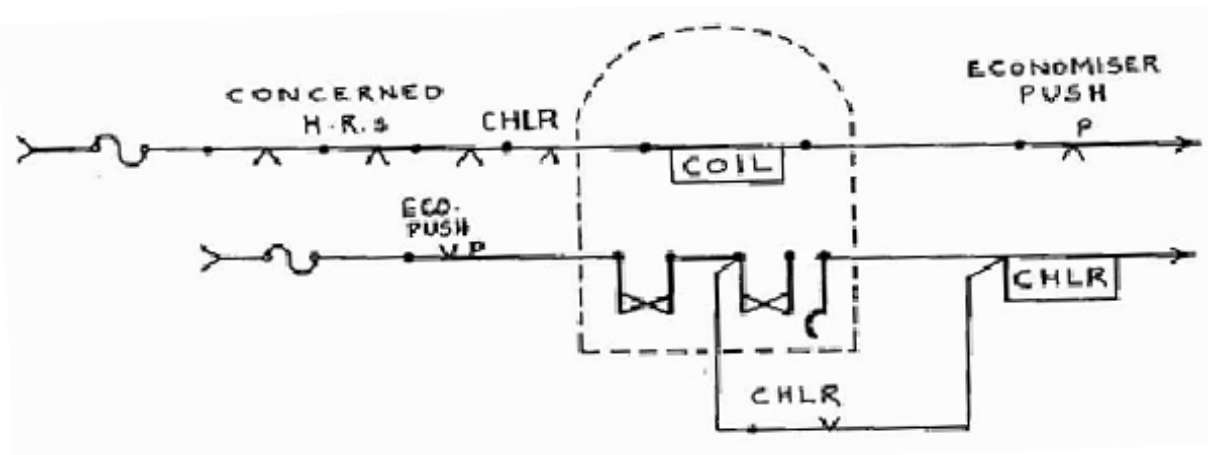


Fig: 4.1

4.2 SIDING CONTROL

Sidings are provided at the stations to:

- (a) detach a vehicle/a few vehicles from the 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. after the day's work has been completed.

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

Operation of siding points directly from the cabin/panel is resorted to, only if the movements over these points (into and out of siding) 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 from/to the siding then these points are operated locally, but controlled from the cabin/panel. The siding points remain locked in position and the same can be released only where there is no signaled movement over/towards 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/siding control knob or switch/button in case of relay interlocking which will be possible only when the concerned signal levers/controls are normal and other interlocking's 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 when 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 concerned signal clearance circuits (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 when 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.

CRANK HANDLE, SIDING CONTROL CIRCUITS AND CALLING-ON SIGNAL

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.

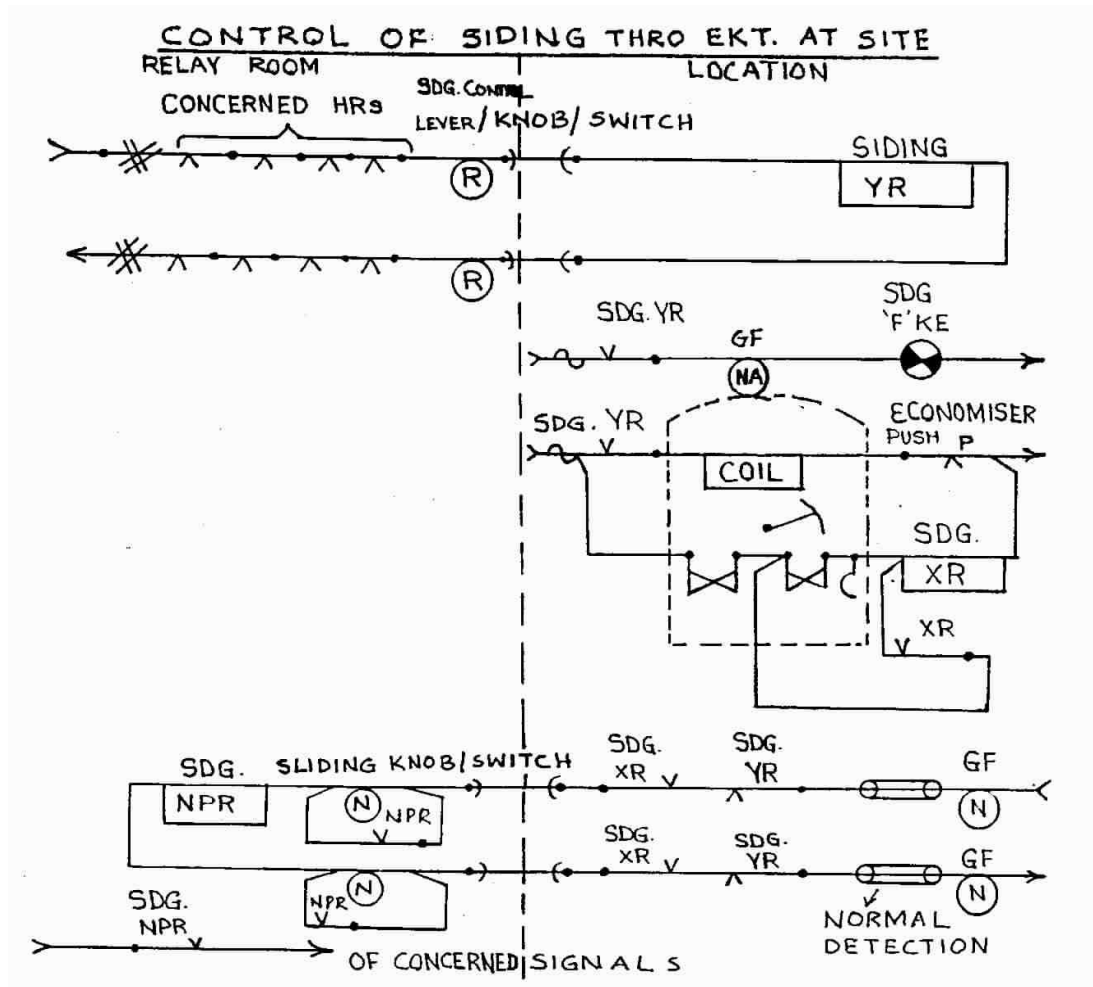


Fig: 4.2

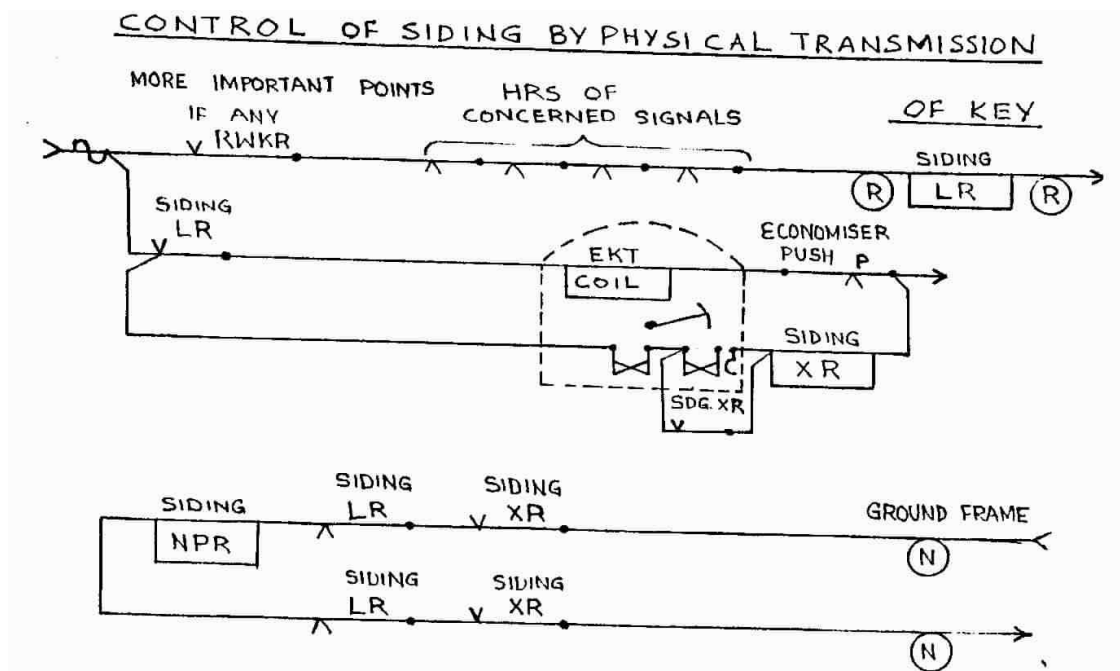


Fig : 4.3

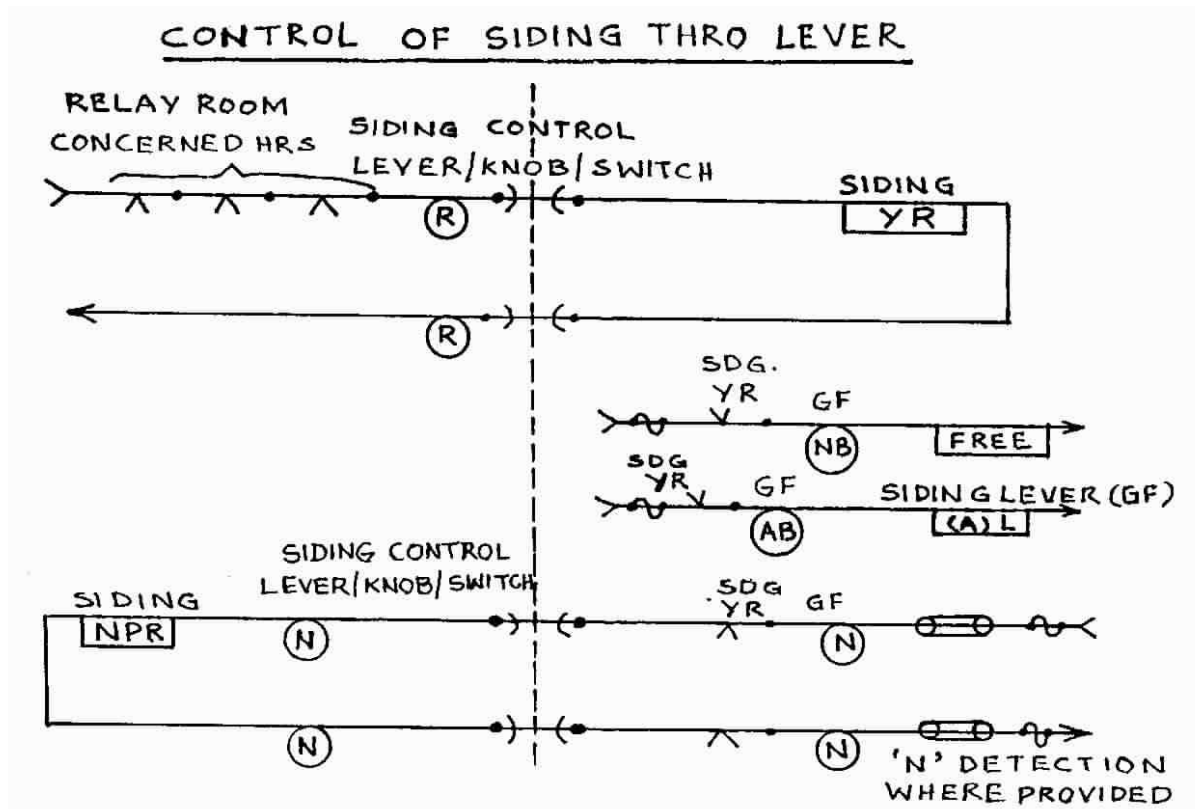


Fig: 4.3

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 road.
- (b) When the main signal above it, can't be taken off due to
 - (i) Failure of track circuit/circuits in advance
 - (ii) Failure of points (indication) 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 for calling-on signal in Double Line Sections.
- (b) All points in the route, isolation and Overlap for calling-on signals on single line sections. Points in the overlap may be exempted if approved by Competent Authority.

- (c) Calling-on track circuit occupied.
- (d) Crank Handles of the power operated points if any, are 'IN' and locked.
- (e) Signal in advance is not taken off
- (f) Conflicting signals are at ON
- (g) LC Gate in the route closed and locked against the road traffic.
- (h) 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 circuit.
- (i) 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
- (j) Cross protection is provided to prevent energisation of calling-on HR by a foreign feed.
- (k) Relevant control switch/button (COGGN) operated together with the main signal lever already in pulled condition,

In addition to proving calling-on track circuit occupied and the predetermined time delay is already completed, it is necessary to prove the first track circuit in advance is clear and TSR in case of calling-on signals provided in automatic section.

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 concerned switch/lever 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 concerned TSR 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 which is the simple circuit 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 relays/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 of track, position of track circuit. In case of A.C. Track Circuits, it is preferable to give the track indications through the track repeating relays, as the A.C. Track relays sometimes fail to make the back contacts.

Additional track indication (white) are made available on the illuminated diagram provided in the cabins with lever frame to indicate the clear/free condition of the concerned track circuits. 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 / sub route is locked (engaged) for a signalled move.

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

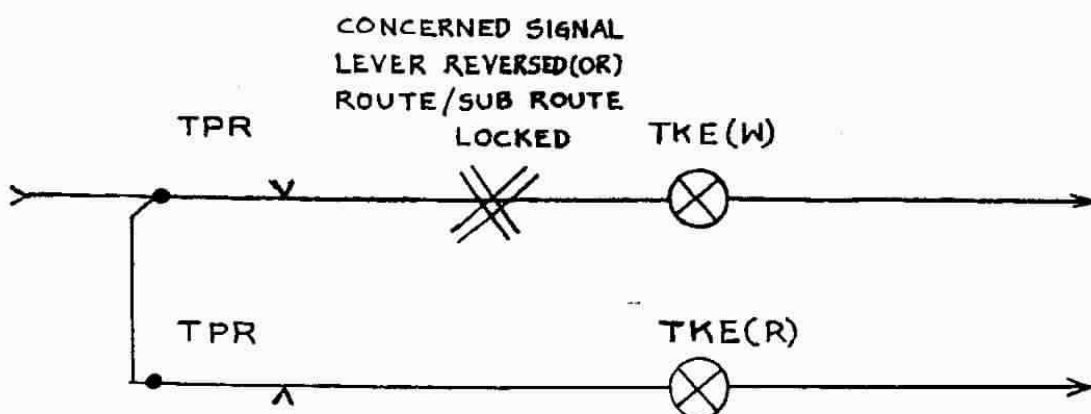


Fig: 5.2

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 is given by providing two bulbs at the ends of the track circuit boundaries on the illuminated diagram. Berthing Track circuits may be provided with 4 bulbs, since the length of track circuit is more.

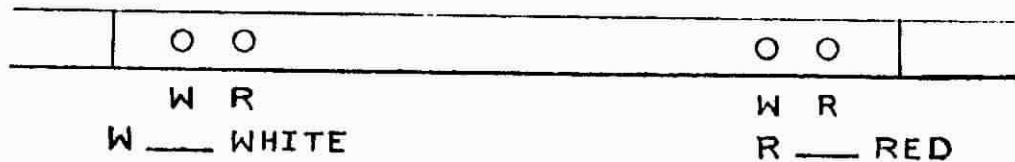


Fig: 5.3

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 side 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 are given by lighting strip in the illuminated diagram. These strip 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.

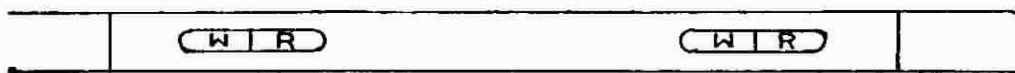
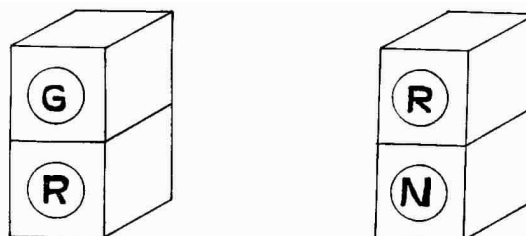


Fig: 5.4

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 strips 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 me lever frame and also at ground frames, at level crossing gates, sidings, shunting necks, etc.



SIGNAL INDICATION POINT INDICATION

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 are 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 section S5D (Color Light Signal Chapter).

In case of signals controlled by slides/switches/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 5.5 or by using 'I' Type indication transformer, where proving of signal aspects is not mandatory in controlling any other circuits.

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

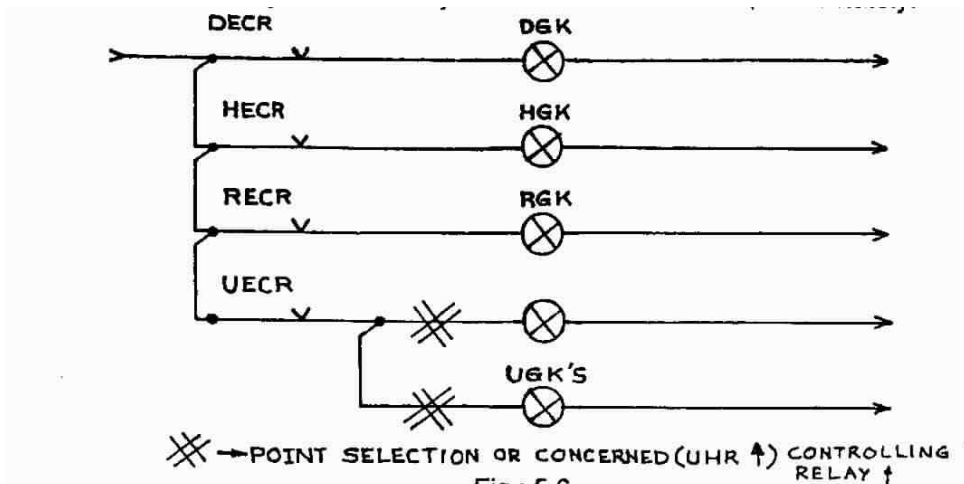


Fig: 5.6

Further, in siemen's system where common "OFF" aspect indication (green) 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 aspect (more respective) is lit through 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. This indicators are given by the illumination of a stencil having alter '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 points indication relays. (Fig 5.6) 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.

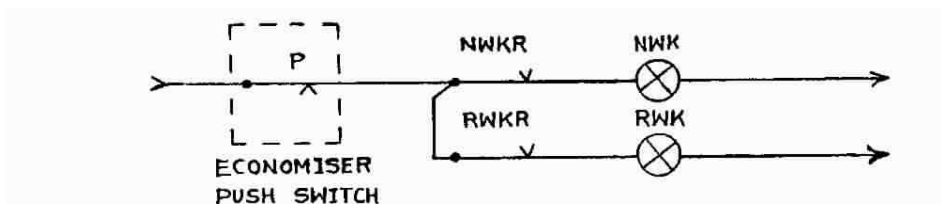


Fig: 5.7

5.4.2 Spot Light Indicators

Spot light indicators are provided on illuminated diagrams in the cabins or at stations, above the SM's control instrument from where points and signals are operated. Spot light indications are also provided on the panel (Anglo-American Type) above the concerned point knob. 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

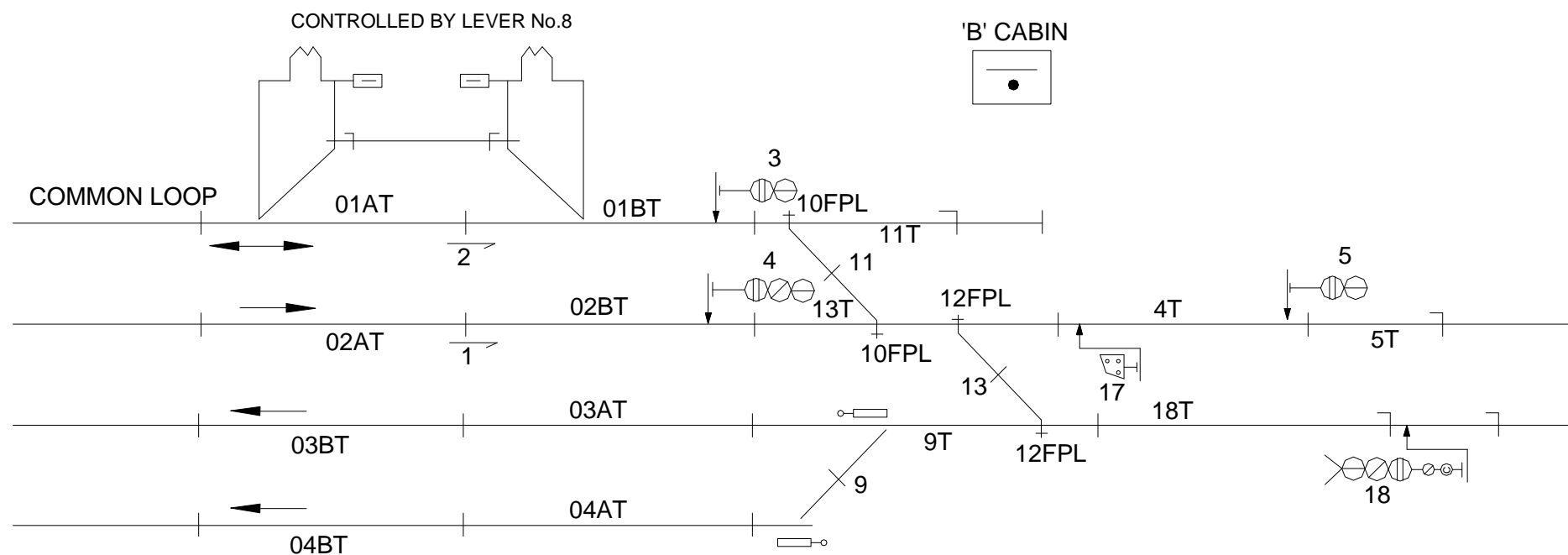
Strip light indications are provided on the track diagram of the panel at the exact location of the point. Two strip lights are used for indicating the condition of the point.

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

CHAPTER - 6: PRACTICE

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 signalling installation. The necessary Control Table and vital Selection circuits are given for reference.

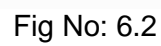


* SEPARATE SLOT SHALL BE GIVEN FOR CALLING ON SIGNAL WHICH WILL BE INITIATED BY PRESSING THE CALLING ON BUTTON / OPERATION. THE SWITCH PROVIDED ABOVE THE CONCERNED SLOT LEVER.

Fig No: 6.1

CONTROL TABLE (DOUBLE LINE)

S No	SIGNAL No	ROUTE	ASPECT	APPROACH LOCKED BY	BACK LOCKED BY	CONTROLLED BY			LOCK & DETECTS POINTS		LOCKS ROUTES / SIGNAL	OTHER CONTROLS	REMARKS
						TRACK	ASPECT OF SIGNAL AHEAD	C.H ZONE	NORMAL	REVERSE			
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,1 3T,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	



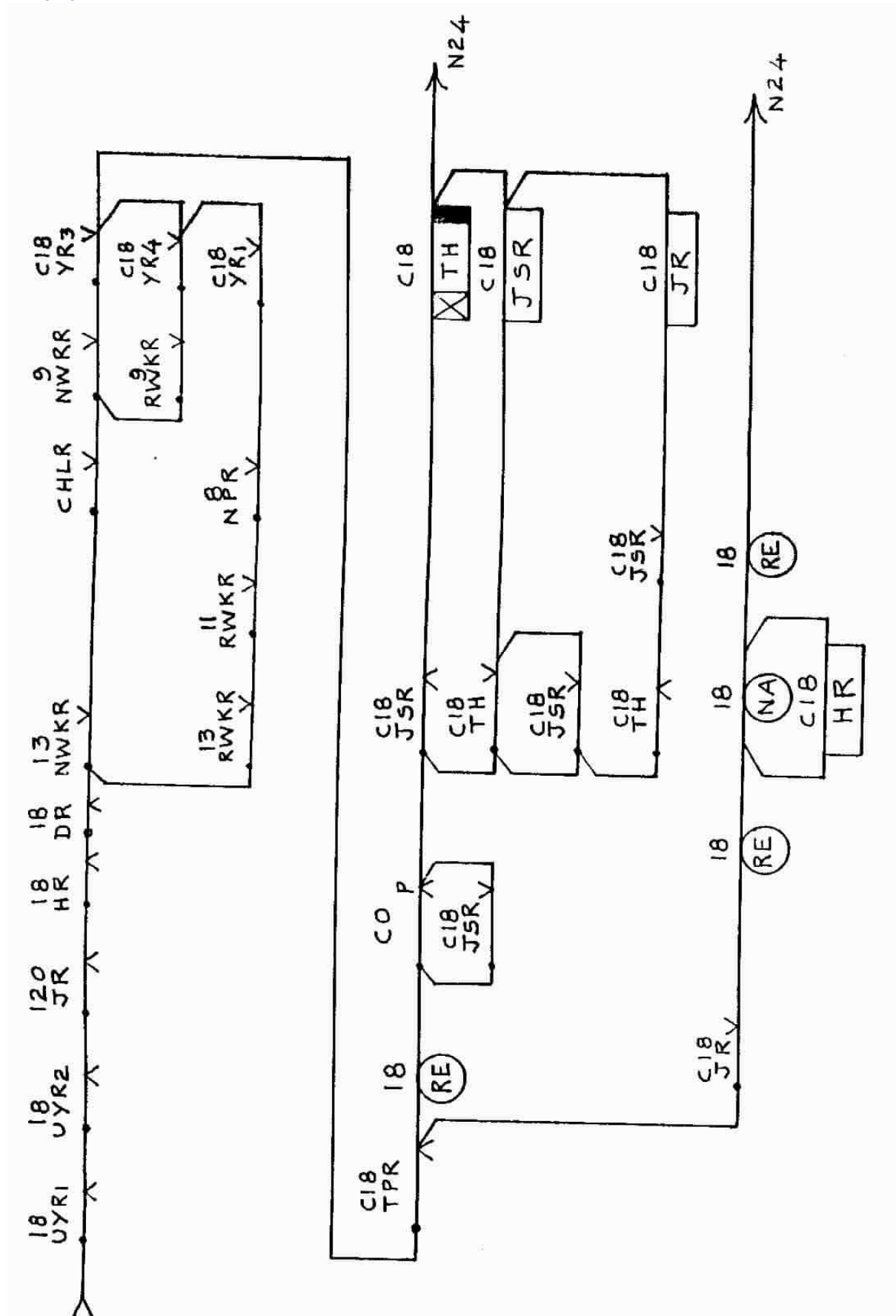
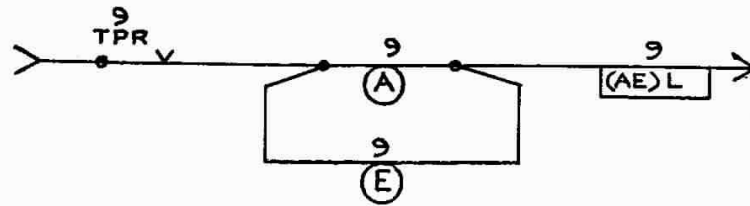
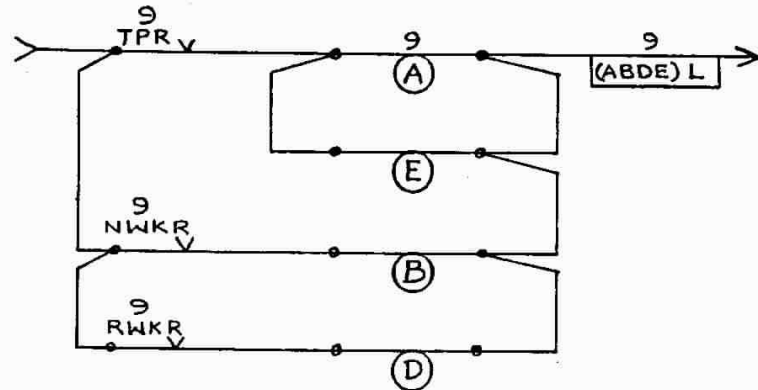
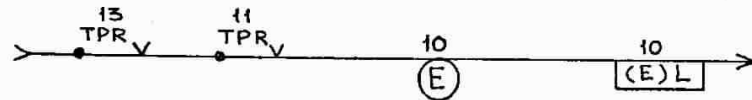


Fig No: 6.3

TRACK LOCKING CIRCUIT ON POINTS. 9.TRACK AND INDICATION LOCKING CIRCUIT ON POINT. 9
(MOTOR OPERATED POINTS)TRACK LOCKING CIRCUIT ON PTS. 11

(PROVIDED ON LOCK LEVER 10)

TRACK LOCKING CIRCUIT ON POINTS. 13

(PROVIDED ON LOCK LEVER 12)

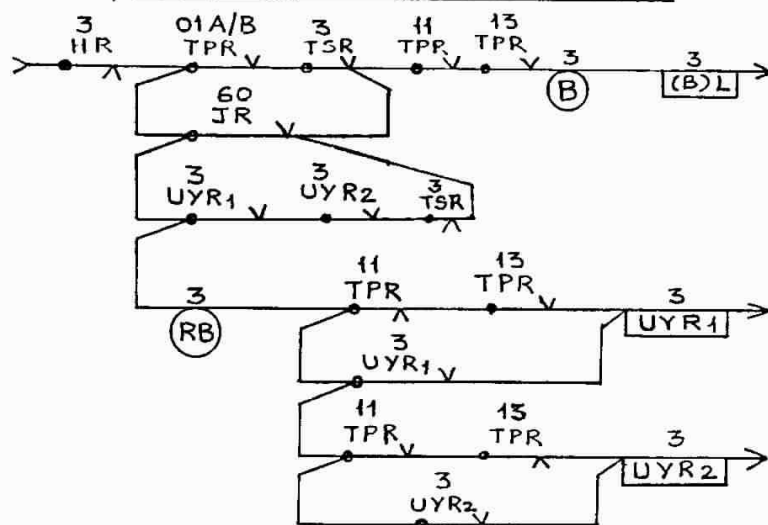
(B) L CIRCUIT ON SIGNAL LEVERS.

Fig No : 6.4

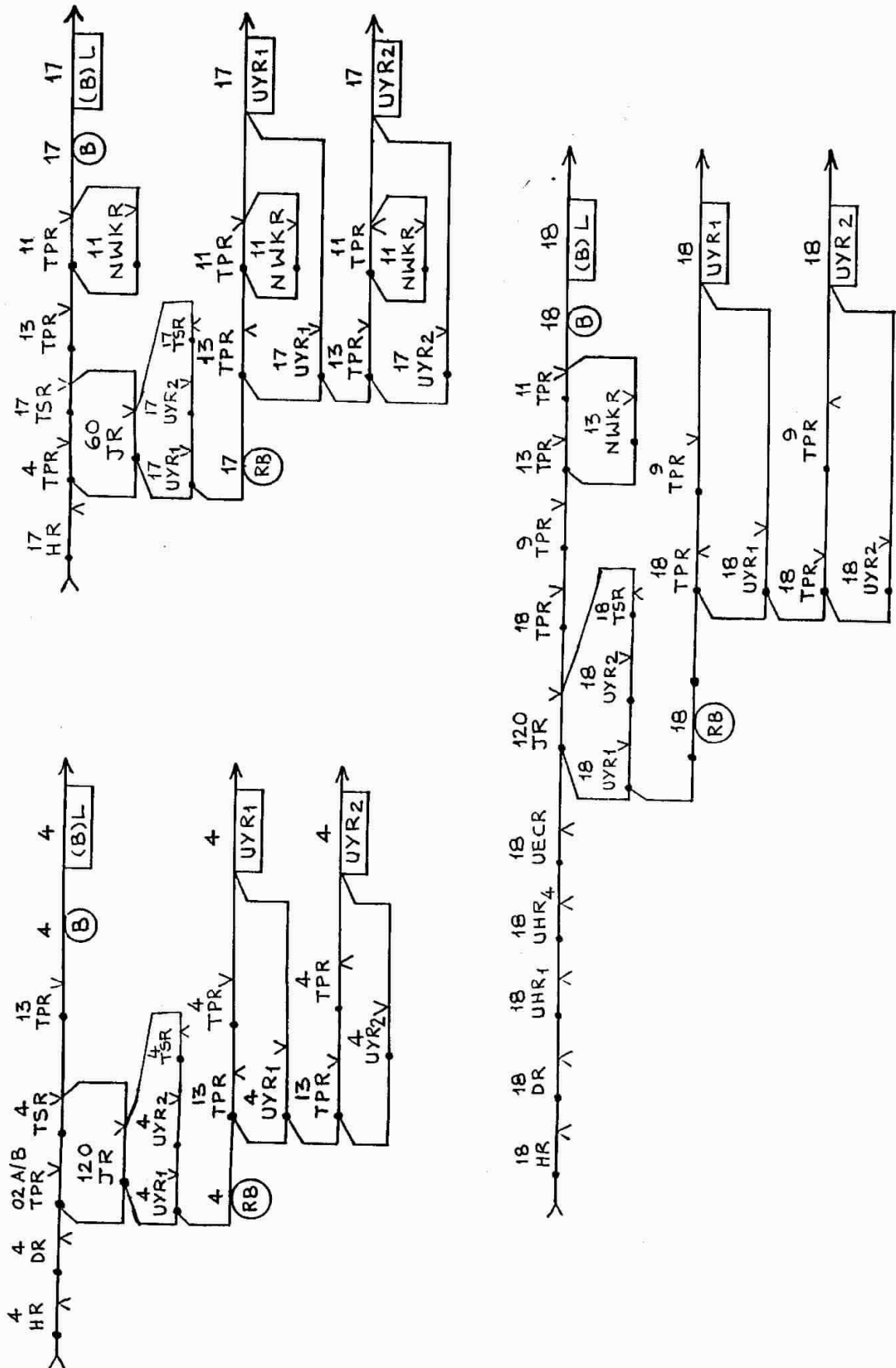


Fig No: 6.5

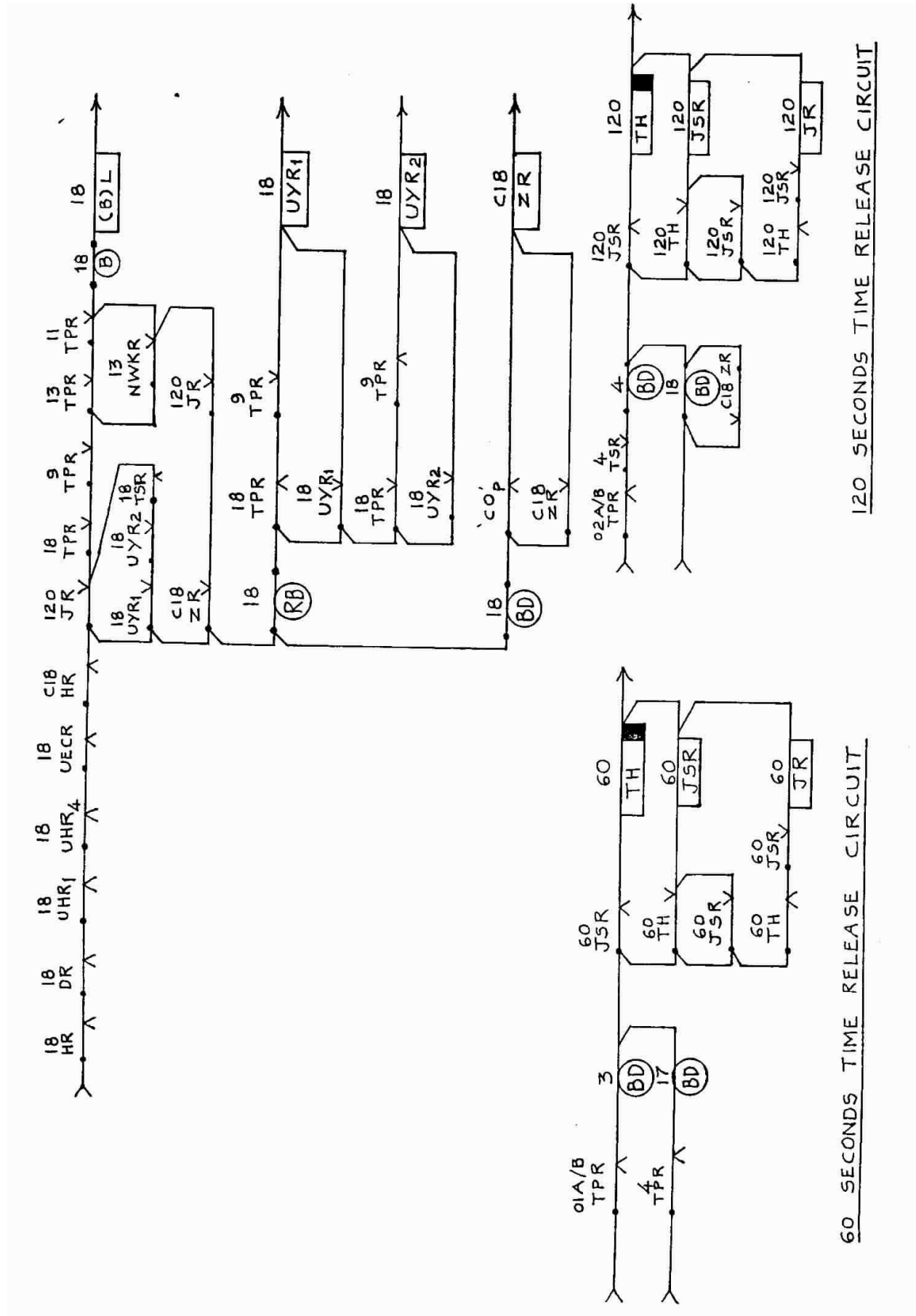


Fig No: 6.6

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 prior 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 Track circuits of shunt single 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).