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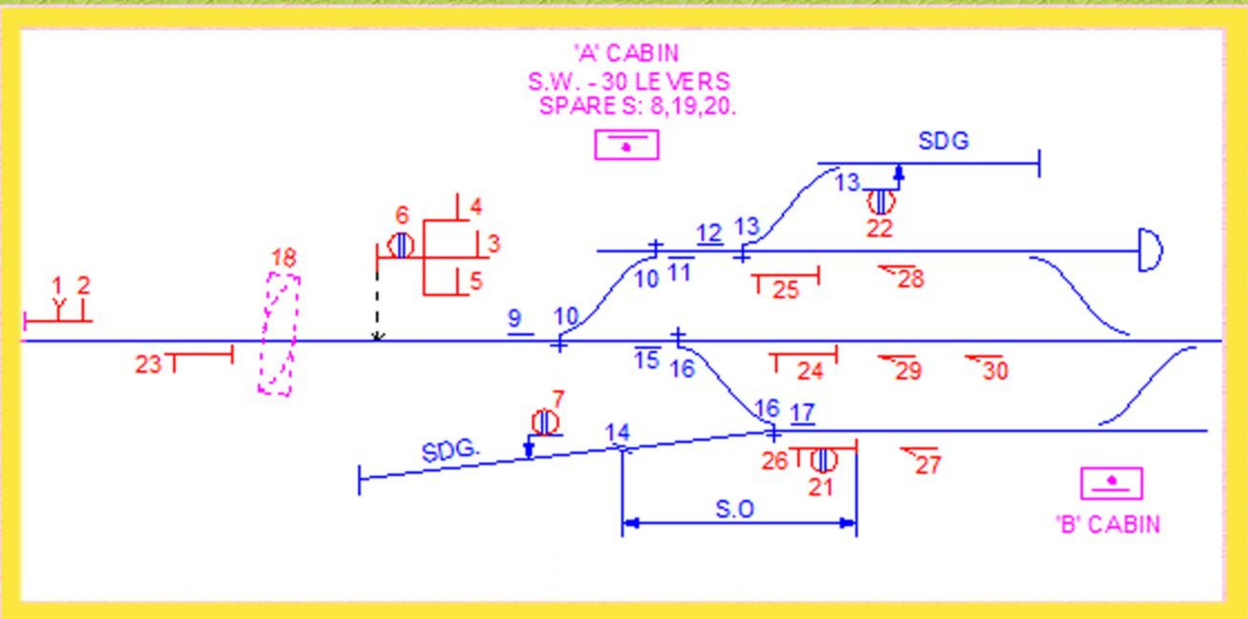
PRINCIPLES OF INTERLOCKING



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

S 2

PRINCIPLES OF INTERLOCKING

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INDIAN RAILWAYS INSTITUTE OF
SIGNAL ENGINEERING & TELECOMMUNICATIONS
SECUNDERABAD - 500 017

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PRINCIPLES OF INTERLOCKING

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CHAPTER – 1
INTRODUCTION TO INTERLOCKING

1.1 The interlocking is a set of systematic logical relations between different sub systems to ensure safe working of total system whether Railway Operations or in any system having safety Implications. Some examples are given below for illustration.

For Ex: 1. Doors of Lift used in Buildings to be closed before it is allowed to move.

2. Doors of Aircraft to be closed before it is allowed to take Off.

3. In Under ground Metro Trains, all the doors of the coaches are to be closed and locked before train can start.

4. Level Crossing gates are to be closed against Road, before a train is allowed to move on tracks.

In a station, different signalling gears are to be operated in a logical sequence for receiving or dispatching of trains for ensuring their safe running. This logical sequence is implemented by a mechanism to ensure compliance to a set of logical relations among different signalling gears of a station. This Mechanism / arrangement is called "**INTERLOCKING"**. Technical means to implement this may be – Mechanical or Electrical or Electronic or a combination of these.

Signals, Points, Lockbars, interlocked level crossing gates etc., existing in a station yard are referred as 'functions'. A certain relationship should exist between these functions such that the operation of one function is dependent upon the certain conditions being fulfilled by other functions. For example, taking off of a signal depends upon the points being correctly set, locked in facing direction and interlocked level crossing gates (if any) are closed and locked against road traffic etc.

The above concepts are explained here keeping the mechanical signalling, in view and these are useful in understanding their application in Electro-Mechanical / Electrical / Electronic Interlocking installations.

1.2 Definition of interlocking as given in G.R.1.02 (29) is

"An arrangement of signals, points and other appliances, operated from a lever frame or panel, so interconnected by Mechanical locking or Electrical locking or both that their operation must take place in proper sequence to ensure safety".

1.3 **In mechanical signalling**, since levers operate the functions, the relationship that should exist between/ among the functions to/among the levers. To ensure that the signal can be taken 'OFF' only after the points are correctly set, we can arrange the interlocking between the signal lever and the point lever is such a manner that the signal lever can be reversed (pulled) only after the point levers are in the correct position, Viz. 'Normal' or 'Reverse', as the case may be.

1.4 If the levers operating the functions are located in the same lever frame, then the interlocking between the levers can be achieved mechanically. If the levers are situated in different lever frames, then the easiest method would be to provide electrical interlocking between the functions. Electric signal reversers or electric signal machines or electrical lever locks are used for this purpose. For example, the interlocking between a signal operated from cabin 'A' and the points in the overlap operated from cabin 'B' is achieved electrically through the 'Slot'.

1.5 If the relationship between two levers, say 1 and 2, is such that, levers 1 and 2 should not be in reverse position at the same time, then the interlocking should ensure that 1 can be operated to reverse position only if 2 is in its normal position and on reverse of 1, lever 2 gets locked in the normal position. This interlocking relationship is expressed as 1 locks 2 symbolically expressed as (1 x 2). Similarly if 2 is operated to the reverse position 1 should remain locked in the normal position. This interlocking relationship is expressed as 2 locks 1. (2 x 1). This is called as 'Normal Locking', as the effect of the interlocking is to hold these levers in their respective Normal positions. In 1 x 2, lever 1, is called locking lever and 2 is called locked lever. In case of 2 x 1, the roles (names) are interchanged.

1.6 At the other instance if the relationship between levers 1 and 2 can be such that lever No-1 has to be first operated to the reverse before lever No.2 could be operated to the reverse position. This requires, once 2 is reversed it should not be possible to normalise 1 unless, 2 is first normalised. This implies that a predetermined sequence is to be followed for operation of these levers. This relationship is expressed as "2 is Released by 1" and the converse is “1 releases 2”. This interlocking relationship can also be expressed as 2 back locks 1, because, by reversing lever No.2, lever No.1 is held in the reverse position. Corresponding to the effectiveness of the interlocking in the reverse position of lever No.1 this is referred to as "Back locking". The terms (2 released by 1) or (2 R by 1) or (2 back locks 1) symbolically (2 ÷ 1) are one and the same 2 back locks 1 should not be confused with 2 locks 1, as in the former case 1 is held in reverse position where as in the later case of (2 X 1) is held in the normal position.

1.7 The relationship between 1 and 2 can also be such that the reversal of 1 will lock 2 in the normal or reverse position depending upon whether 2 was in the normal or reverse position when 1 was reversed. This is expressed as "1 locks 2 both ways” symbolically 1 X 2 .

1.8 The relationships between two functions can be conditional i.e., the relationship between two levers is dependent upon the position of some other lever/levers. For example, there can be a case where 1 locks 2 only if lever No.3 is in normal position. If 3 is in reverse position, 1 need not lock 2. This is expressed as 1 locks 2 when 3 is normal or symbolically expressed as 1x(2W 3N) or 2x(1W3N). The condition can also be imposed by more than one lever. For example, there can be a locking relationship between 1 and 2 depending upon the position of levers 3,4,5,6. Thus 1 x (2W 3N 4R 5R 6N) would mean that 1 x 2 or vice versa only if 3 is in normal, 4 is in reverse, 5 is in reverse and 6 is in normal position. 3,4,5, and 6 are said to be condition imposing levers and if the position of any of these levers is other than what is given in the relationship then 1 would not lock 2 or in other words both 1 and 2 can be operated to reverse position at the same time. Similarly, we can have a relationship like 1R By (2W 3N 4N 7R 8N) i.e., for reversing 1, 2 has to be reversed only if 3 is in normal, 4 is in normal, 7 is in reverse. and 8 is in normal and if any of the levers is in a position other than what is indicated above, then for operating 1 to reverse, 2 need not be operated to reverse.

1.9 In the conditional lockings mentioned above, the interlocking between 1 and 2, the locking and locked levers will be effective only when all the condition imposing levers are in their respective positions at the same time. If any one of the condition imposing levers is not in the required position then the interlocking between the locking and locked levers will not be effective.

* * *

CHAPTER – 2
PREPARATION OF SIGNALLING PLAN: THE SIZE OF LEVER FRAME

2.1 Based on the approved Engineering plan or Engineering scale plan that is issued by the Engineering Department, a signalling plan is prepared. The type of signals that have to be provided and the location of these signals with reference to a point or level crossing and the means of operation of signals, points and facing point locks etc. will depend upon the following factors.-

(a) The type of signalling, viz. two aspect or multiple aspect.

(b) The class of station (class A, class B or class C)

(c) The standard of interlocking (Standard-I (R), Standard-II (R), Standard-III (R), Standard-IV (R)).

2.2 Having marked the requisite signals, points, FP locks etc., on the signalling plan, the next step is to decide the size of the lever frame.

2.3 For operating each function a lever is required and if the number of functions in the yard is added up, the actual number of levers required is known and consequently, the size of the lever frame can be decided.

2.4 If the size of the lever frame is decided taking into account only the actual number of levers required to operate the various functions, then in the event of a future expansion such as the addition of a loop line or for interlocking the existing non-interlocked level crossing gate etc., the whole lever frame may have to be scrapped and replaced by an entirely new frame to cater for the additional requirements. Therefore, while deciding the size of the lever frame it should be thought of, not only the actual requirements as on date, but also certain spares should be provided to cater for the requirements at a future date.

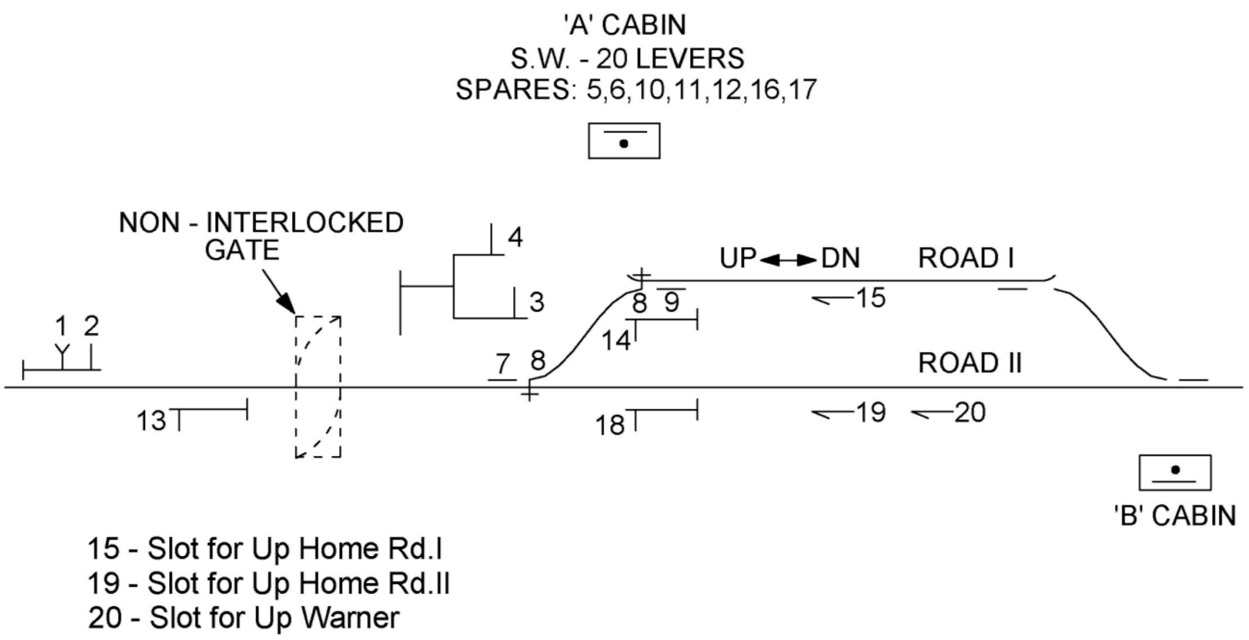


Fig. 2.4

2.5.1 Figure 2.5 gives the layout of a 'B' class station equipped with two aspect lower quadrant signals. In this layout the points and facing point locks are operated by rodding transmission and the signals by single wire transmission. A single end point with rodding transmission can be operated up to a distance of 460 Meters only. For a crossover, the maximum range of operation is 275 Meters only. Therefore, all the functions in the yard can not be operated from a single cabin. The functions at one end of the yard will be operated from one cabin. Therefore, two cabins as shown in the diagram are necessary. Hence the train reception requires coordination between the two cabins so additional levers should be catered for this purpose (i.e., slot levers). The station has one loop as on date, but it is anticipated that a second loop may be added in the near future. Therefore, while deciding the size of the lever frame, the levers required not only to work the functions on date, but also the levers that would be required to work the functions when the additional loop is provided should be taken into account. The remaining levers would be kept as spares. In the given example 13 levers are required and to work the additional functions that would be provided when the next loop is added and for interlocking the non-interlocked gate, 7 additional levers are required. Taking both into account, the size of the lever frame to be provided should have at least twenty levers.

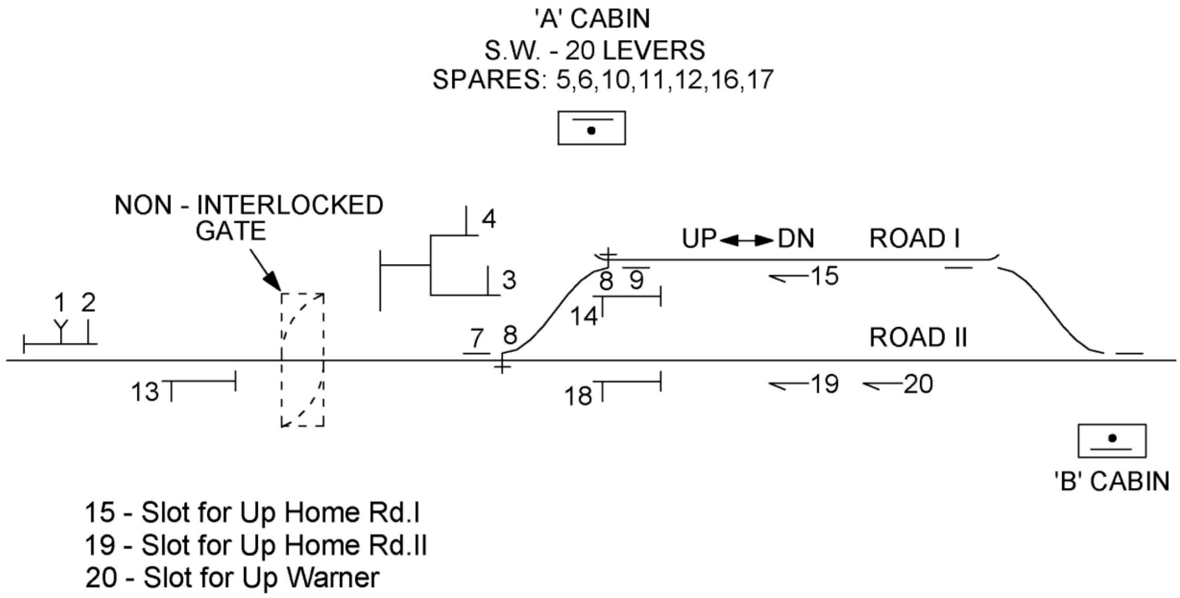


Fig. 2.5

The size of the lever frame		
Name of the function	**Present requirement**	**Future requirement**
Signals	7	2
Slots	3	1
Points	1	1
Lockbars	2	2
L.C.gate	-	1
Total	13	7

2.5.2 In certain cases it may not be possible to predict how would be the expansion in future. In such cases, some railways provide spare levers for certain percentage of the existing levers as spares while other railways provide certain quantum of levers as spares, say one spare lever for every 6 or 8 levers.

2.5.3 Having decided the total number of levers required to cater for the present and the future requirement, the nearest standard lever frame size which can accommodate the total requirement is chosen as the size of the lever frame.

2.5.4 The locking tray of a "Catch Handle" type lever frame will be in combination or multiples of 8 and 10. In "Direct locking" type, the lever frame will be in a combination or multiples of 5 and 7. For example, the standard size for Catch Handle type (C.H.) lever frames would be 8,10,16,18,20,24,26,28,30,32, and so on and whereas the direct locking type lever frames would be 5,7,10,12,14,15,17,19 etc., in size.

2.5.5 If the sum of the present and future requirements in any particular case is 19, the standard size of the lever frame chosen would be 20 if it is a Catch Handle lever frame and 19 if it is a direct locking type lever frame.

2.6. NUMBERING

2.6.1 Having provided the signals and decided the size of the lever frame, the next step is to number the functions. Every function in the yard has to be given a number for the purpose of easy identification and operation of levers by the cabin man. Every function that numbered will be connected to and operated by a lever bearing the corresponding number in the lever frame. All the levers in the frame are serially numbered from left hand to right hand with respect to the leverman facing the leverframe.

2.6.2 The numbering scheme can be one of under mentioned two methods.

(a) Geographical method

(b) Group cum geographical method.

2.6 GEOGRAPHICAL METHOD OF NUMBERING

2.7.1 The simplest method of numbering would be geographical method in which the functions operated from a particular cabin are numbered serially depending upon the geographical location in which they are situated. For example, the function which is at the farthest left hand end of the cabin man as he faces the lever frame is given number 1, the function next right to it number 2 and so on, as shown in fig.2.7.

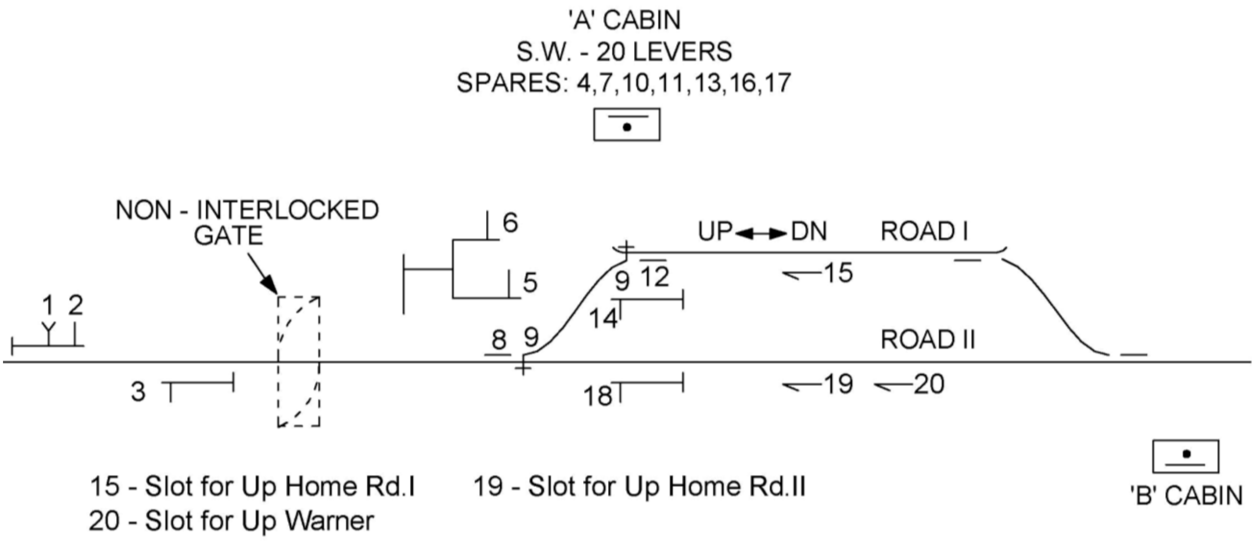


Fig. 2.7 Numbering as Per Geographical Method

2.7.2 The disadvantage of this method is that the cabin man may have to move about to and fro in the cabin for the various train moves. This can easily be seen from fig. 2.7, in which the numbering has been done as per the geographical method. For dispatch of up train from Road I the sequence of lever operation would be 9,12,3,14. It can be seen from this that the cabin man has to walk to and fro to reach the levers for train movements. This may not matter much in a small layout as shown in figure, but this can be considerably cumbersome in big yards. Also the lead out may become clumsy when the rod transmission levers and wire transmission levers get mixed up due to their geographical sequence.

2.7.3 The difficulty in lever operation experienced in geographical method of numbering can be overcome by numbering the functions in "Group-cum geographical" method. In this method the functions in the yard are divided into three distinct groups and the numbering is done group-wise and within the same group geographically.

2.8 GROUP-CUM-GEOGRAPHICAL METHOD OF NUMBERING

2.8.1 The following principles have to be borne in mind while numbering functions in a yard in the "Group- cum -Geographical Method".

2.8.2 The functions operated/controlled by this cabin are divided into three groups. The signals/slots to the extreme left of the cabin man as he faces the lever frame is identified and all signals/slots, which govern movement in the same direction, are grouped together in Group I. In the figure 2.8.3 the signal to the extreme left of the cabin man is the Warner/Outer signal leading to the down direction and therefore the down Warner the down Outer and the down home signals are grouped together in Group I. All the level crossings, points and Lockbars operated from the cabin are grouped together in Group II and the signals/slots leading to the direction opposite to that of signals in Group I are grouped together in Group III. In this case signals in Group I control movement in down direction and therefore all signals leading to the up direction namely the up advanced starter, the up starters, the up home slots and the up Warner slot are grouped together in Group III.

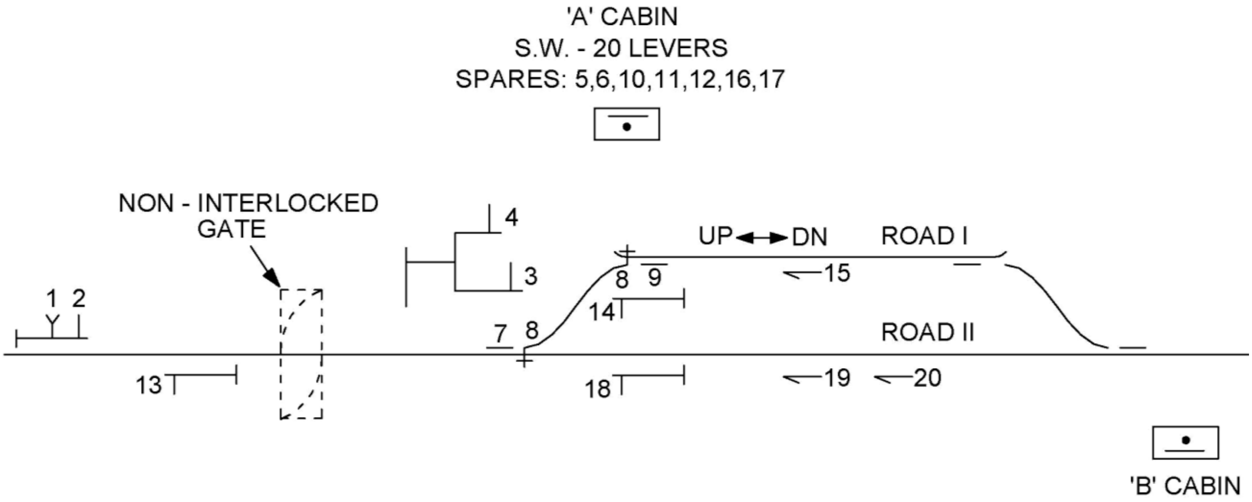


Fig.2.8.2 Numbering as per Group-Cum-Geographical Method

2.8.3 Numbering is now done group wise starting with the signals in Group I, then the functions such as Interlocked level crossings, points and the Lockbars in Group II and finally the signals/slots in Group III. The numbering within a group is done serially from left to right depending upon their geographical disposition (as seen by the cabin man while facing the lever frame). In group I, the shunt signals are to be numbered after main signals and in group III, shunt signals are to be numbered before main signals. The first number is given to the function at extreme left in that group. Layout in figure 2.8.2 has been numbered on the group cum geographical method. The advantage in group cum geographical method numbering, it can be seen by comparing the sequence of levers required to be pulled for an up dispatch from loop. The levers to be pulled are 8,9,13,14 in that order, which will be convenient for the cabin man and the operation is economised.

2.8.4 If spare levers are available in the lever frame, instead of leaving the spare levers at the end of Group III, they are distributed in between the groups. The common practice is to allow certain spare levers between groups I & II and between group II & III. If the shape of the future yard expansion is known, the spare levers could be left at the appropriate place so that any alteration in leadout at a later date could be kept to the minimum. In fig. 2.8.2, since it is known that the non-interlocked L.C. gate would be interlocked at a later date and an additional loop line would be commissioned, the spares have been provided at the appropriate place. For example No.5 for DN Home Road 3, No.6 for interlocked L.C. number 11 for the points connecting road 2 and 3, numbers 10 and 12 for the Lockbars of points No.11, numbers 16 and 17 for the up starter from road 3 and slot on Up Home road 3. When the additions are done, the arrangement would be as shown in fig. 2.8.4 from which it can be seen that no alteration needs to be done to the existing numbers.

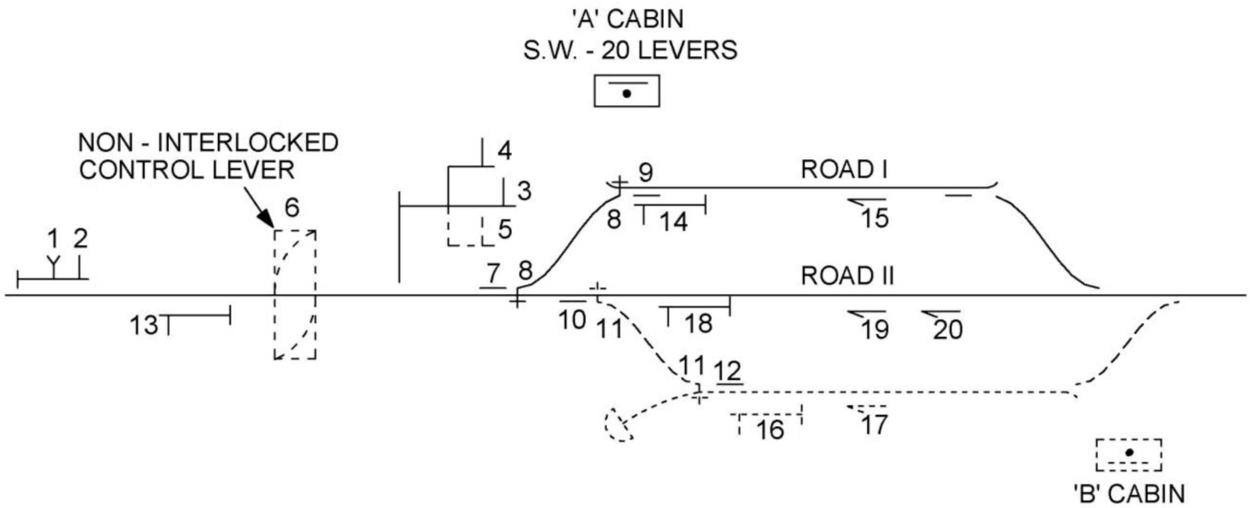


Fig. 2.8.4

2.8.5 In the case of a single wire catch handle or a direct locking lever frame it becomes difficult to pull a lever in between two pulled levers. The numbering should be so done as to avoid such operation. For example if the interlocking between three consecutive levers 7,8 and 9 is such that 7 and 9 have to be reversed before 8 can be reversed then the numbering should be readjusted to avoid this. To avoid this, functions 8 & 9 can be interchanged such that 8 becomes 9 and vice versa. Refer figure 2.8.5(b).

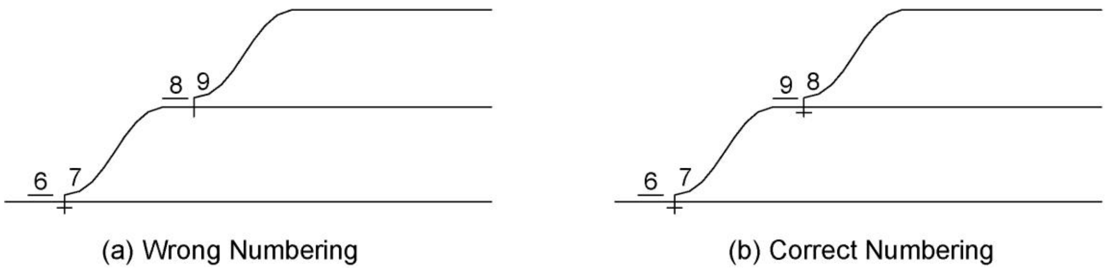


Fig. 2.8.5

2.8.6 Going from main line to II loop in Dn. direction the sequence of lever operation is 7, 9, 8 (with 9 released by 7). Therefore, as per figure (a) if numbering is done 8 has to be operated between two pulled levers i.e.,, 7 & 9. To avoid this, the numbering of Lockbar 8 and point 9 has to be interchanged as shown in figure (b) now the sequence of lever operation is 7, 8, and 9 which will be more convenient thereby operational reliability can be improved.

CHAPTER – 3
ESSENTIALS OF INTERLOCKING
(Para 7.82 of SEM part-1, 1988 Edition)

3.1 Lever frames and other apparatus provided for the operation and control of signals, points, etc., shall be so interlocked and arranged as to comply with the following essentials:

(i) It shall not be possible to take 'OFF' a running signal, unless all points including isolation are correctly set, all facing points are locked and all interlocked level crossing are closed and locked against public road for the line on which the train will travel including the overlap.

(ii) After the signal has been taken ' OFF ' it shall not be possible to move any points or lock on the route, including overlap and isolation, nor to release any interlocked gates until the signal is replaced to the ' ON ' position.

(iii) It shall not be possible to take ' OFF ' at the same time, any two fixed signals which can, lead to any conflicting movements.

(iv) Where feasible, points shall be so interlocked as to avoid any conflicting movements

3.2 Interlocking will be provided between concerned levers to comply with the above. The clause (a), (b) and (c) of the foregoing Paragraphs must be rigidly complied with and no exceptions are allowed. However, clause (d) permits certain exemptions in locking for flexibility of the yard and the interlocking between points leading to conflicting movements only may be provided to the extent feasible.

Some examples of Point to Point interlocking are given in Paragraph 3.10.

3.3. ROUTE HOLDING

(a) In view of the interlocking provided between related functions in conformity with essentials of interlocking, the 'OFF' position of a signal ensures that the points etc., are correctly set and locked and so long as the signal lever is in the reverse position, it should not be possible to alter the position of points, Lockbars, level crossing gates etc., This ensures safety, as the route is held/locked for a train as long as the signal is in 'OFF' position. If the signal lever is normalised, when a train is approaching the signal and if the train is far away from the signal it may be possible for the Loco Pilot to stop his train short of the signal on seeing the signal going back to 'ON'. But if the signal is put back to 'ON' when the train is close to the signal, then there is the possibility of either the Loco Pilot not seeing the signal going back to 'ON' or even if he has seen, it may not be possible to stop the train short of the signal. With the result of signal lever put back to normal position, there will be no interlocking effective between the signal and the other functions, and therefore the route can be changed by altering the position of points in the face of an approaching train. To avoid such a danger situation, the route must remain locked and unchanged when the train is on the approach of the signal and such a locking is termed as "approach locking".

(b) And also if the signal lever is normalised after the train has been passed the signal even the limited protection indicated above is not available, as the Loco Pilot is completely unaware of the signal having been normalised. Once the signal lever is put back to normal, the points can be unlocked and position altered. This is dangerous. Therefore, once the train passes the signal, the route must remain locked i.e., held unchanged for the train till such time the train has actually passed over all the points even though the signal lever might have been put back to normal. This is termed as "Route Holding".

(c) Since the route can not be altered as long as the signal is in ' OFF ' position one method by which the route can be held for a train is to ensure that the signal lever can not be restored to the normal position till such time the train has actually travelled the entire route.

(d) Lockbar working in conjunction with facing point lock, which is used to lock the points at site in the position, once the Lockbar lever is reversed, the point gets locked at site in the position in which it was lying prior to the reversing of the Lockbar. The point position can not be altered unless the point is first unlocked. For unlocking the point, the Lockbar lever has to be normalised, which is not possible when a train is on that Lockbar. Therefore if the Lockbar not normalised, the point can not be unlocked and its position would remain unaltered. This gives us an application by which the route can be held.

(e) Referring to Fig. 2.8.5 points 8 and 11 have to be first locked in the normal position by operating Lockbar levers 7 and 10 to reverse before the signal No.3 for main line is taken 'OFF'. Once the signal lever is operated to reverse, the Lockbar levers get back locked and can not be put back to normal. This protection is available so long as the signal lever is not normalised.

(f) But once the signal lever is normalised, the interlocking between the signal lever and the Lockbar levers is released and therefore, the point position can be changed after unlocking it. But, if the distance between the signal No.3 and the point No.8 can be kept restricted such that before the cabinman has had time to normalise the Lockbar lever No.7 (after normalising the signal lever), the train has already been on the Lockbar No.7, then, even though the interlocking on lever No.7 is free, it is not possible to normalise the Lockbar as the train is physically on it. If the Lockbar is not normalised, the position of the point also can not be changed. This way point No.8 is held for the train even though the signal lever No.3 was put back to normal.

(g) But how can the route holding be extended to point No.11 which is a little away from signal No.3. Because of the longer distance involved, the cabin man, after normalising the signal lever, may have enough time to normalise Lockbar lever No. 10 which is locking point No.11. Once the Lockbar lever is normalised, the point position can be changed. To prevent this, interlocking between successive Lockbars in the route is introduced in such a way that the lever of Lockbar in advance can not be normalised unless the lever of Lockbar in rear has first been normalised. In the present situation, the Lockbar lever No.10 can not be normalised unless Lockbar lever No.7 is normalised which is not possible as long as a train is on lockbar 7. Now if we restrict the distance between those two successive points and the successive Lockbars, such that, by the time the cabin man normalised lever no7 after the train has cleared the lock bar No7, the train had already reached on Lockbar 10, then the point No.11 is held by the LB10. By extending similar interlocking between all the Lockbars, all the facing points in the route advance of the train can be held till the train actually clears them.

(h) The time interval that lapses from the instant the signal lever has been put back to normal to the instant when the train actually occupies the first Lockbar, or the time interval that lapses between the instant the train clears the Lockbar in rear and the instant it occupies the Lockbar immediately in advance is the crucial factor in the satisfactory working of the above method. In other words the distance between the signal and the first facing point and the distance between successive facing points has to be limited and Para 7.83 of Signal Engineering Manual Part-I specifies that this distance should not be more than 180 Meters.

(i) If the distance becomes more than 180 Meters then an additional lockbar called Lock Retaining Bar (sometimes called holding bar) has to be introduced between the signal and the first facing point or between two successive facing points. In such cases, the distance between any two adjacent functions i.e., the signal and the Lock

Retaining Bar and Lock Retaining Bar and the Lockbar of the facing point is not more than 180 Meters Interlocking also shall be provided between successive Lockbars in a route such that the Lockbar in advance can not be normalised unless the Lockbar/Lock Retaining Bar in rear is normalised. (It will be seen later on that, this is the same relationship as Lockbar in rear released by Lockbar in advance.)

(j) If the system of working is such that enough time is lapsed between the instant the cabin man puts back the signal to ON to the instant when he is in a position to operate the point then during this time if the train is actually cleared the route, then, special arrangements for holding the route are not necessary. An example of this type of working is the Route Key Method employed in Double Wire Cabins or Standard-I interlocking with locally operated key locked points.

(k) The factors by which route holding is achieved (in the above methods) are:-

(i) The Interlocking between the signal and the facing points and the Lockbars, results the points can not be unlocked and altered unless the signal lever is normalised.

(ii) The distance between the signal and the first facing point and the distance between successive facing points (which is limited to 180 Meters) and the interlocking between successive Lockbars due to which it is ensured that the cabinman can not unlock any facing point in the face of an approaching train even though concerned signal has been put back to normal behind the train.

(iii) The purpose of the lockbar on the facing point is such that the point can not be unlocked when the train is passing over the Lockbars.

(iv) Where the distance from the signal to the first facing point or from one facing point to next facing point is more than 180 Meters provision of lock retaining bar/bars ensures route holding. In the case of successive facing points, the Lockbar of a facing point in the rear serves as a lock-retaining bar for the facing point Lockbar in advance of it. This is ensured by interlocking between successive Lockbars.

(l) The following are the provisions of 7.83 SEM part-1 in this connection

7.83.1. Signals governing movements over Points shall be placed- as close as possible to the Points. Where a signal is more than 180 metres from the Facing points it controls, arrangements shall to made to keep the Points locked until the train has passed them. Similar arrangements shall also be made to hold consecutive Points should the distance between them be more han 180 metres.

7.83.2. At a station where trains run through at speeds more than 50kilometres per hour, such arrangements to hold the route are also required in case of trailing points situated more than 180 meters from the signal controlling them. However, such arrangements are not required if the Points are locked in either position by the signal in advance as stipulated in paragraph 7.84.

7.83.3. Route holding arrangements for facing or trailing points are, however, not necessary, if due to the manipulations required in the system of control, it is impossible under normal working conditions for the Points to be operated before the train has passed.

7.83.4. It is desirable to provide continuous track circuit for holding the route.

3.4 INTERLOCKING BETWEEN SIGNAL IN ADVANCE AND REAR TRAILING POINTS

(a) The above method for Route Holding can be employed only when there is a Lockbar to lock the point and separate levers operate the point and Lockbar. As per Para above the facing point lock before a signal is taken 'OFF' need lock only facing points. Trailing point need only to be set correctly as locking of trailing points (by pulling its corresponding Lockbars) is not insisted upon. This is so, because the vibrations induced by the train movement can cause the switches to shift away from the stock rail causing the gaping of points which in turn may cause a derailment if a train moves over the points in the facing direction. If the movement over the points is in the trailing direction, no derailment can occur due to this.

(b) Therefore, while the facing points in the route can be held with the help of the interlocking between Lockbars, as indicated above, the trailing points may have to be held by interlocking it with signal in advance, in normal and reverse positions by locking the point levers both ways since Lockbar to Lockbar interlocking is not available for points in trailing direction.

(c) This is illustrated by the following examples: -

(i) Suppose a train has to be despatched from main line (see fig. 3.4.) signal No.22 should be taken 'OFF'. The interlocking between levers 22 and 8 will ensure that point No.8 can not be reversed as long as lever No.22 is in reverse position. As the train advances beyond the starter, then cabinman may put back lever No.22 to normal position, in which case the interlocking between 22 and 8 will not be effective any more. Consequently it is possible to reverse No.8 and the moving train may trail through the point and damage the ground connections. Also, the isolation of the main line from loop line will not be existing. To prevent such damages, interlocking is provided between the signal in advance and the trailing points, so that the points can not be altered as long as the lever of the advance signal (i.e., 21) is in reverse position, even though lever No.22 is put back to normal.

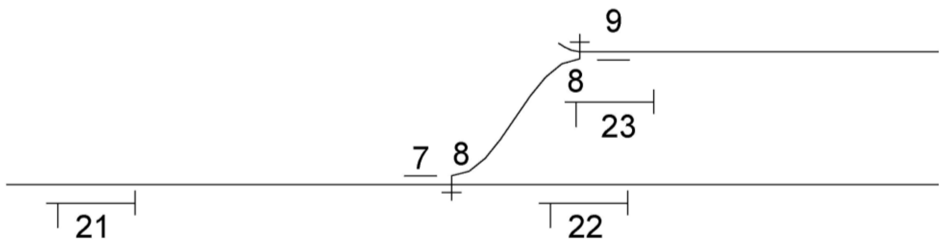


Fig. 3.4

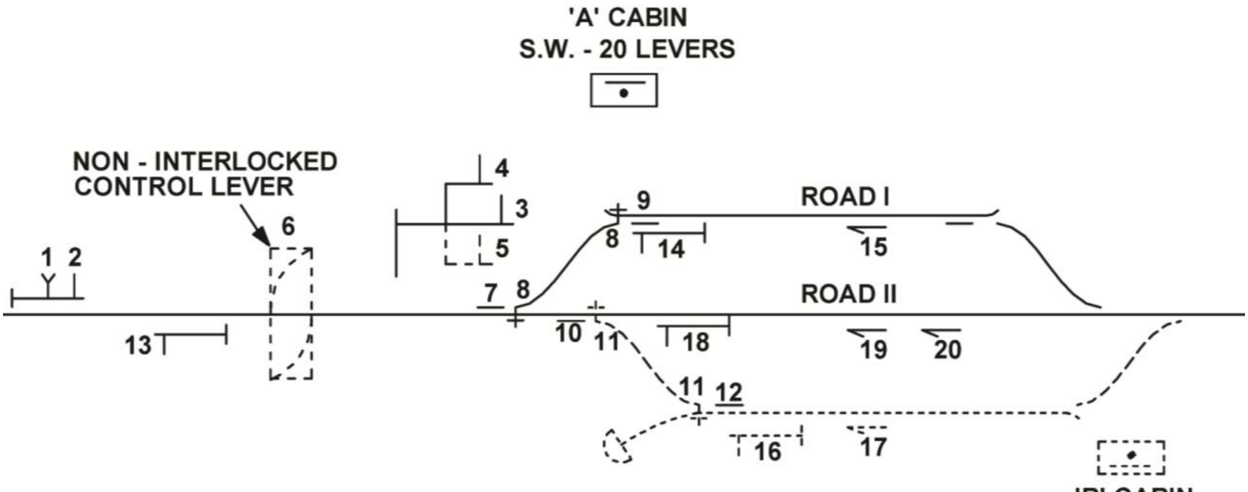
(ii) With the interlocking mentioned above, signal No.21 should hold point No.8 in both normal and reverse positions as signal No.21 is common for train movements from main line as well as loop line.

(d) This ensures that once the lever of the signal in advance is reversed the point position can not be altered till such time the lever of the advance signal is normalised.

In this context 7.84 of SEM part-1 states as follows

"Locking trailing points by signal in advance - Levers operating stop signals which are next in advance of trailing points operated from the same cabin, shall when reversed, lock such point levers in either position unless route locking is provided or the distance between the points and the signal is such that the locking interferes with traffic movements".

3.5 INTERLOCKING BETWEEN VARIOUS FUNCTIONS



Interlocking between Signal and Points in the Route

Fig. 3.5

(a) To comply with the essentials of interlocking, before taking 'OFF' a signal (by reversing the signal lever) all points on the route including overlap are to be ensured set correctly. Therefore, in the case of points which requires to be set in the normal position for a signal such signal when taken 'off' would lock the points in normal position (i.e.,, signal locks the normal the points) e.g., 3X8,11 and 18X8,11

(b) Similarly points which requires to be set in the reverse position for a signal, such signal when taken 'off' will lock the points in the reverse position (back locks). This means before reversing the signal lever, relevant point levers have to be first reversed (i.e., signal released by points). Ex:- 4Rby8, 16Rby11 (4 ÷ 8, 16 ÷ 11)

(c) The above locking between signal to point will also ensure that, once a signal is taken 'OFF' for a particular route, concerned points remain locked in the normal or reverse position as the case may be, so long as the signal is in the 'OFF' position (signal lever reverse). Therefore conflicting signals pertaining to other routes can not be taken 'OFF' since the position of points required for these signals are not available. Example 3 x 4 is not necessary because signal 3 requires point No.8 normal and when 3 is reversed point No.8 is locked in the normal position whereas signal No.4 requires points No.8 in the reverse position.

$$\left.\begin{array}{ll} 3 \times 8 \ \text{\_\_\_\_\_\_\_\_\_\_\_\_} & (1) \\ 4 \div 8 \ \text{\_\_\_\_\_\_\_\_\_\_\_\_} & (2) \end{array}\right\} \text{3 x 4 ensures through 8}$$

(d) A signal shall lock the point for "isolation" though it may not be in the route and negotiated by the train.

(i) When signals have to be taken off for simultaneous reception or despatch of trains, physical isolation between the two running lines on which the trains to be dealt must be ensured by setting of points, mere signal overlap is not sufficient.

(e) Points in the overlap and isolation need not be set for shunt signals. Only the points in route of this signal are to be correctly set and facing points are to be locked. However, sometimes, the interlocking between points ensures isolation. Generally, movements by taking off shunt signals into and from sidings with key locked points are not permitted.

(f) When there is no lever for facing point lock or Lockbar for a point, which is, used signal shall lock such points in both ways.

3.6. INTERLOCKING BETWEEN SIGNAL AND LOCKBARS

(a) Before taking 'OFF' a signal all the facing points on the route including overlap must be locked in the relevant position. A facing point is locked at site through its lock plunger by reversing the Lockbar lever. Therefore a signal lever should back lock the Lockbar lever (signal lever is released by the Lockbar lever). Since there is already interlocking relation between successive Lockbars as mentioned above, the farthest point on the route has to be locked first, then the next in rear and so on. The last Lockbar to be operated will be the nearest to the signal that is geographically the Lockbar of the first facing point on the route. Therefore, this Lockbar will release the signal. In other words, the signal is released by the first facing point Lockbar. This will ensure all the facing points Lockbars on the route are operated and no further locking is necessary between the signal and the rest of the facing point Lockbars on the route. e.g.: 3 R by 7 only and 3 R by 10 is redundant (see fig.3.5). Where successive Lockbar locking is provided, there the Lockbar of first facing point only releases the signal and 2nd, 3rd --- facing point Lockbars in the route release the signal will become redundant (duplicate).

(b) If in the route of a signal including overlap, no facing point is available and only trailing points are existing, then the signal should lock normal the first available Lockbar of the trailing point. This will ensure that all the Lockbars of the trailing points on the route are locked in normal position. E.g. 18x10, 19x10, is only required and 18x7, 19x7 will be redundant (Fig.3.5)

(c) In the case if there are trailing and facing points in the route of a train, then direct locking between signal to Lockbar of the trailing points is not necessary, since the same will be achieved indirectly through opposite Lockbar locking as explained in Para 3.8 later.

3.7 INTERLOCKING BETWEEN SUCCESSIVE FACING POINT LOCKBARS

This is provided for the purpose of achieving route holding, as already explained in Para 3.3(h). This is provided between two Lockbars applicable to same direction of train movement. A Lockbar in rear is released by another Lockbar immediately in advance, when they fall in the same route. The interlocking is generally conditional, as it is required to be effective only when both the Lockbars exist in the same route.

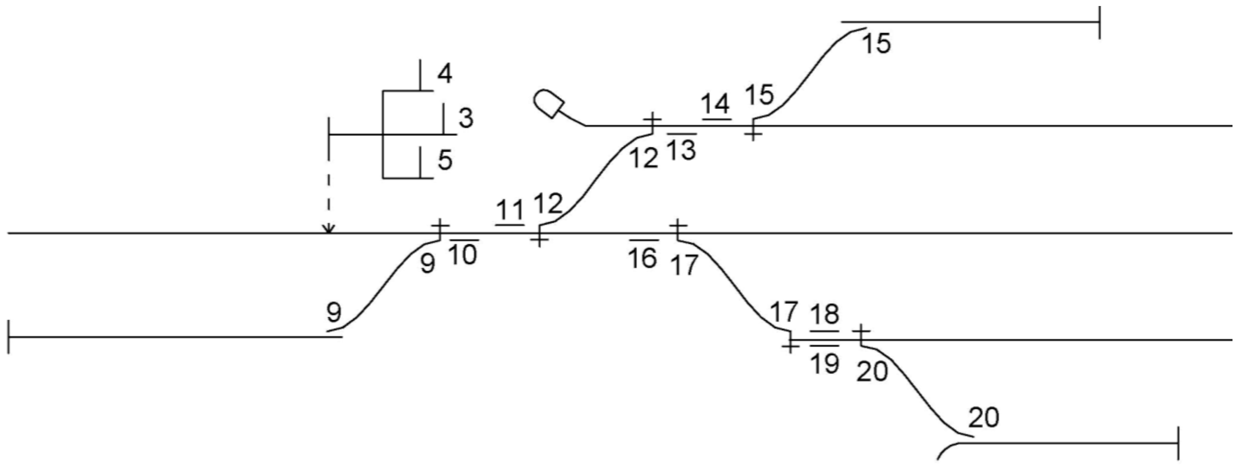


Fig. 3.7

For the above layout, the successive Lockbar lockings are 11R.by(16W12N); 11R.by(14W12R); 16R.by(19WI7R); 13R.by(10W12R); 18Rby10

3.8 INTERLOCKING BETWEEN FACING AND TRAILING LOCKBARS (Opposite Lockbar locking)

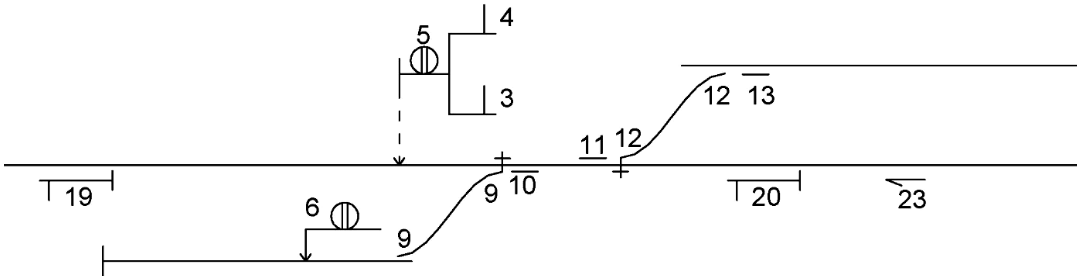


Fig. 3.8

Referring to Fig. 3.8 Interlocking should be provided between 10 and 11 i.e., 10 x 11.

The advantages of this interlocking are (i) in the case of unsignalled moves, the trailing point Lockbars are not left free to be operated and (ii) interlocking becomes more economical because in case this interlocking is not provided, every signal is required to hold the Lockbar of trailing point in its path by having direct interlocking with that Lockbar, since the Lockbar lever should not be free to be operated after the signal is taken off. (Referring to Fig. 3.8) 3,4,5,6 will be released by 11 and 19,20,23 will be released by 10. If 10x11 is not provided then interlocking 3,4,5,6x10 and 19,20,23x11 is required to be provided. Therefore 10x11 economises, the interlocking to a great extent. Also when this interlocking is provided, direct opposite signals of the same line remain locked, therefore no direct interlocking is required for them e.g. 3x19,20,23 will be redundant.

3.9 INTERLOCKING BETWEEN LOCKBARS AND POINTS

Interlocking is provided between the Lockbar lever and the point lever. When the Lockbar lever is reversed it operates the Lockbar, which in turn locks the point at site. The interlocking corresponds to the way the Lockbar locks point at site. If movements is possible over the point in its Normal as well as reverse positions, then Lockbar lever locks the point lever both way correspondingly. But if the train movement is possible only in the reverse position of the point as in the case of derail switch, then the Lockbar locks the derail switch in its closed/reverse position only. In interlocking is expressed as back locking e.g 13 R by 12 (see Fig 3.8).

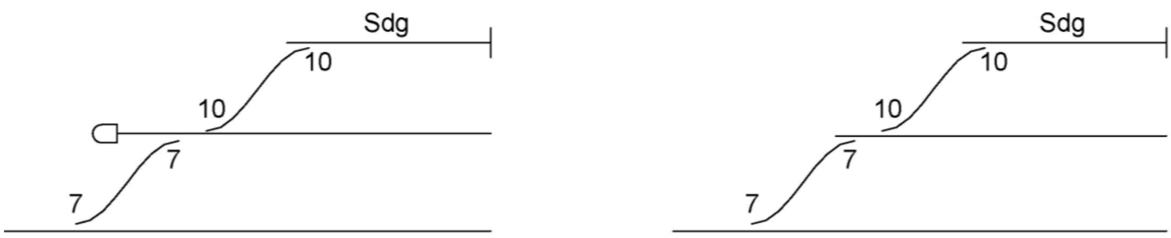
3.10 INTERLOCKING BETWEEN POINT LEVERS (point to point locking)

As per the sub - Para (iv) of Para 7.82 of SEM (1988) the interlocking between point levers shall be provided to the extent feasible to avoid the conflicting movements. Here the conflicting movement shall broadly refer to the movement, which is (i) unsafe for the rolling stocks and (ii) unsafe for the permanent way. However the interlocking between point levers shall be considered only when the points are in the close vicinity to each other such that a train, before it clears the first location of points, negotiates the other location of points.

3.10.1 Interlocking between points is mainly provided to achieve

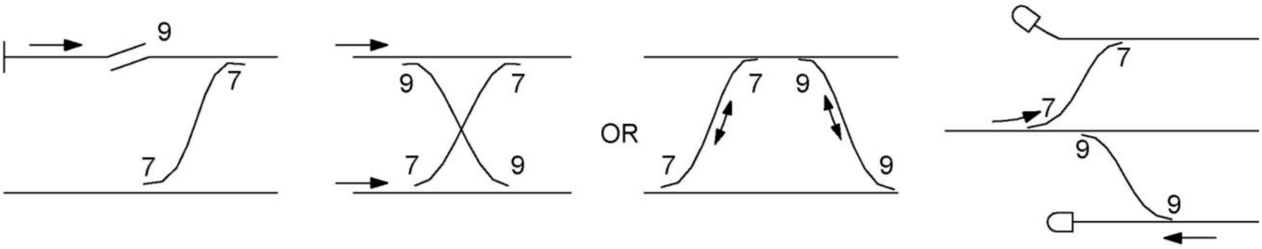
(a) Safety of the unsignalled train movement and

(b) Safety of the ground gear during unsignalled movement.



Locking relation 10 R.by 7

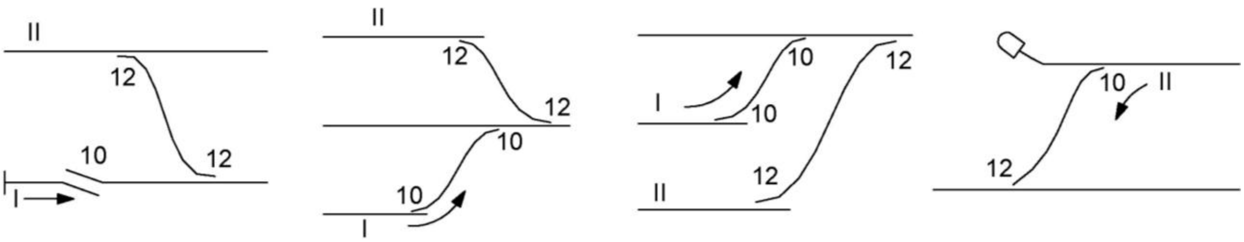
For example in the figures above the interlocking between 7 & 10 has to be, 10 R.by 7. If such locking is not given then point No.10 can be reversed without reversing 7, at that time an un-signalled movement initiated from siding may get derailed, so it is unsafe for the movement.



Locking relation 7 locks 9

In some other cases as shown above, if 7 locks 9 locking is not given then, at the time of performing a movement with 7 reverse, point No.9 is free and if 9 also is reversed this will give an access to another train movement encroaching in the route of the first movement. It is unsafe and dangerous. So 7 locks 9 isolate the moves and shall be provided to the extent it is feasible.

3.10.2 Points and crossovers are the important structures of permanent way usually they are protected by the signals. But some time when there has to be an unsignalled move over the points there may be a possibility of the points connections getting damaged if the correct position of points are not ensured by the points man.



(a) 10 locks 12 (b) 10 locks 12 (c) 10 X 12 (d) 10 R.by 12

In the case of figure (a), (b) & (c) above, there has to be an interlocking between 10 & 12 as 10 locks 12. If such locking is not provided then there may be a possibility of keeping both 10 & 12 in the reverse position, at that time a movement initiated from line I will damage the point No.12 while trailing through. Similarly in fig (d) the interlocking between 10 & 12 has to be preferably 10 Rby 12. If such locking is not provided then 10 can be reversed keeping point No.12 normal, at that time a movement initiated from line I, will damage point No.12 while trailing through (when one point is released by another point has to be considered, then "less important point is released by the more important point" may be preferred, to protect the more important point or as preferred in the yard. The importance of the points is decided by the speed of train over the points.

3.10.3 To sum up, the following are the advantages of point to point interlocking

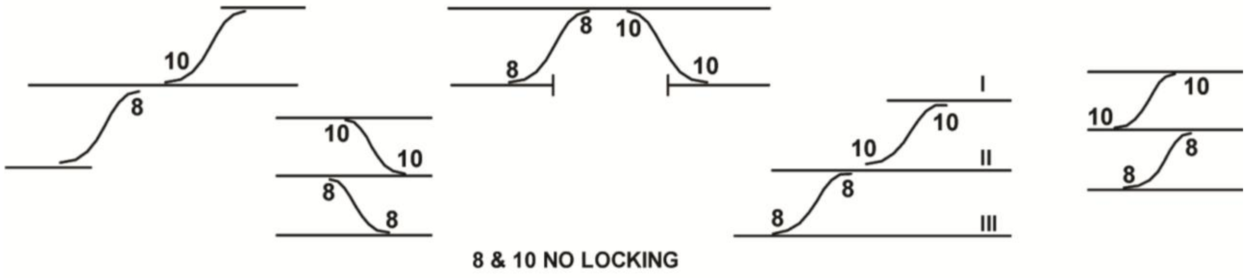
(a) It prevents damage to the points during unsignalled move

(b) It is for safety of unsignalled movement

(c) It isolates the moves

(d) It economises the interlocking

3.10.4 However in situations when one point is reversed for a movement the position of other points can be normal or reverse for the same movement or other Parallel movements, the interlocking between such points is not considered necessary.



8 & 10 NO LOCKING

In all the examples shown above, there should not be any interlocking relation between 8 and 10. If we provide any locking between them, then this will disturb the flexibility of the yard to which it is designed.

3.11 Interlocking of Level Crossing gates

(a) The level crossing gate can have relationship only with the signal which protects the level crossing gate in route or overlap a key locked siding point shall be released by LC gate in the route. To ensure the closed position of the level crossing gate, for interlocking purposes, a gate control lever is used in the cabin. There are two different practices followed on Indian Railways. In certain railways the control lever is in the Reverse position with the L.C.gate open to road traffic and can be normalised only after the L.C. gate is closed and locked against road traffic. In certain other railways the LC control lever is in normal position with the LC open to road traffic and the lever can be reversed only after the L.C. is closed and locked against road traffic. Depending upon the practice is being followed the interlocking relationship can be given accordingly.

(b) L.C. gate control lever locks the signal lever, if the arrangement is such that the normal position of the L.C. gate control lever ensures the closed condition of the L.C. and

(c) Gate control lever releases the signal lever if the arrangements are such that the reverse position of L.C. gate control lever ensures the closed condition of the L.C.

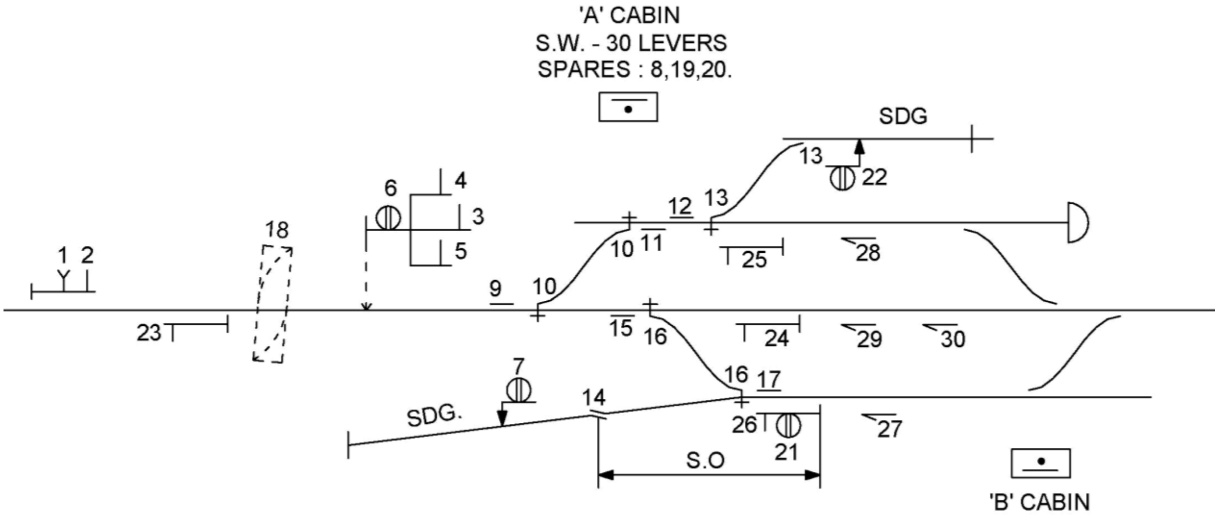


Fig. 3.12

3.12.1 The interlocking relationship between signal lever and levers of other functions (Refer fig.3.12).

Sl. No.	Main function	Sub function	Locking relation	Example
1	Signal	Signal	Signal locks normal the conflicting signal	3X6
			Signal is released by the signal in advance	1 R by 2,3
			Signal releases signal in rear	3 Rls 1
		Point	Signal locks normal the point if required in normal	3X10
			Signal is released by the point if required in reverse	4 R by 10
			Signal locks both ways the point for route holding purpose	23 locks BW 10
		Lockbar	Signal is released by first facing Lockbar	3 R by 9
			Signal locks normal its trailing Lockbar	24X15
		LC. Gate	Signal is released by L.C. Gate in the route	24 R by 18
		Slot	Signal releases slot in rear for the same direction	23 Rls 30
			Signal locks normal the slot for the opposite direction	3X27

3.12.2 The Interlocking between point lever and levers of other functions (Refer fig.3.12).

Sl. No.	Main function	Sub function	Locking relation	Example
2	Point	Signal	Point locks normal the Signal if required in normal	10X3
			Point releases the Signal if required in reverse	10 Rls 4
		Point	Point locks normal the conflicting points	16 X14,10
			Point is released by more important point in the route	13 Rby 10
			Point releases less important point in the route	10 Rls 13
		Lockbar	Point releases Lockbar in case of trap point	10 Rls 11
			Point is released by Lockbar in case of fouling protection	
			Point is released by in Lockbar in both ways in case of Slip siding /Catch siding	
		L.C. Gate	Point is released by L.C gate in the route in case of siding point	13 Rby 18
		Slot	Point locks normal the slot if required in normal	16 X 29
			Point locks normal the slot in case of isolation	14 X 27

3.12.3 The interlocking relationship between Lockbar lever and levers of other functions (Refer fig.3.12).

Sl. No.	Main function	Sub function	Locking relation	Example
3	Lockbar	Signal	First facing lockbar releases the signal	9 Rls 3,4,5,6
			Trailing lockbar locks normal the signal	15X24
		Point	Lockbar is released by point in case of trap point	11 Rby 10
			Lockbar releases Point in case of fouling protection	
			Lockbar releases point in both ways in case of Slip siding /Catch siding	
			Lockbar locks its own point both ways	9 lock BW 10
		Lockbar	Lockbar is released by lockbar in advance in the route	9 Rby(15W10N)
			Lockbar releases lockbar in rear in the route	15 Rls (9W10N)
			Lockbar locks normal the opposite lockbar in the route.	15X(17W16R)
		L.C. Gate	NO RELATION	----------
		Slot	First facing lockbar releases the slot	17 Rls 27
			Trailing lockbar locks normal the slot	15X29

3.12(iv) The interlocking relationship between L.C gate lever and levers of other functions (Refer fig.3.12).

Sl. No.	Main function	Sub Function	Locking relation	Example
4	LC gate	Signal	Releases signal in the route	18 Rls 25,26,24
		Point	Releases the siding point	18 Rls 13
		Lockbar	NO RELATION	--------
		L.C. Gate	NO RELATION	--------
		Slot	Releases slot in the route	18 Rls 29
			Releases slot conditionally if separate overlap is available	18 Rls (27W16R)

3.12(v) The interlocking relationship between Slot lever and levers of other functions (Refer fig.3.12).

Sl. No.	Main function	Sub Function	Locking relation	Example
5	Slot	Signal	Slot released by Signal in advance for the same direction	30Rby23
			Slot locks normal the Signal for the opposite direction	27X3
		Point	Slot locks normal the Point if required in normal	29X16
			Slot locks normal the Point in case of isolation	27X14
		Lockbar	Slot is released by the First facing lockbar	27Rby17
			Slot locks normal the Trailing lockbar	29 X 15
		L.C. Gate	Slot is Released by LCgate in the route	29 Rby 18
			Slot is Released by L.C. Gate conditionally if separate overlap is available in the route	27 Rby (18W16R)
		Slot	Slot is released by slot in advance of the route	30Rby 29
			Slot releases slot in rear of the route	29 Rls 30
			Slot locks normal the conflicting slot	27 X 28,29

3.13 The interlocking relationship of a lever with respect to other levers is listed in a form of a table called "Locking Table". Starting from Lever No.1 in serial order, the locking of each lever is tabulated in progressive order in every column. Format below shows a specimen of a Locking Table.

Lever No.	Released by	Locks Normal	Locks Both ways	Releases
1	2,3	--	--	--
2	(3 or 4 or 5)	--	--	1
3	9,18	6,10,16,27	--	1, (2)
4	9,10,18	6,13	--	(2)
5	9,16,18	6	--	(2)

3.14 General Lockings which are to be usually provided in Rod-operated points layout: (Ref: Fig.3.12)

(a) Warner is released by Outer and Main line Home. Eg. 1 R By 2,3

(b) Outer is released by any one of Home signals. Eg. 2 R By (3 or 4 or 5)

(c) Main line Home locks loop line slot having separate overlap. Eg. 3 locks 27

(d) Running signal locks shunt signal below it (or in the same route) Eg. 3,4,5 locks 6.

(e) (i) A shunt Signal locks main signal above it (or in the same route) (Converse locking of item (d)

(ii) A shunt signal leading towards Advanced Starter must lock the Advanced starter (No direct dispatch into block section is permitted by taking off shunt signal) Eg. 22 locks 23 .

A shunt signal below home or shunt back locks opposite loop line slot

Conditionally, if separate overlap is provided for that slot E.g. 6 locks (27W10N)

(f) A slot having separate overlap must lock all other slots. Eg. 27 locks 28.29

Note: Converse locking of items c,d & e. (iii) must also be ensured.

While doing shunting on main line, which has got no isolation in the overlap, the shunt signal lock normal, the connected loop line slots either directly or indirectly.

(g) Wherever, shunt signals are provided below all starter signals, Advanced Starter should release starter. If no shunt signals are provided and starters are used for shunting purpose, then no relationship exists between starter and Advanced Starter.

* * *

CHAPTER – 4
LOCKING TABLES (Single Wire)

4.1 For preparation of Locking Tables, one of the following two methods can be adopted

(a) Square sheet method

(b) Route method

Square Sheet Method: This Method is obsolete now due to its disadvantage of laboriousness and time consuming, hence it is not dealt in this note.

4.2 ROUTE METHOD

4.2.1 The route method does not suffer from the above disadvantage, as we can see in the layout.

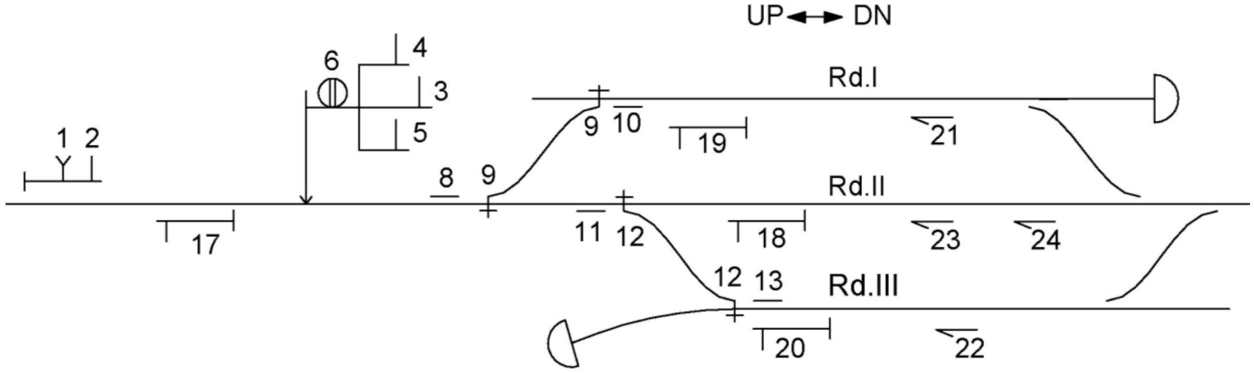


Fig. 4.2.1

Lever No.1 is down Warner, which indicates the down train to run-through via main line, therefore Warner is fully dependant upon the 'OFF' positions of main line signals of down direction. i.e., (1Rby 2,3) and is not directly concerned with the conflicting functions of main line, as they are taken care by the home signal No.3. Similarly 24 is a slot for up Warner, so released by up main line signals 17, 18, 23.

The Outer signal lever No.2 also dependant upon the 'OFF' position of any one of the Home signals, therefore 2Rby (3 or 4 or 5) and releases the Warner, and is not directly concerned to any conflicting functions.

4.2.2 In the route method the signals, which are directly interlocked with the points Lockbars in their route, are considered route wise. For example: -

(a) If point No.9 is reversed point 12 is locked normal, the route is set for Rd.I. We find the signals pertaining to Rd.I. are free and all other signals of Rd.II & Rd.III which are conflicting, remain locked due to unfavorable position of points.

(b) When route is set for Rd.II keeping both the points 9 & 12 normal we find all the signals directly on main line are free and signals pertaining to Rd.I & Rd.III, which are conflicting, remain locked.

(c) Similarly when route is set for Rd.III keeping 9 normal and 12 in reverse position, the signals pertaining to Rd.III only are free and the conflicting signals of Rd.I & Rd.II remain locked due to the position of points.

4.2.3 From the above it can be seen that the number of conflicting functions to be considered have been reduced to great extent. Now, what is to be considered is, the conflicting functions which are directly on the same road. Supposing if the route is set for Rd.I by reversing point No.9 for singal No.4 the conflicting signals on the same line are 17,19,21. But the Lockbar levers also lock these signals. When we reverse Lockbar No.8, for signal No.4, it is locking Lockbar No.10 and signal No.17, moreover when 10 is locked, 19,21 can not be operated. Hence 4 need not lock 17,19,21 directly. Similarly, when the route is set for signal No.3 keeping 9&12 normal Lockbar levers 8&11 have to be reversed and 8&11 will lock the conflicting signals 17,18,23. Therefore 3X17,18,23 is also redundant. Same way when the route is set for Rd.III for signal No.5 the conflicting signals 17,20,22 are also locked by the Lockbar levers as explained above.

4.2.4 Now we can conclude that locking between the conflicting functions pertaining to different routes is redundant through the point levers and the locking between the conflicting functions, which are directly on the same road, is achieved by the Lockbar levers.

4.2.5 However signal No.3 should lock the slot lever No.22 directly as the same is neither achieved by the point levers nor by the Lockbar levers, hence 3X22 has to be given. For the same reason, 6X(22W9N) also should be existing.

4.2.6 Hence the route method of preparing locking tables as explained above is less tedious and less time consuming but requires some care and practice, since redundant locking is to be identified and eliminated by keen observation.

4.2.7 Yard (figure 4.2.7) and locking table for route method are given as an example.

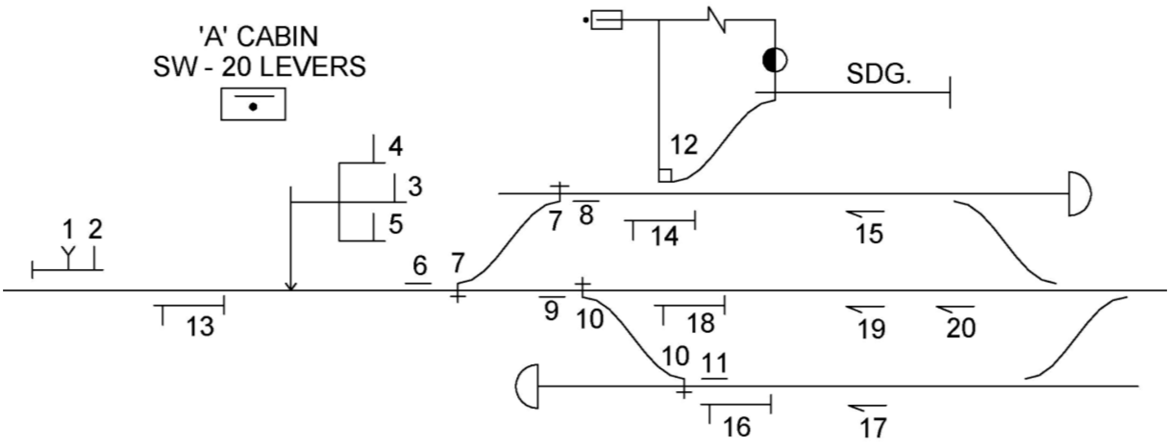


Fig.4.2.7

Locking table for yard of Figure 4.2.7

Sl. No.	Released by	Locks Normal	Locks Both ways	Releases
1	2,3	-	-	-
2	(3or4or5)	-	-	1
3	6	7,10,17	-	1,(2)
4	6,7	12	-	(2)
5	6,10	-	-	(2)
6	(9W7N)	8,13	7	3,4,5

Sl. No.	Released by	Locks Normal	Locks Both ways	Releases
7	-	3,10,18,19	-	4,8,12
8	7	6	-	14,15
9	-	(11 W 10R), 13,18,19	10	(6W7N)
10	-	3,7,18,19	-	5,16
11	-	(9W10R)	10	16,17
12	7	4,13,14,15	-	-
13	-	6,9,12	7,10	20
14	8	12	-	-
15	8	12,17	-	-
16	10,11	-	-	-
17	11	3,15,19	-	-
18	-	7,9,10	-	20
19	-	7,9,10,17	-	20
20	13,18,19	-	-	-

4.2.8 Locking Table for Electro-Mechanical yards

Electro-Mechanical interlocking is a combination of electrical interlocking (by using relays) and Mechanical Interlocking (by using locking tray and locking tappets).

In such yards track circuits are to be provided throughout the yard as shown in the following figure. As the function of route holding and track locking (keeping the points inoperative when point zone is occupied) will be done by track circuits. Lockbars are removed in such yards. However, the facing point locks are retained. Multiple Aspect color light signals are provided. F.P.L s of both ends cross over is operated by the same lever.

The following points shall be borne in mind while preparing Locking Table for such yards.

(a) As there is no Lockbar, no opposite Lockbar locking is available. Hence signals should lock opposite signals of the same route directly.

(b) As facing points are to be locked for taking off a signal, the signal shall be released by the levers of all F.P.L s in the route irrespective of facing or trailing.

All other locking is similar to what is explained earlier in these notes.

A layout for Electro-mechanical interlocking and its locking table is given below:-

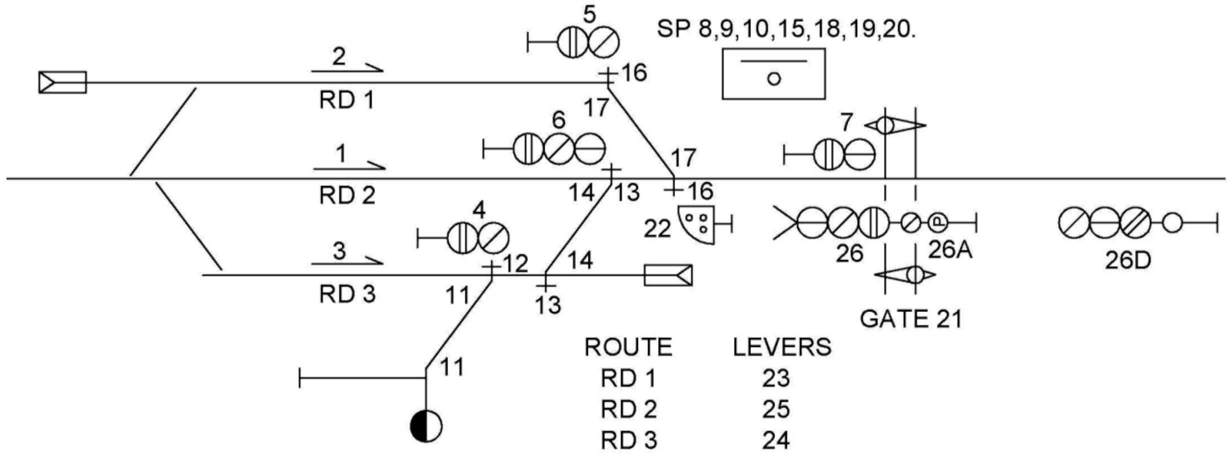


Fig: 4.2.8

Locking Table (For Fig:4.2.8)

Sl. No.	Released by	Locks Normal	Locks Both Ways	Releases
1	13,16	3,14,17,22,25	-	-
2	16,17	3,22,23	-	-
3	12,13,(16W14R)	1,2,11,(22W17N),24,25	-	-
4	12,13,14,16	11,22,24	-	-
5	16,17	22,23	-	-
6	13,16	14,17,22,25	-	-
7	21	11,22,23,24,25	14,17	-
8,9,10	SPARE			
11	14	3,4, 7,24	-	-
12	-	-	11	3,4,(22W14R),24
13	-	-	14	1,3,4,6, (22W17N),24,25
14	-	1,6,17,25	-	4,11,24
15	SPARE			
16	-	-	17	1,2,(3W14R),4,5, 6,22,23,24,25
17	-	1,6,14,25	-	2,5,23
18,19,20	SPARE			
21	-	-	-	7.23.24.25
22	(12W14R), (13W17N),16	1,2, (3W17N), 4,5,6,7,23,24,25	-	-
23	16,17,21	2,5,7,22	-	(26)
24	13,14,16,21,12	3,4,7,11,22	-	(26)
25	13,16,21	1,3,6,7,14,17,22	-	(26)
26	(23 or 24 or 25)	-	-	-

MECHANICAL YARD

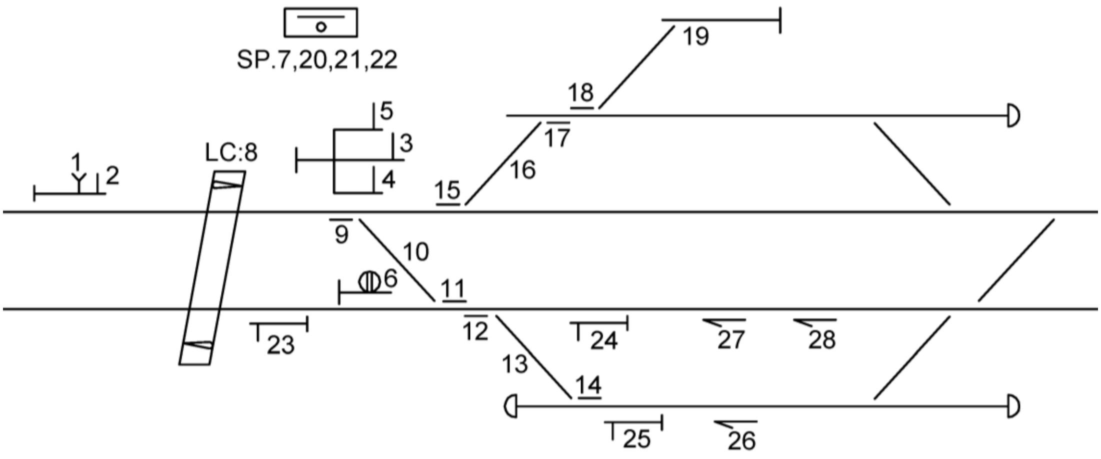


Fig:4.2.9

LOCKING TABLE (For Fig:4.2.9)

L.No.	Released by	Locks Normal	Locks Both Ways	Releases
1	2,3	–	–	–
2	(3 or 4 or 5)	–	–	1
3	8,9	10,16	–	(2),1
4	8,9,10,13	–	–	(2)
5	8,9,16	19	–	(2)
6	12	10,26	–	–
7	SPARE	–	–	–
8	–	–	–	3,4,5,23
9	(15W10N) (12W10R)	–	10	3,4,5
10	–	3,6,16,23, 24,27, 25, (26W13R)	–	4
11	–	12	10	23,24,27,(14W13R)
12	–	11	13	6, (9W10R)
13	–	24,27	–	4,25
14	(11W13R)	–	13	25,26
15	(18W16R)	–	16	(9W10N)
16	–	3,10	–	5,19,17
17	16	18	–	–
18	–	17	19	(15W16R)
19	16	5	–	–
20	SPARE	–	–	–
21	SPARE	–	–	–
22	SPARE	–	–	–
23	8, 11	10	13	28
24	11	10,13	–	28
25	13,14	–	–	–
26	14	6, (10W13R),27	–	–
27	11	10,13,26	–	28
28	23,24,27	–	–	–

ELECTRO-MECHANICAL YARD

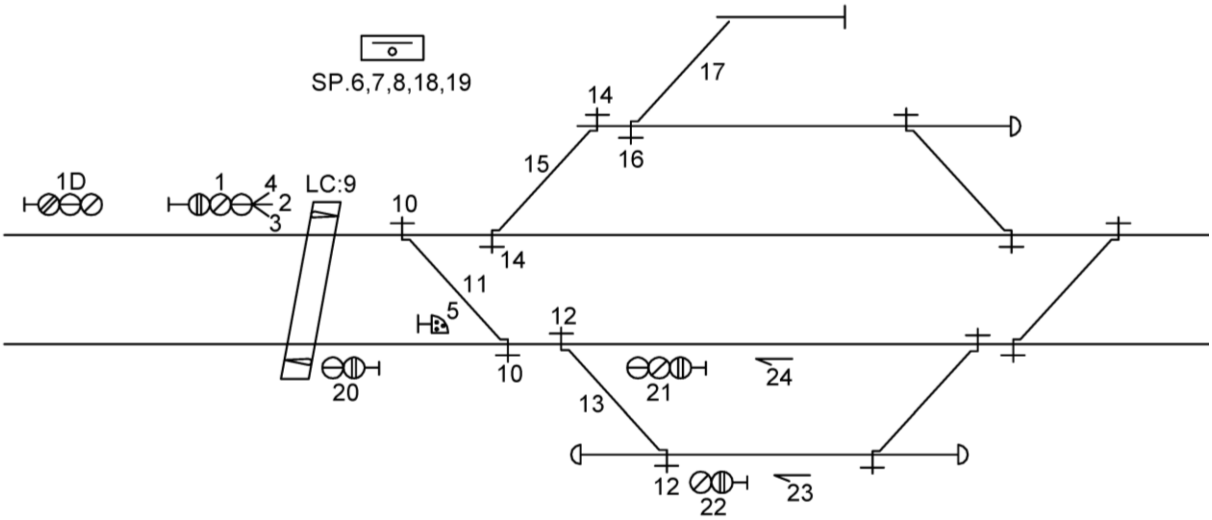


Fig No: 4.2.10

LOCKING TABLE (For Fig No: 4.2.10)

L.No.	Released by	Locks Normal	Locks Both Ways	Releases
1	(2 or 3 or 4)	–	–	–
2	9,10,14	11,15	–	1
3	9,10,11,12,13	–	–	1
4	9,10,14,15,16	17	–	1
5	10,12	11,20,21,22,23,24	–	–
6	SPARE	–	–	–
7	SPARE	–	–	–
8	SPARE	–	–	–
9	–	–	–	2,3,4,20
10	–	–	11	2,3,4,5,21,22,(23W13R),24
11	–	2,5,20,15, (23W13R) 21,22,24	–	3
12	–	–	13	3,5,21,22,23,24
13	–	21,24	–	3,22
14	–	–	15	2,4
15	–	2,11	–	4,17
16	–	–	17	4
17	15	4	–	–
18	SPARE	–	–	–
19	SPARE	–	–	–
20	9	11,5	13	–
21	10,12	11,13,5	–	–
22	13,10,12	5,11	–	–
23	12,(10W13R)	5, (11W13R),24	–	–
24	10,12	5, 11,13, 23	–	–

ELECTRO – MECHANICAL YARD

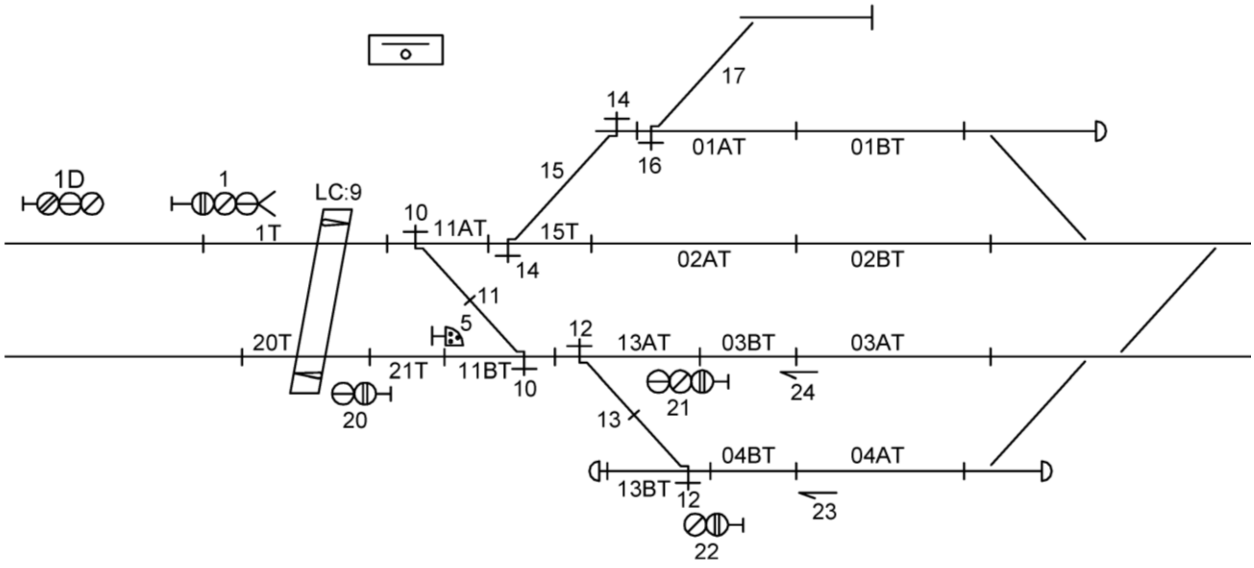


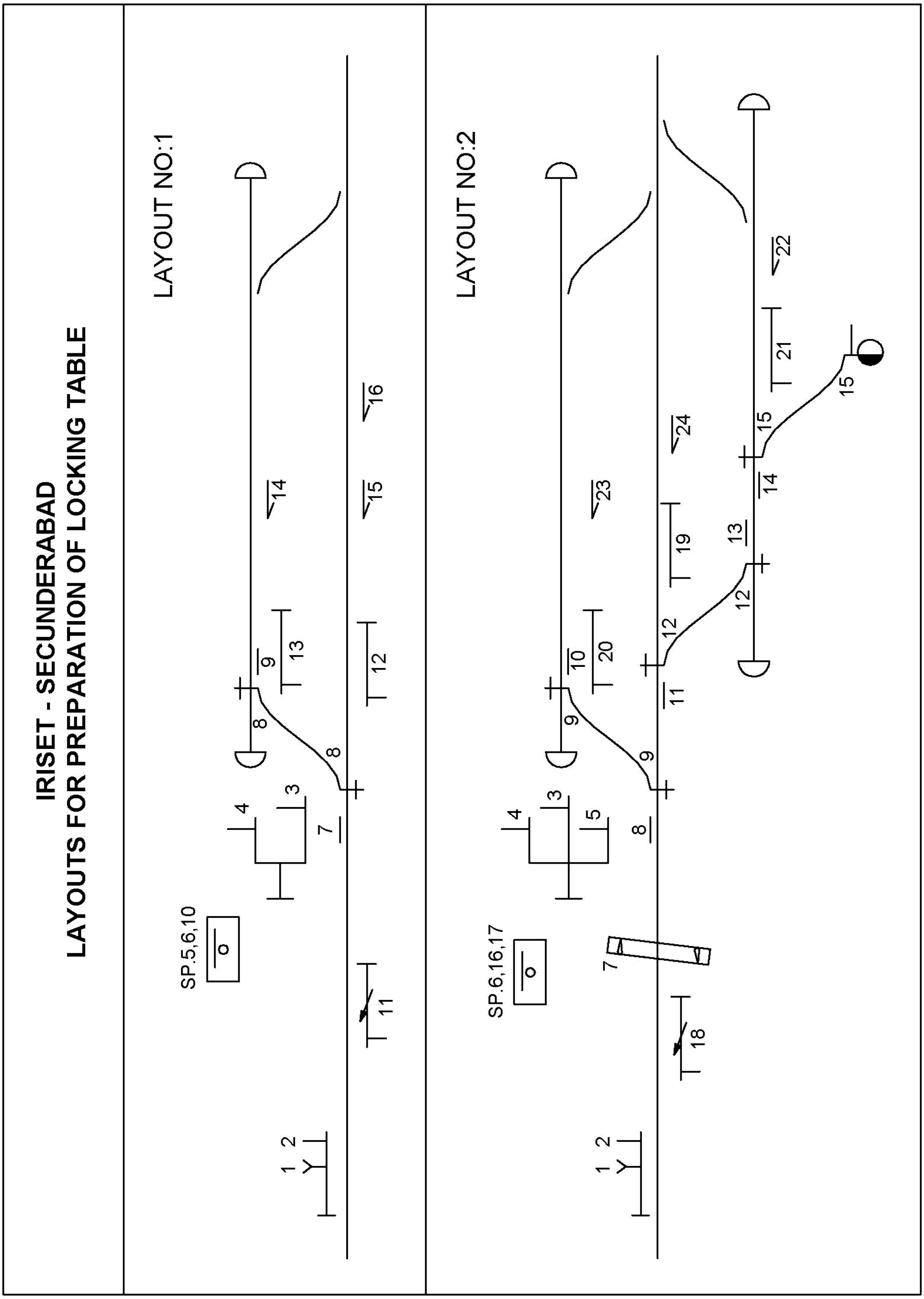
Fig No: 4.2.11

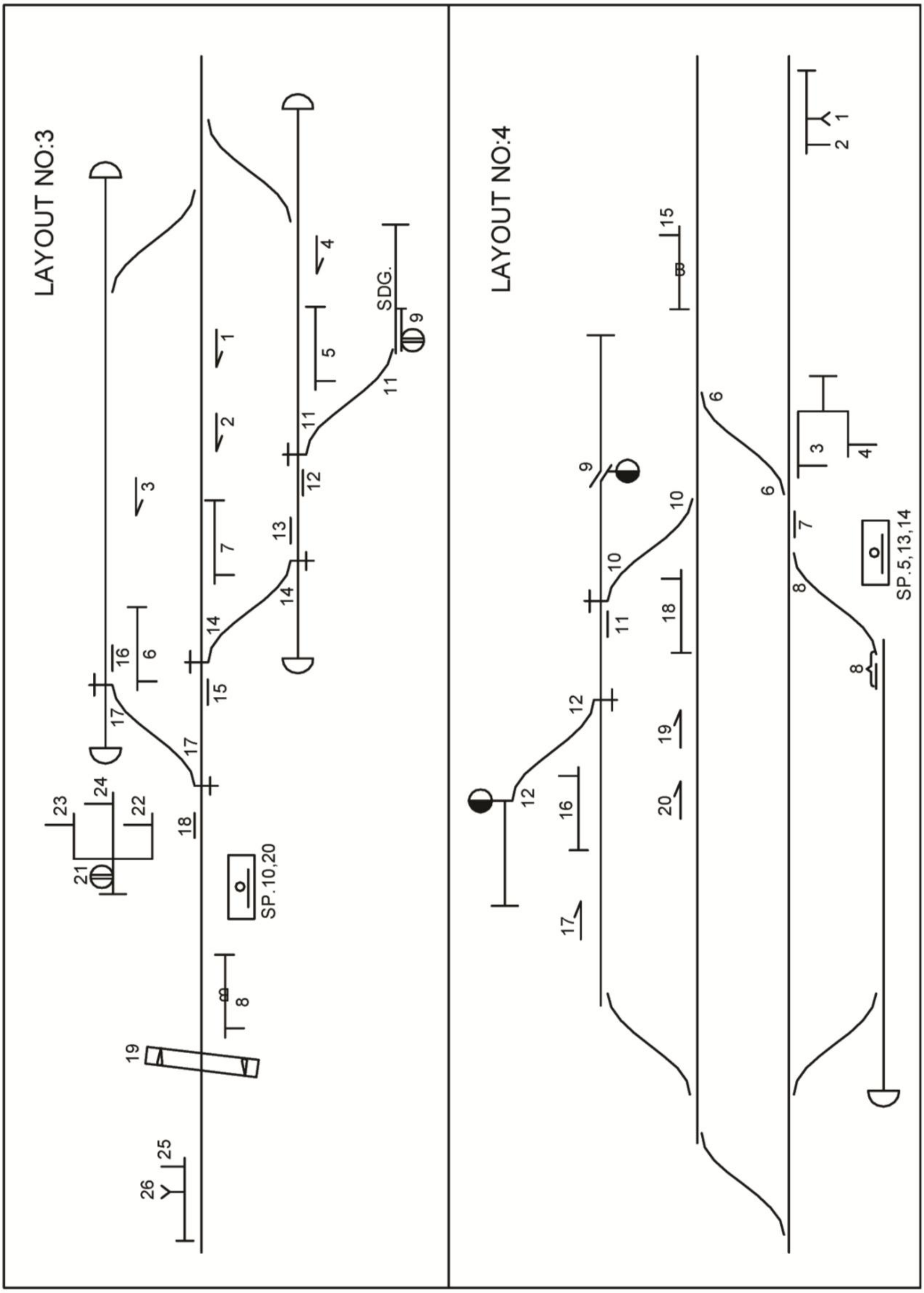
CONTROL TABLE (Fig No: 4.2.11)

S No	SIGNAL No	ROUTE	ASPECT	APPROACH LOCKED BY	BACK LOCKED BY	CONTROLLED BY			LOCK & DETECTS POINTS		LOCKS ROUTE/ SIGNAL	OTHER CONTROLS	REMARKS
						TRACK	ASPECT OF SIGNAL AHEAD	C.H ZONE	NORMAL	REVERSE			
1	1	Rd1	YR1	DA(120Sec)	1T,11AT,15T	1T,11AT,15T 01AT,01BT	–	–	11,17	15	–	LX9,1YR1 ('B' CABIN)	1UHR1 ↑, 1UECR ↑
2	1	Rd2	Y	DA(120Sec)	1T,11AT,15T	1T,11AT,15T 02AT,02BT	–	–	11,15	–	–	LX9,1YR2 ('B' CABIN)	1UHR1 ↓, 1UHR3 ↓, 1UECR ↓
3	1	Rd2	G	DA(120Sec)	1T,11AT,15T	1T,11AT,15T 02AT,02BT	–	–	11,15	–	–	LX9,1YR2 ('B' CABIN), 1DR ↑	1UHR1 ↓, 1UHR3 ↓, 1UECR ↓
4	1	Rd4	YR3	DA(120Sec)	1T,11AT,11BT, 13AT,13BT	1T,11AT,11BT, 13AT,13BT, 04AT,04BT	–	–	–	11,13	–	LX9,1YR3 ('B' CABIN)	1UHR3 ↑, 1UECR ↑
5	5	Rd3	OFF	21T	11BT,13AT	11BT,13AT	–	–	11,13	–	20,21	–	–
6	5	Rd4	OFF	21T	11BT,13AT,13BT	11BT,13AT, 13BT	–	–	11	13	20,22	–	–
7	20	Block Section	G	–	–	20T	–	–	11	–	5	LX9, SMYR ↑	Controlled By B.I, LCPR ↑
8	21	M/L	Y	03AT,03BT	13AT,11BT	13AT,11BT, 21T	20 R/G	–	11,13	–	5	–	–
9	21	M/L	G	03AT,03BT	13AT,11BT	13AT,11BT, 21T	20G	–	11,13	–	5	–	–
10	22	M/L	Y	04AT,04BT	13BT,13AT,11BT	13BT,13AT, 11BT,21T	20 R/G	–	11	13	5	–	–

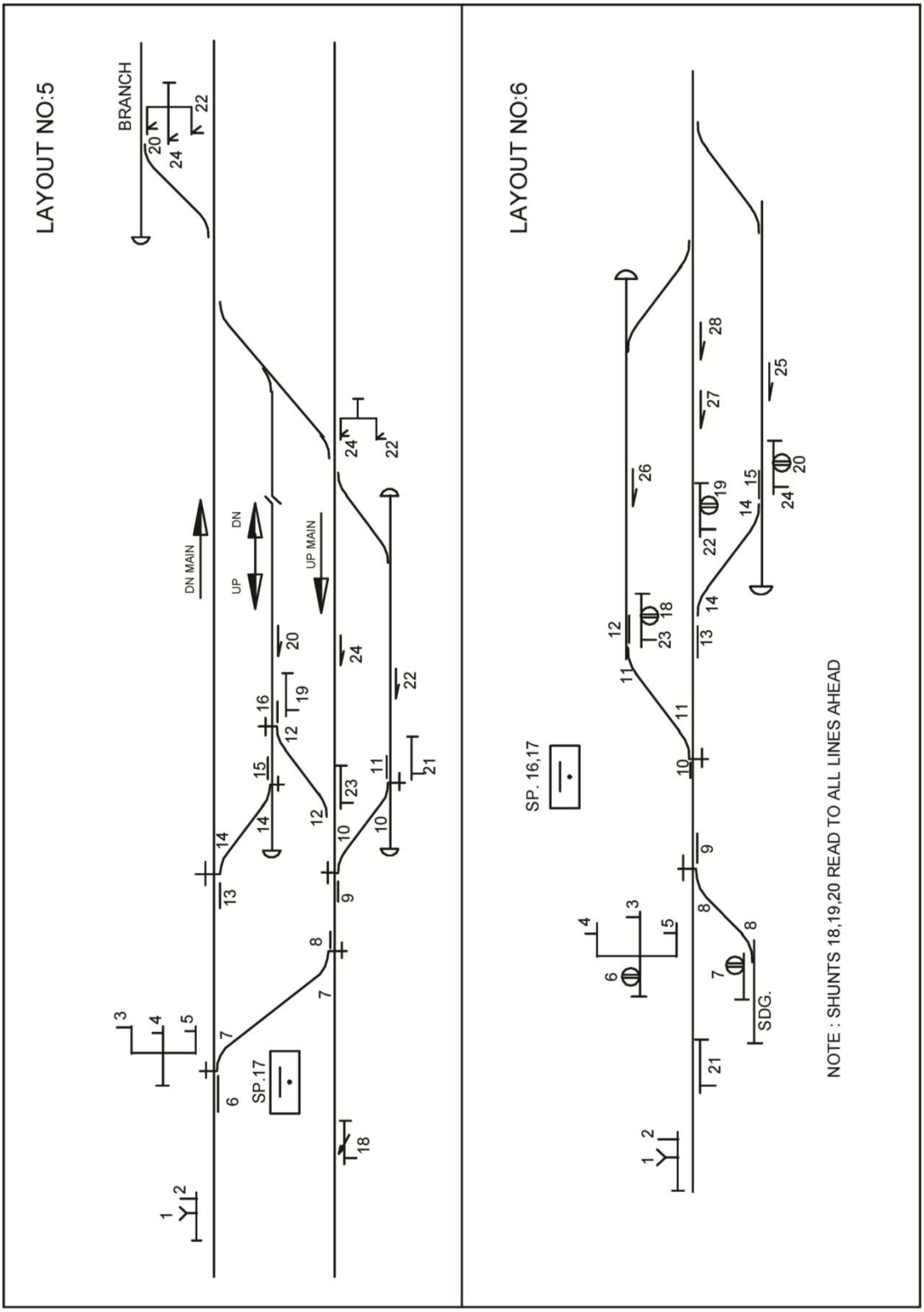
Details will be discussed at S-11

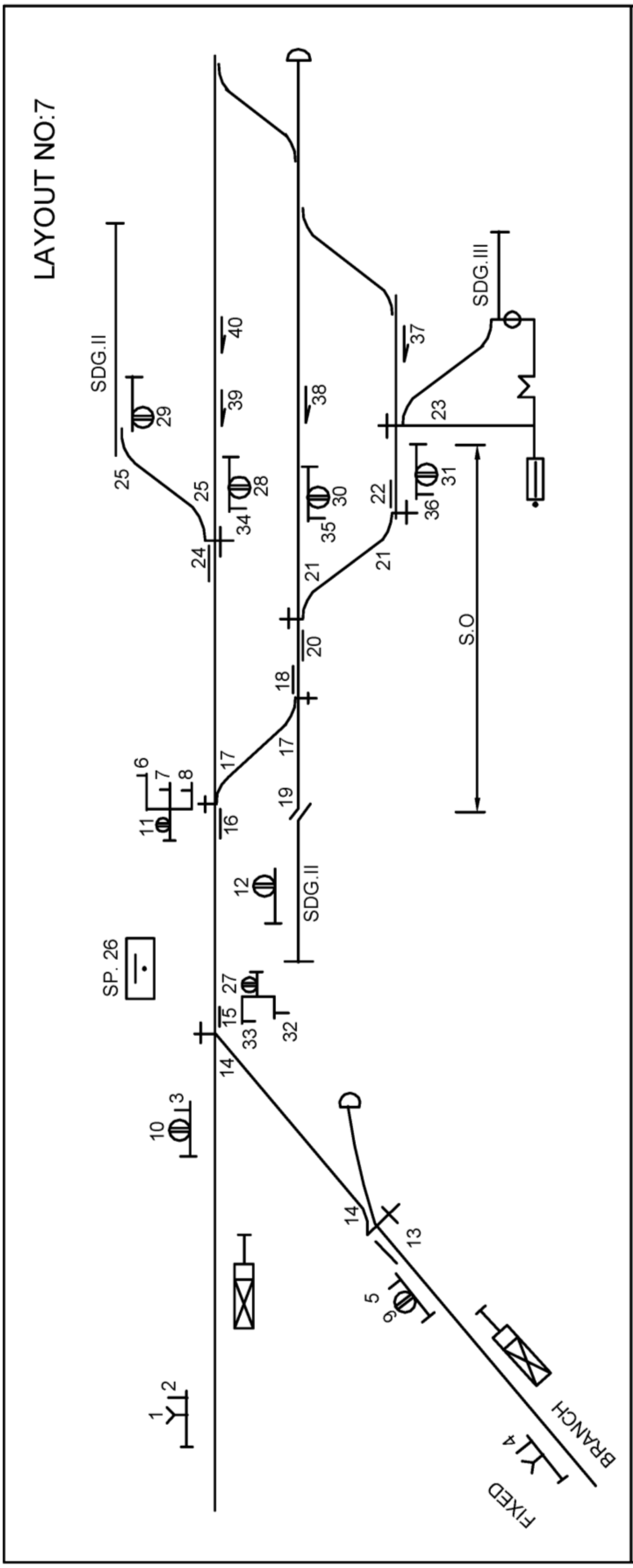
CHAPTER – 5
LAYOUTS FOR LOCKING TABLE PRACTICE

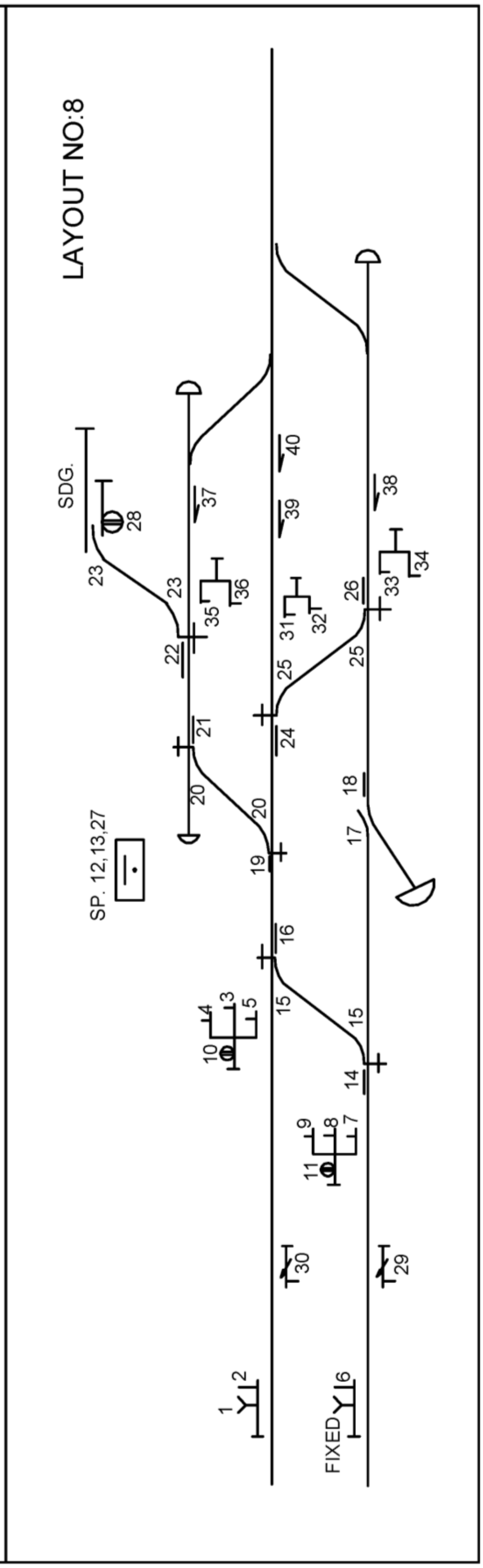


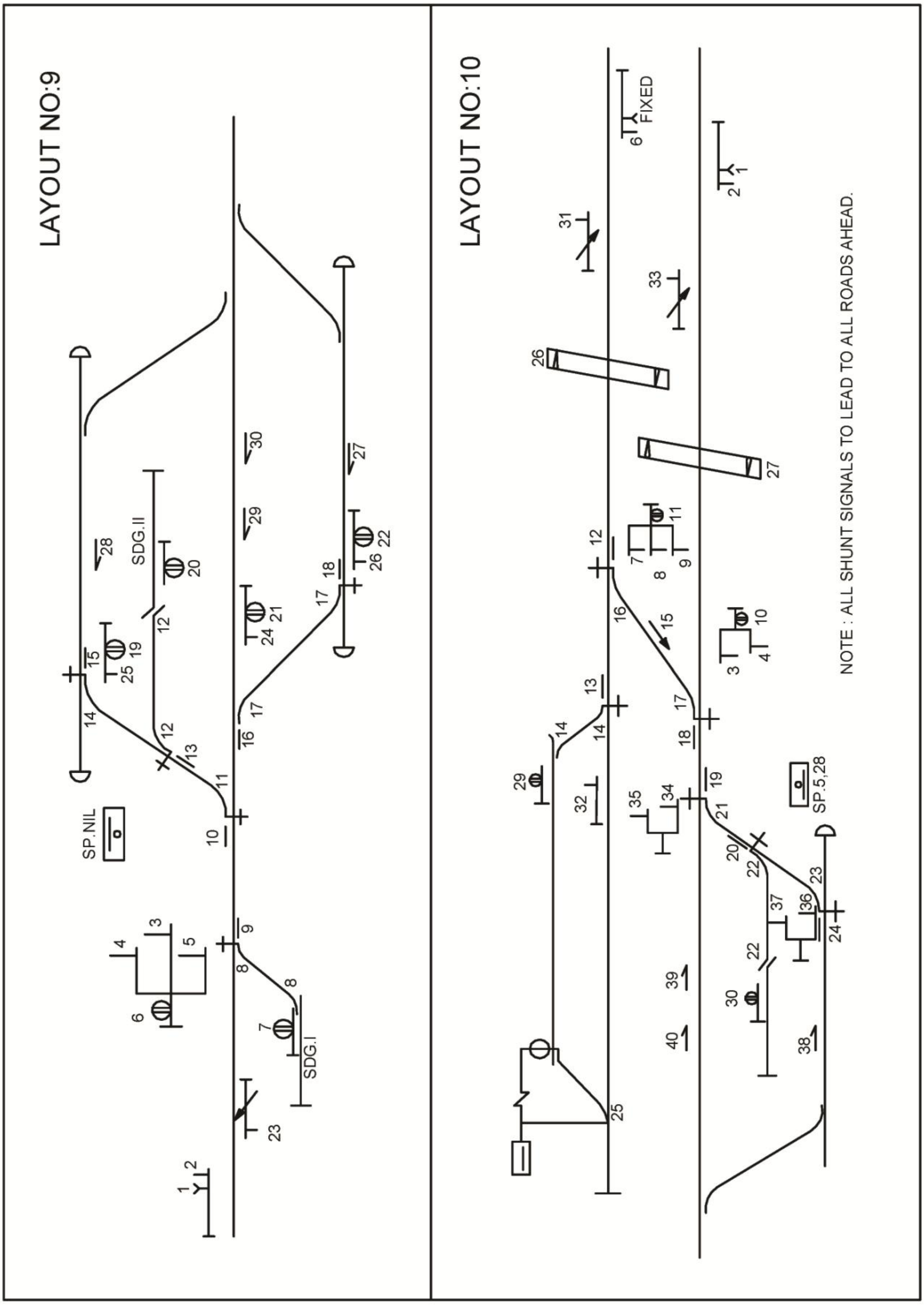


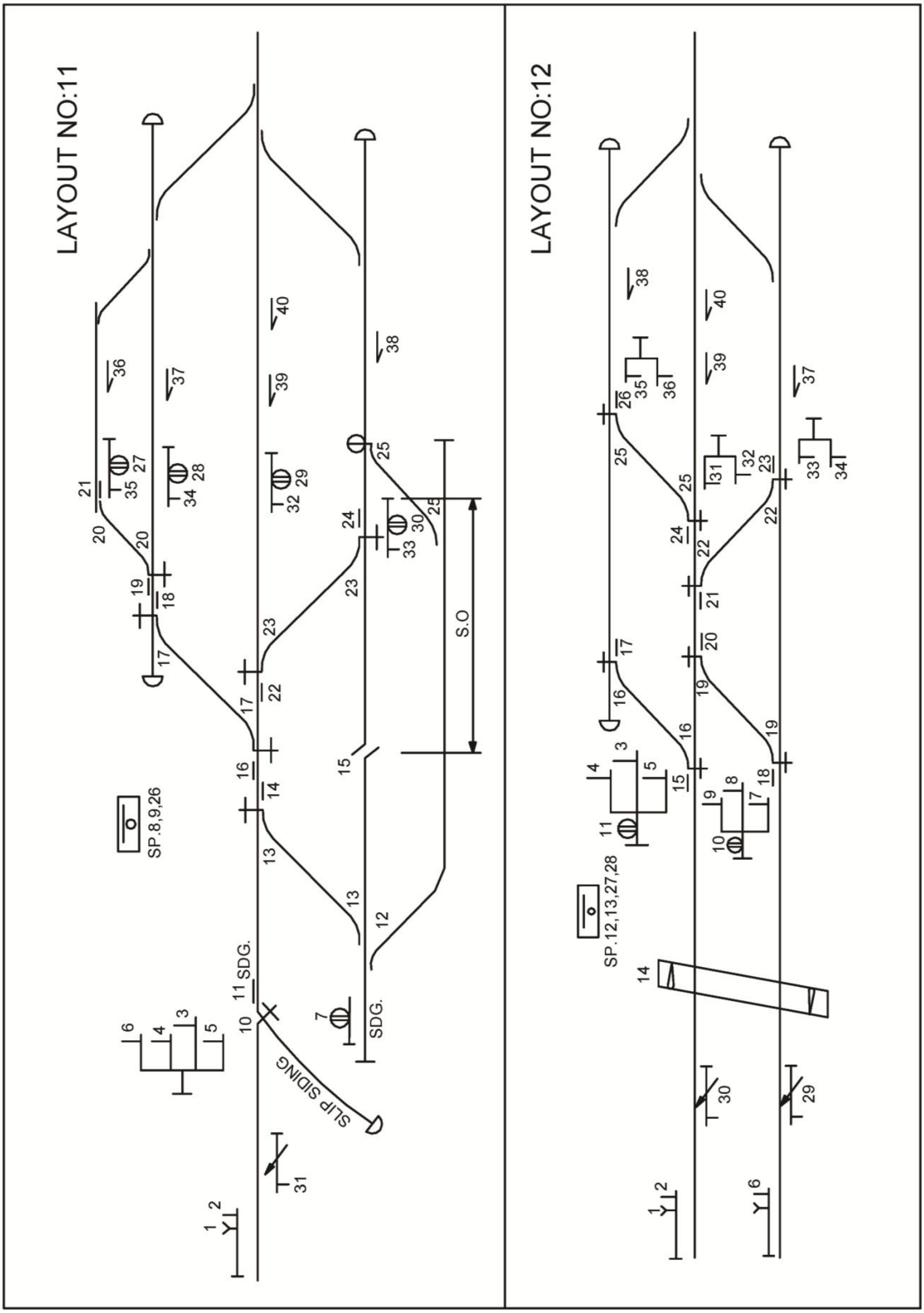
LAYOUT NO:3
SDG.
SP.10,20
LAYOUT NO:4
SP.5,13,14


LAYOUT NO:5
BRANCH
DN MAIN
UP
DN
UP MAIN
SP.17
LAYOUT NO:6
SP. 16,17
SDG.
NOTE : SHUNTS 18,19,20 READ TO ALL LINES AHEAD

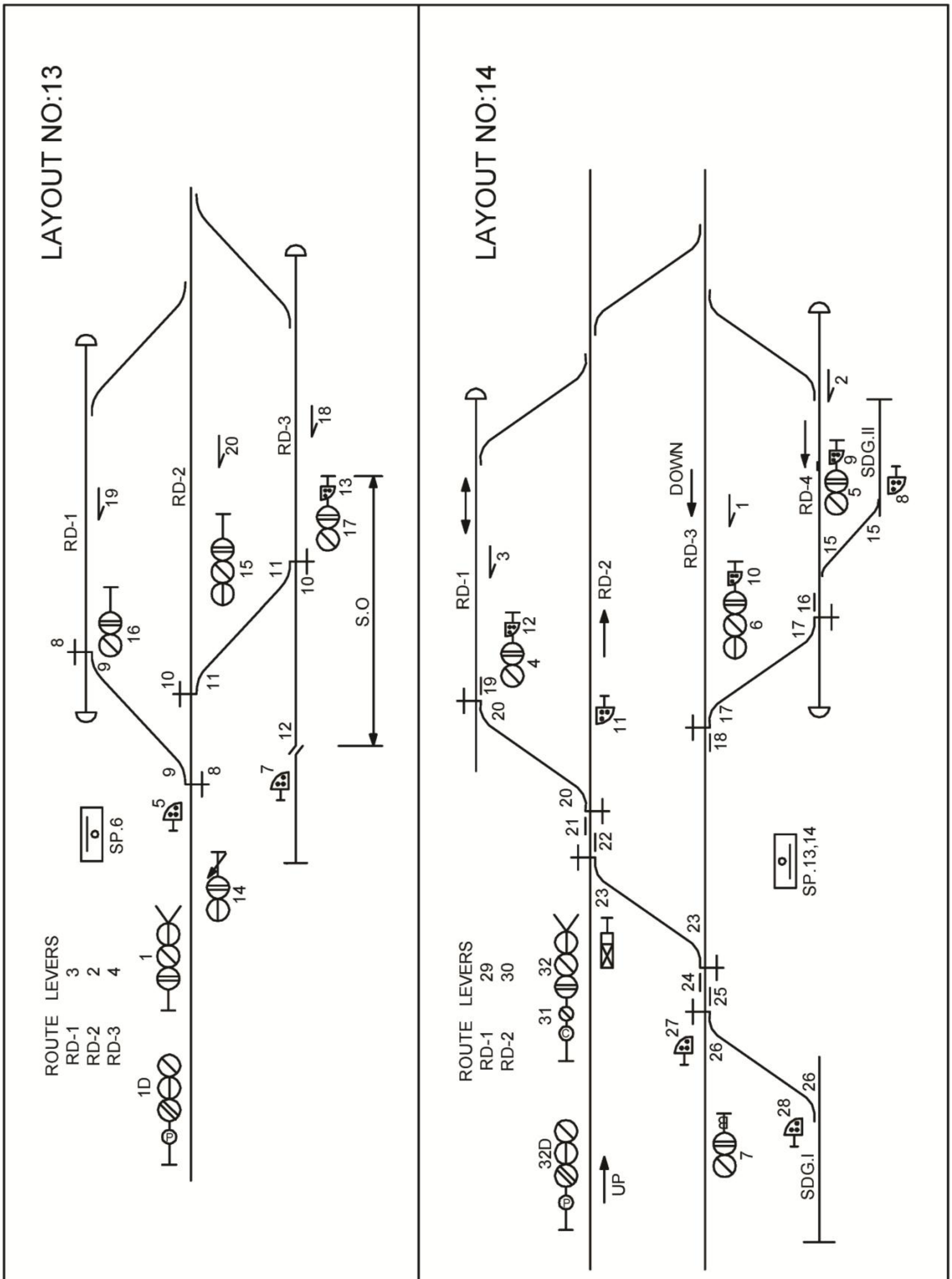

LAYOUT NO:7
SDG.II
SDG.III
SDG.II
S.O
SP. 26
BRANCH
FIXED

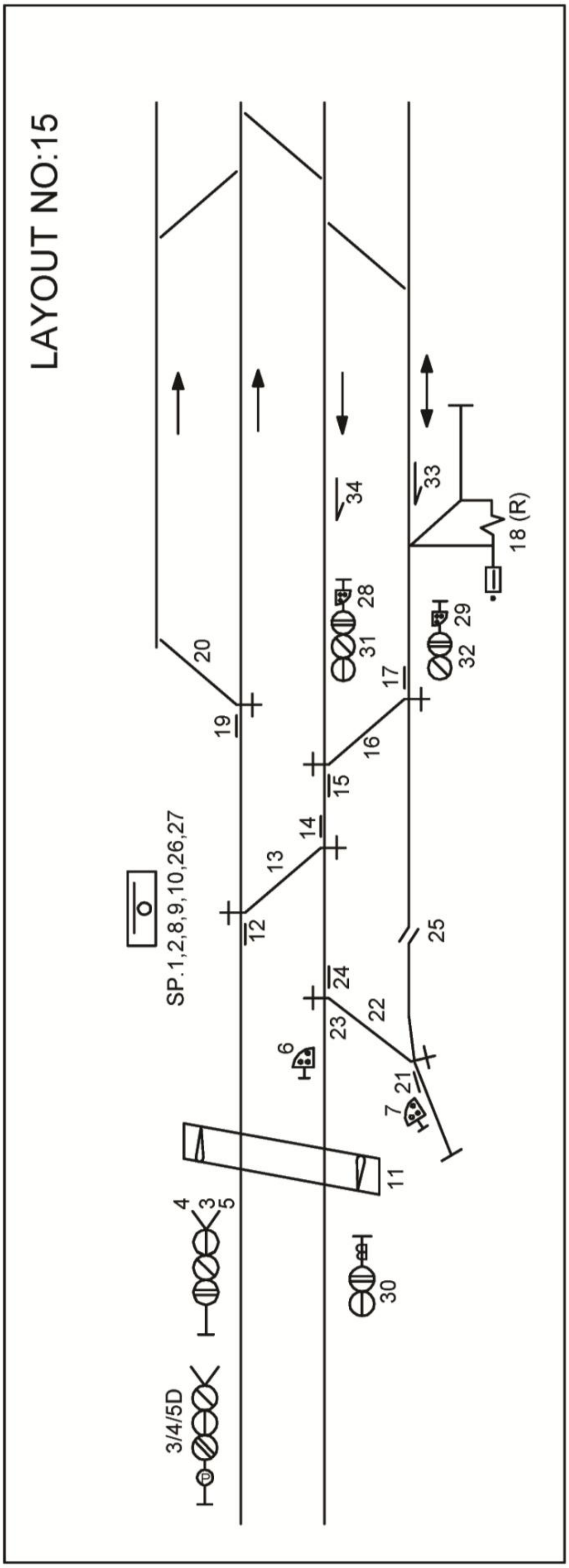

LAYOUT NO:8
SDG.
SP. 12,13,27
FIXED


LAYOUT NO:9
SP.NIL
SDG.II
SDG.I
LAYOUT NO:10
FIXED
SP.5,28
NOTE : ALL SHUNT SIGNALS TO LEAD TO ALL ROADS AHEAD.



LAYOUT NO:11
LAYOUT NO:12
SP.8,9,26
SP.12,13,27,28
S.O
SLIP SIDING
SDG.


LAYOUT NO:13
ROUTE LEVERS
RD-1 3
RD-2 2
RD-3 4
RD-1
RD-2
RD-3
SP.6
S.O
LAYOUT NO:14
ROUTE LEVERS
RD-1 29
RD-2 30
RD-1
RD-2
RD-3
RD-4
DOWN
UP
SP.13,14
SDG.I
SDG.II

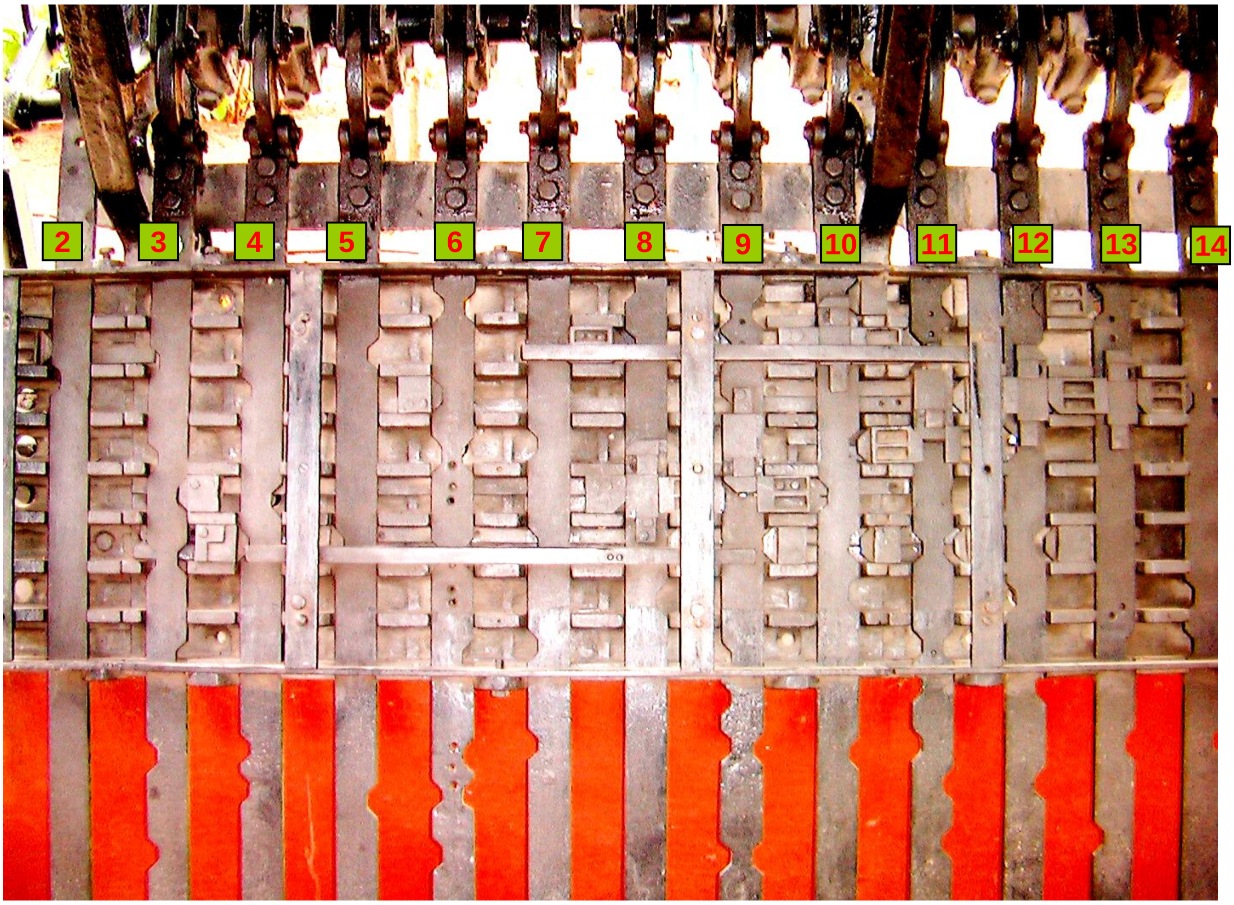

LAYOUT NO:15
SP.1,2,8,9,10,26,27
3/4/5D
4
3
5
11
30
6
7
21
22
23
24
25
12
13
14
15
16
17
19
20
31
28
32
29
18 (R)
33
34

* * *

CHAPTER – 6
LOCKING DIAGRAMS (to suit SA1101)

6.1 The interlocking relationships between various functions can be achieved either electrically or mechanically. For achieving it mechanically an interlocking lever frame is used. This comprises of a locking tray with number of channels, tappets, lock pieces and bridle bars etc. The tappet is vertically connected to the lever and moves across the channels when it's lever is operated. The lock pieces fit into and slide in the channel way and are inter-connected by means of a bridle bar (interlocking bar).

6.2 The lever is so connected to the tappet that if the lever is to move, tappet has to move, conversely if tappet can not move the lever can not move. The tappet can be prevented from moving by placing a lock engaging the notch cut on the tappet. When the tappet is to move the lock piece has to come out of the notch, if lock can not come out we can say the lever is locked. The lock can be prevented from coming out by connecting it to a lock of another lever by means of a bridle bar, such that by normal or reverse position of another lever this lock piece does not come out of the notch, thus the operation of these two levers can be made interdependent.



1 R by 4

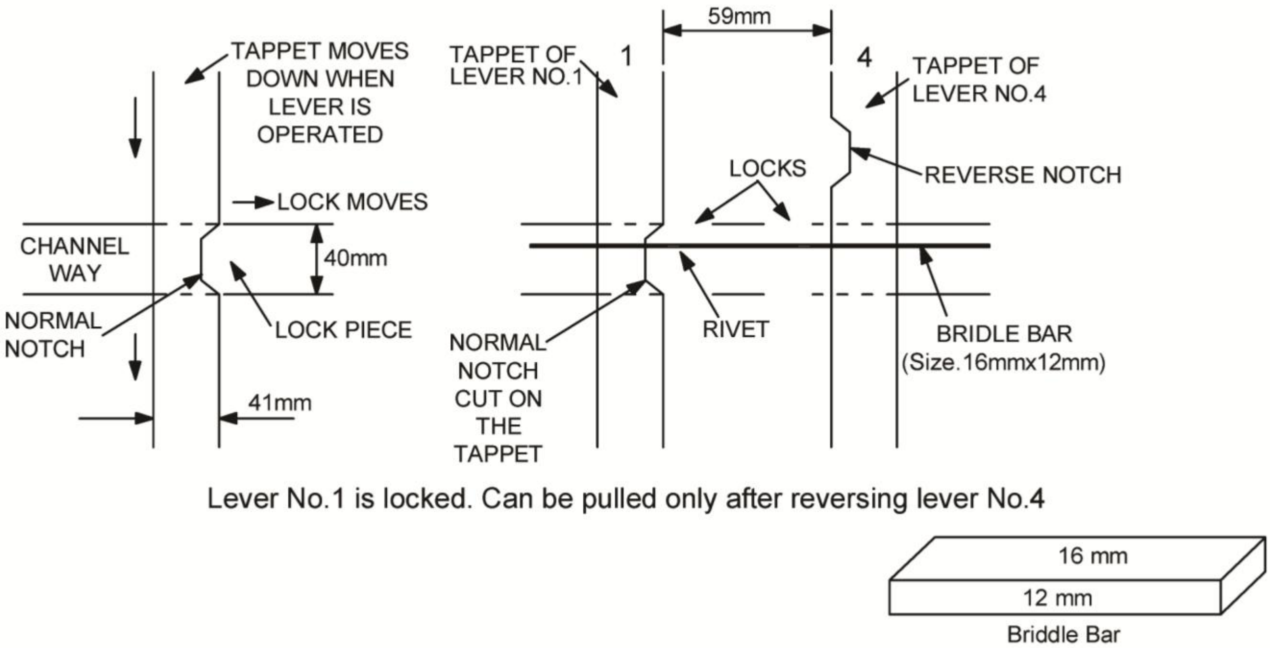


Fig. 6.2

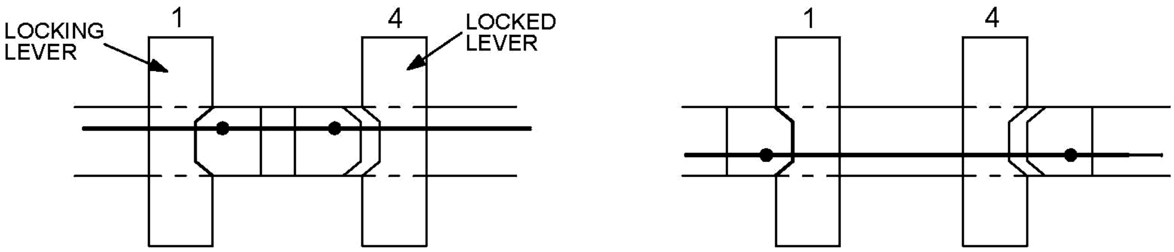
6.3 Where there is a lock, there has to be a notch cut on the tappet. A notch cut on the tappet exactly in the channel and available for the lock when it's lever is normal, is called the 'Normal notch'. A notch cut on a tappet at such a place that it comes in the channel and available for the lock when its lever is reversed, is called the 'Reverse notch". A lock can have normal notch or reverse notch or both normal & reverse, depending upon the nature of locking required between the levers.

6.4 NATURE OF LOCKING

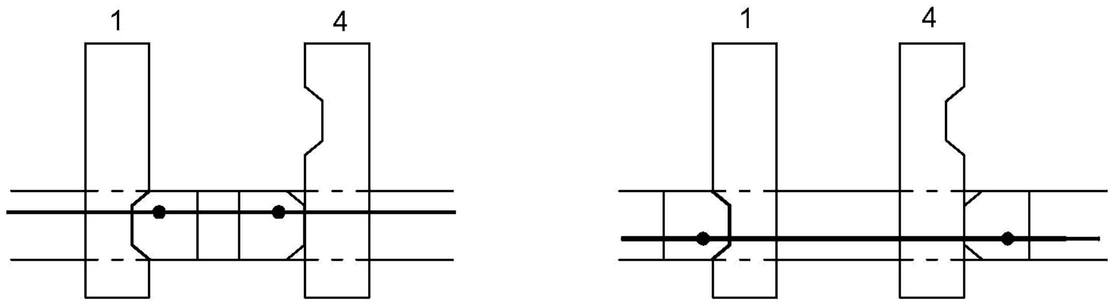
(a) NORMAL LOCKING: When any lever is reversed and due to the action of this lever if another lever is getting locked in the normal position is termed as “normal locking”. For example by reversing of Lever No.1 if Lever No.4 is getting locked in the normal position which is usually expressed as 1 Locks 4, the Tappet of lever No.1 and 4 should have normal notches as shown in Fig. 6.4(a).

(b) BACK LOCKING: Due to the action of any lever if another lever is getting locked in the reverse position or a lever can not be reversed unless another lever is first reversed and when this lever is reversed the other gets locked in the reverse position is termed as "released by" or "back lock". It is achieved by providing reverse notch on the tappet of another lever. For example in Fig. 6.4 (b) 1 R by 4, Tappet of lever No.1 should have normal notch and 4 should have reverse notch.

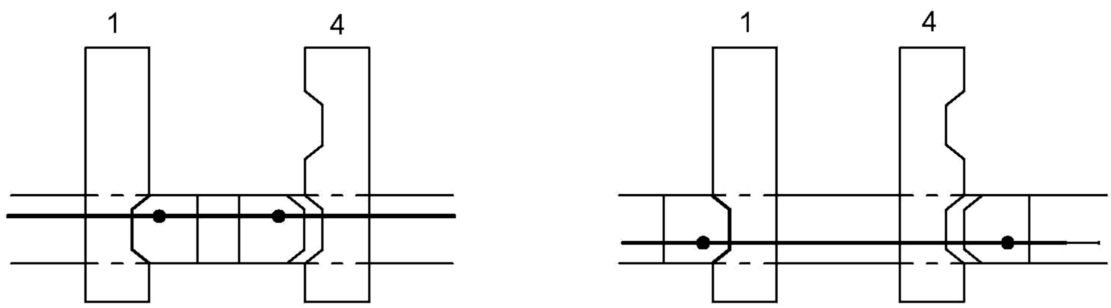
(c) BOTH WAY LOCKING: When action of any lever has to lock another lever in whatsoever position it is prior to the operation of this lever, is termed as both ways locking. In this case the lock of other lever is provided with N & R notches as shown in Fig. 6.4 (c).Here the example of such locking is 1 locks 4 bothways.



(a) Normal Locking 1 Locks 4



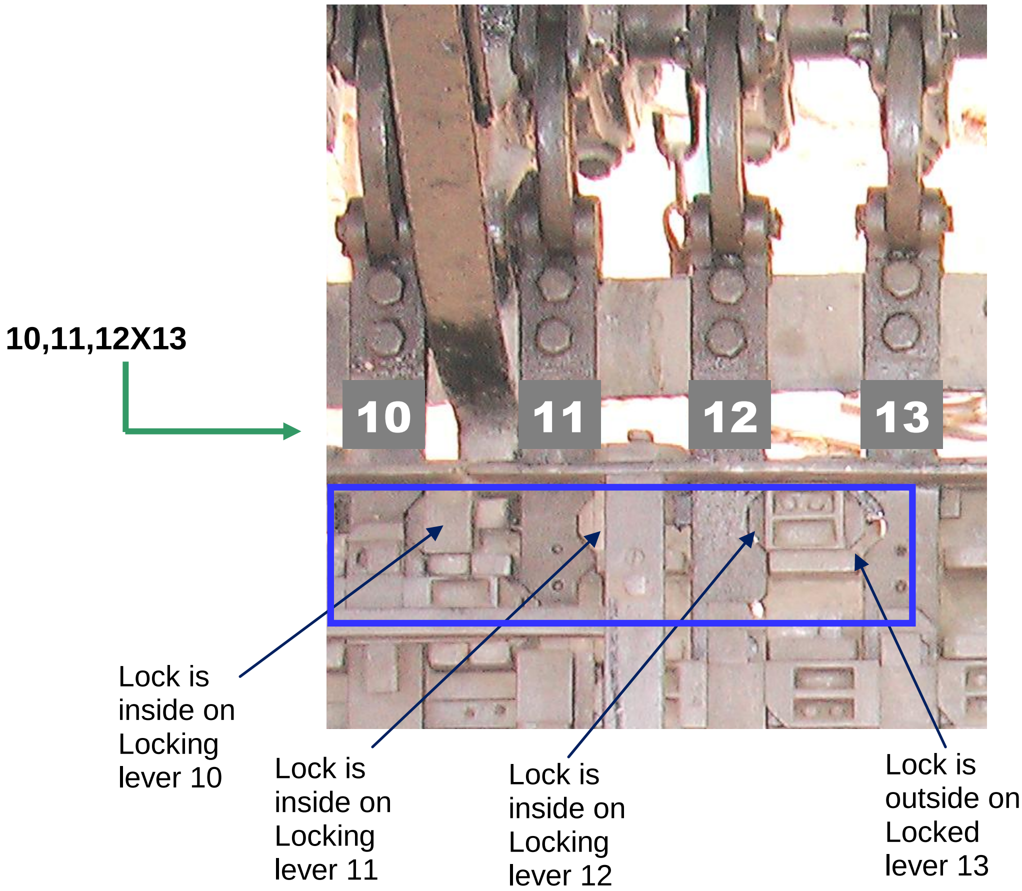
(b) Back Locking 1 R.By 4



(c) Bothway Locking 1 Locks 4 B/W

BAR IN COMPRESSION BAR IN TENSION

Figure: 6.4



Note: Only those levers, which appear in locking expression, are shown. It may be noted that tappets 1,2 and 3 and other tappets also physically exist.

6.5 A lever when operated from normal to reverse position actuates the lock pieces and results locking on other lever/s are generally termed as "Locking Lever" and the lever/s, which is getting locked by such action, is called "Locked Lever". So in the above examples (fig. 6.4) we can say 1 is locking lever and 4 is locked lever.

6.6 Care must be taken while deciding the notches on locking levers and locked levers and position of locks whether inside the notch or outside the notch etc. otherwise this slight error may result in wrong locking, which some times go un-noticed, therefore following conventions may be kept in mind.

Sl. No.	Locking Lever	Locked Lever
1	It should always have a normal notch	It will have a) Normal notch - for locks normal b) Reverse notch - for released by c) Both Normal & Reverse Notches - for locks both ways
2	Lock should be inside the notch	Lock should be out side the notch
3	If the lock is on R.H.S	The lock should be on the L.H.S
4	If the lock is on L.H.S	The lock should be on the R.H.S

Holes for riveting are readily available on the locks for one bar only, whereas the holes on bridle bar have to be drilled after marking the position of lock. Bridle bars should be straight no offsets or bends are allowed. The maximum number of bridle bars that can be used at a given place in the channel shall not exceed to 4. i.e., two bottom below lock and two top above lock. Space for the bottom bars must be utilized first, if third and fourth bars are required then only top bars may be used. This will prevent bending of briddle bar as they are below the tappet. Locks connected on Top/bottom bars are shown below.

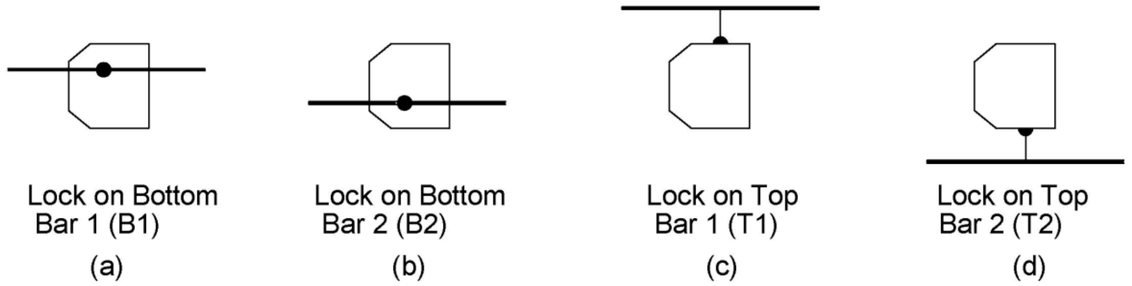


Figure: 6.6 (a)

Note: *Though one rivet is indicated for the drawing purpose, practically there will be two rivettes.*

All the locks shown in the figure from (a) to (d) are of different type and bear separate IRS.Drg. Nos. and not reversible (i.e., can not be turned to down side up and used) for the notch on the tappet. If the locking is between distant levers say 1 Locks 4, two half locks are used. But if, the locking is between adjacent levers, instead of two half locks one full lock shall be used as in the case of 6 locks 7 both ways and this full lock must be connected to a dummy bar extending the ends underneath the adjacent tappets/straps to secure the lock.

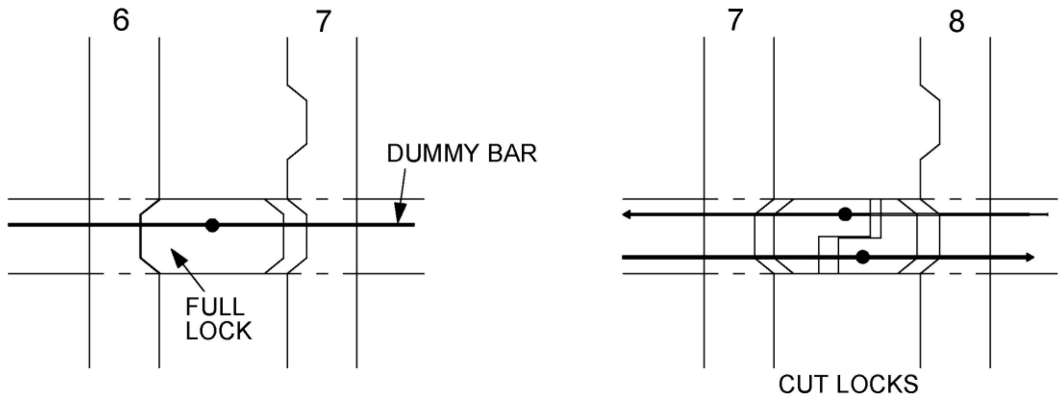


Fig: 6.6 (b)

When the locks between adjacent tappets have to be connected with different bars while carrying different lockings, then two half locks having holes on opposite sides are cut and used because the clear space between tappets is of 59 mm. and each lock is 45 mm. so to accommodate them they have to be cut, as shown in the fig. The use of such cut locks should be avoided as far as possible, since operation of the locked lever will not affect the locking lever.

6.7 In mechanical locking, when a locking relation between two levers say 1 locks 8 is provided, its converse relation 8 locks 1 is automatically achieved. Similarly if 3,4,5 released by 6 is provided its converse 6 releases 3,4,5 is achieved, hence need not be provided separately. There is no converse relation for both way locking.

6.8 SPECIAL LOCKING/CONDITIONAL LOCKING

(a) When a lever is locking another lever directly, say 6 locks 8, then the lock of lever No.6 is directly connected to lock of lever No.8 using one bridle bar. This will enforce rigidity.

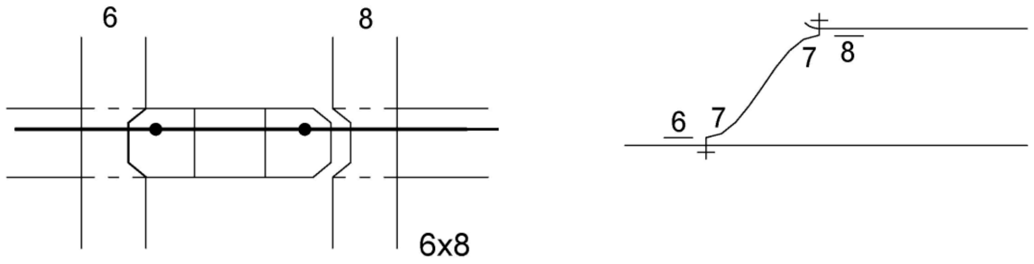


Fig. 6.8(i)

(b) In some cases yards are designed for certain flexibility of movements. For example 6 should lock 8 only when lever No. 7 is in the reverse position, and should not lock 8 when 7 is in the normal position, as there is a necessity to operate 6 and 8 both when 7 is normal for the Parallel movements.

6 X (8W7R)

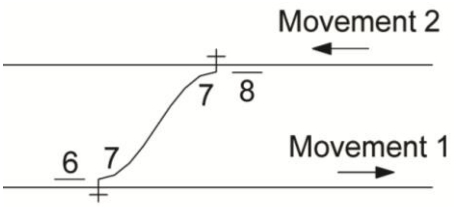


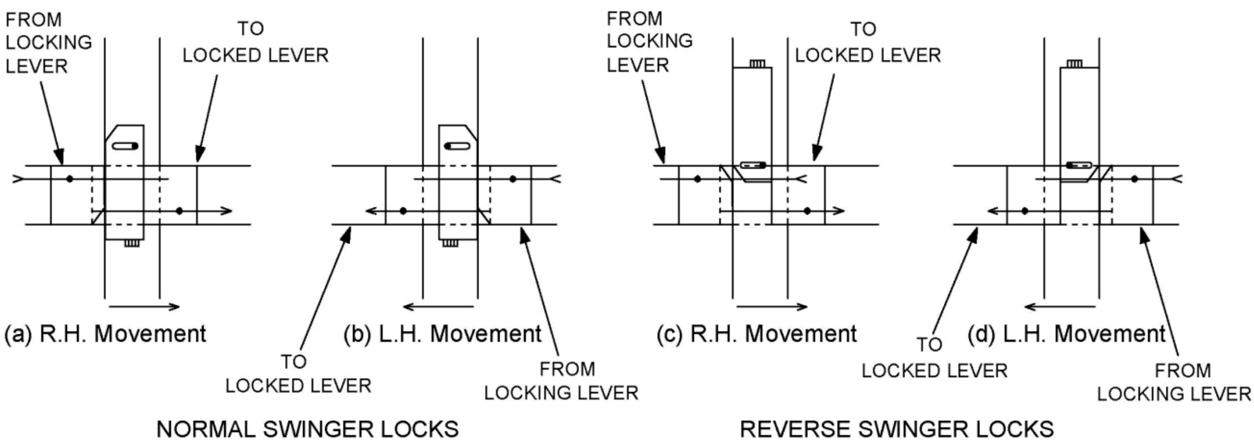
Fig.6.8(ii)

(c) To achieve the flexibility in the tappet locking swinger locks are used. In this case the displacement of lock when lever No.6 is reversed should result in a movement of the lock on lever No.8 only when lever No.7 is in the reverse position otherwise there should not be any locking action between 6 & 8 if 7 is normal. Hence the lock of 6 and 8 should not be directly connected on the same bar, whereas inter connected through swinger locks using two bridle bars. The different positions of swinger locks used are as below:-

Reference to fig 3.7

11 R by (16 W 12N) — Swinger on CIL

11 R by (14W 12R) — Swinger on CIL



6.9 The swinger is mounted on the tappet and can slide from one edge to the other laterally over the tappet and moves up/down along with its tappet. To give an aligned movement to the swinger and secure it on the tappet a guide block and a pin with slotted hole are provided. There are two locks on either sides of the swinger (say lock I and lock II) both of them are under cut and move over the tappet for actuating the swinger. Lock II is generally in contact with the swinger whereas lock I makes contact only when swinger is in the channel. The swinger, which is available in the channel when its lever is normal, is refered to as "Normal Swinger" and that which comes in the channel when its lever is reversed, as the "Reverse Swinger". The guide block acts as a guide support and prevents swinger from tilting. The guide block is riveted on the tappet.

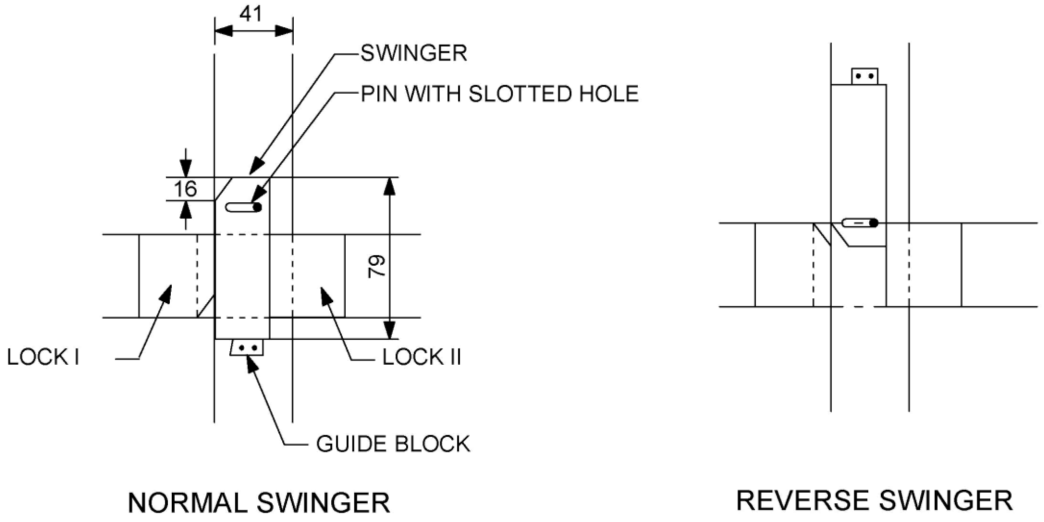


Fig.6.9

6.10 (a) To achieve 6 locks (8W7R), a reverse swinger is used on lever No.7 and locks inter connected are as shown below: -

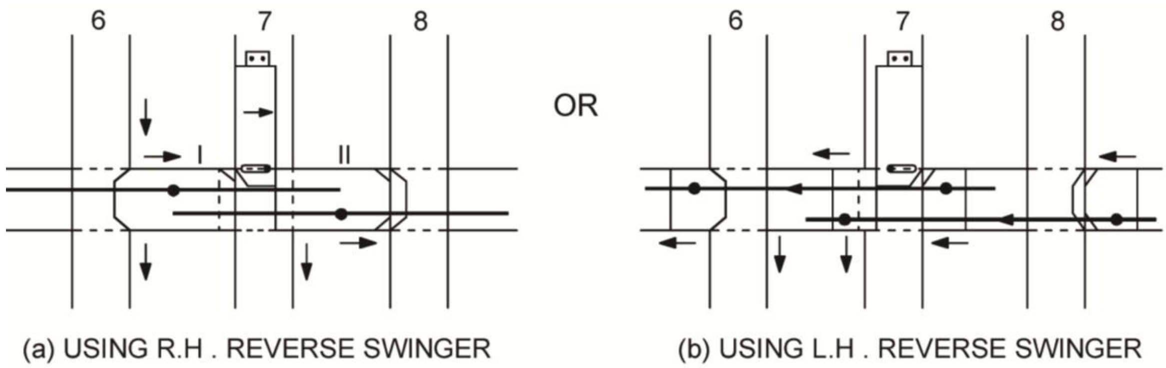


Fig: 6.10 (i)

In the above locking when 7 is reversed swinger comes in the channel and makes contact with lock I. At that time if 6 is reversed, lock I will push the swinger and swinger will push the lock II which in turn drive the lock inside the normal notch of lever No.8. Thus, we can see the lever No.8 is locked. But if 6 alone is reversed keeping 7 in the normal position, then lock I can not push the swinger because the swinger is not in the channel but it will enter in the notch of the swinger, there by no further movement of locks is effected and we find lever No.8 is not locked and free to be operated.

(b) Similarly locking between locking lever and locked lever can be affected by using a normal swinger for normal conditional locking. For example 10 R by (15W12N). If 12 is reversed then no locking relation exists between 10 & 15.

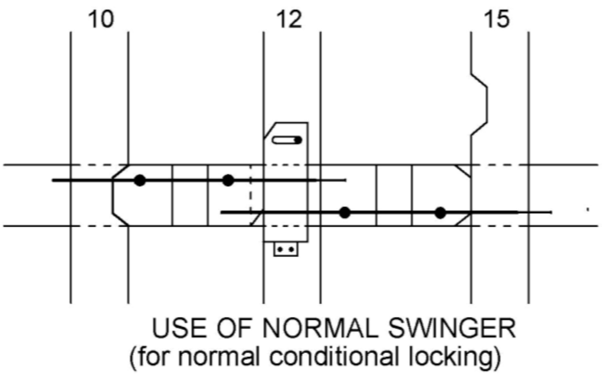


Fig.6.10 (ii)

(c) If more condition imposing levers are there the connection between locks should be in successive order. For example, in relation 6Rby(18W8R10N12R) lever No.6 is released by (back locks) Lever No.18 only when Lever No.8 is reverse, 10 is normal and 12 is reverse. If any one condition imposing lever is not in the required position as it is mentioned in the locking, then there is no locking relationship between lever No.6 and 18 which is shown below: -

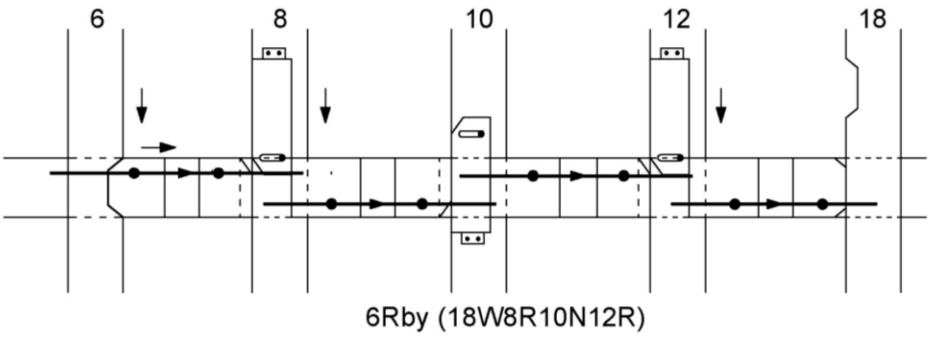
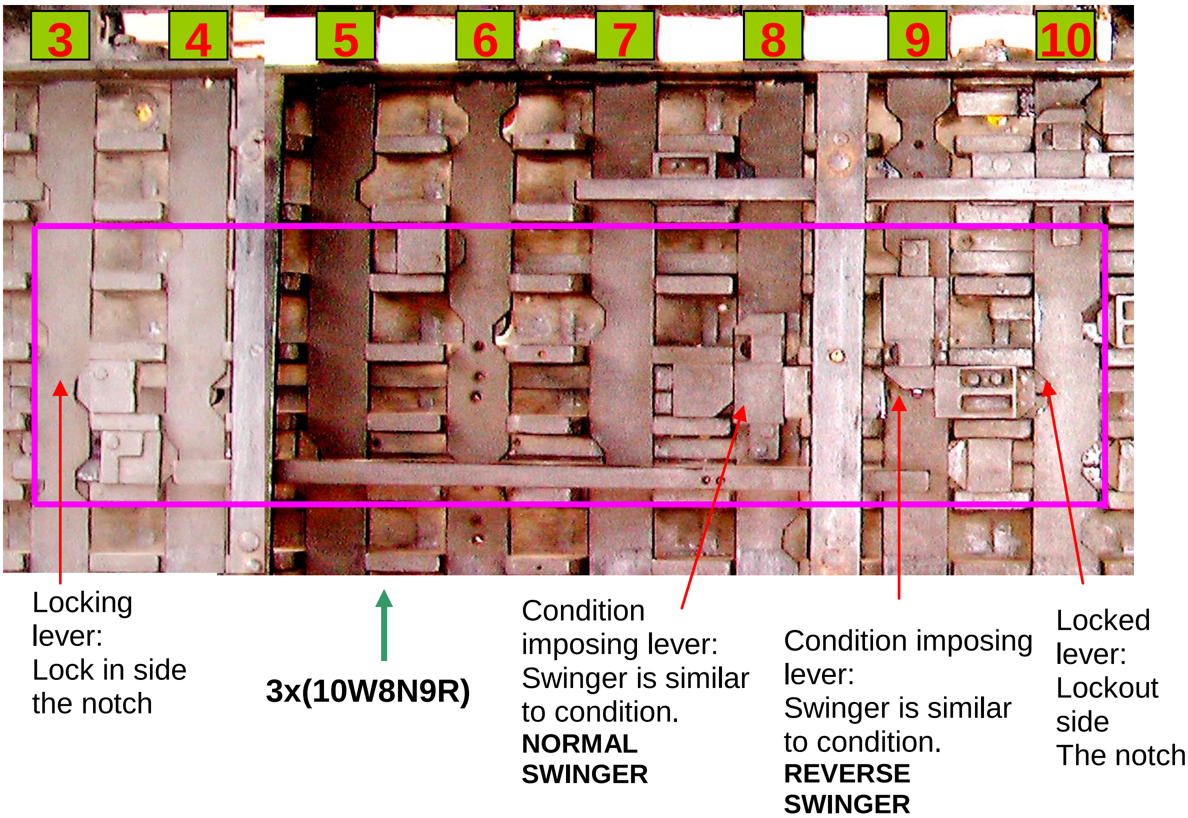


Fig: 6.10. (iii)



6.11 (a) from the above examples we can say, number of swingers required to achieve the Locking is equal to the number of condition imposing levers.

(b) The swinger/swingers can be provided on any lever/ levers in the group to achieve the locking. For example 6 x (8W7R) can be achieved by providing swinger on any lever (6/7/8) and for 8Rby(12W10N), the swinger can be provided on (8/10/12).

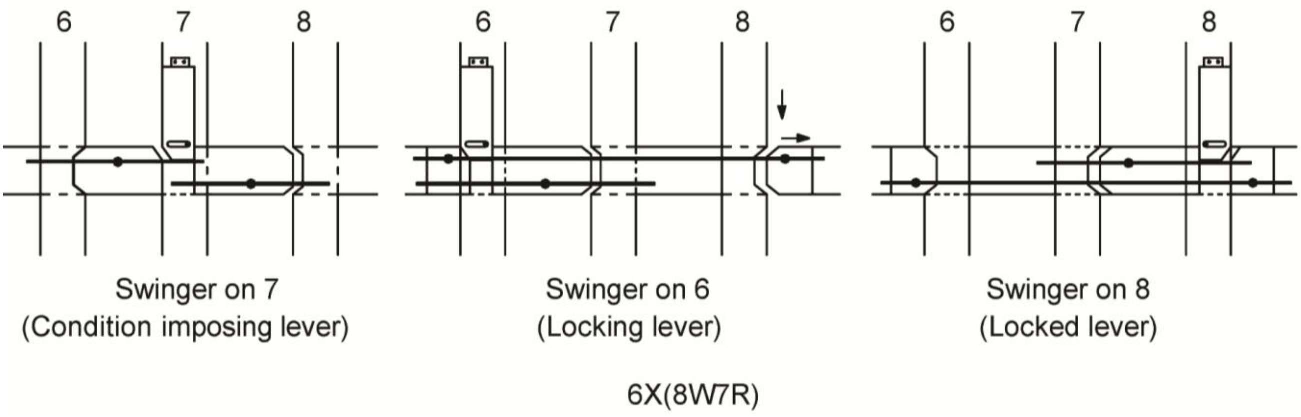


Fig.6.11 (i)

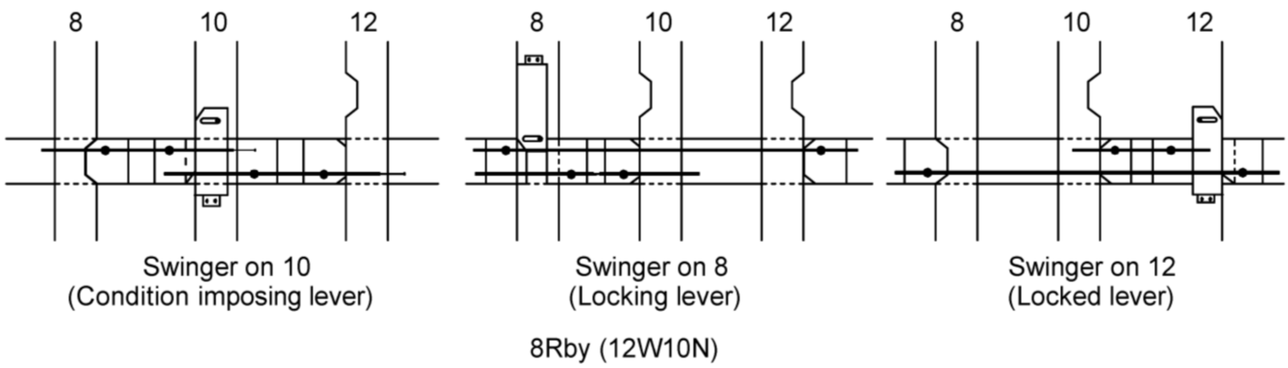


Fig: 6.11 (ii)

(c) From the above locking diagrams it is evident that

(i) When the swinger is on locking lever, it is only a reverse swinger and both the locks are inside.

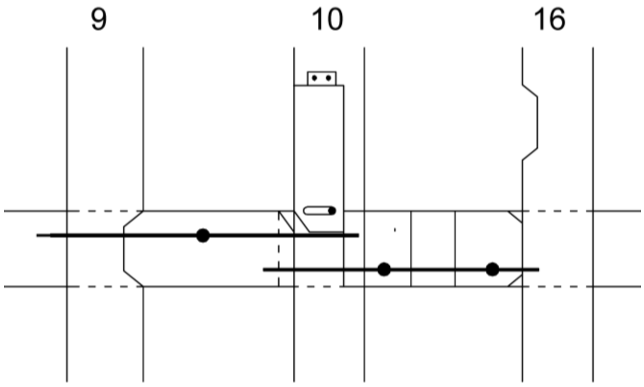
(ii) The condition-imposing lever is having a normal notch for reverse condition and reverse notch for normal condition, whether the notch is on the tappet or notch on the swinger to serve the purpose with respect to the tappet position.

(i) When the swinger is provided on the locked lever because reverse swinger will have normal notch and normal swinger is having the reverse notch, a locked lever having a reverse swinger can be locked only in the normal position and that having a normal swinger can be locked only in the reverse position when there is a locking action on this lever by other levers in the group. Hence, it can be formulated as normal swinger is equal to reverse notch and reverse swinger is equal to normal notch.

(iii) Inherently every special locking is having n(n-1) locking relations (where n = No. of levers in the group). For example: 9Rby(16W10R) will have 3(3-1) i.e., six locking relations. To get the other locking relations, mark the position of notch above each lever as shown below.

Now by seeing the notches we can decide the locking relation as well as the condition 9 Rby(16 W10R)

Lever	9	1 6	10
Required notch	N	R	N
Can be substituted by SWINGER	R	N	R



9 Rby (16W10R)

9 locks (10 W16N)

16 releases (9W10R)

16 releases (10W9R)

10 locks (9W16N)

10 Rby (16W9R)

Figure 6.11.iii

It means when we make the locking diagram for 9Rby(16W10R), all these locking relations are present in this diagram. Knowledge of converse locking relationship of course useful for grouping of special lockings. For example, in the layout 6Rby(14W11R12N) is required for route setting and 28 locks(11W12N14N) for isolation. To avoid ambiguity to the readers please note 11 releases 12, 12 X 14 locking also exists.

Now one of the locking expressions can be converted making common levers as condition imposing levers, then we find the locking of 6 and 28 is one and the same. i.e., 6 and 28 locks (11W12N14N) or 6 Rby(14W11R12N). This simplifies making locking chart using two swingers only.

6.12 GROUPING AND ECONOMISING OF LOCKING

Grouping of locking is necessary for economising the locking materials, channels and workmanship. This is possible when two or more levers are having the same locking relation with other levers. In-adequate experience in grouping will result in more locking materials and notches, which will limit the scopes of completing the locking within the given channels. For achieving grouping of lockings, we can consider the following categories.

(a) Grouping between direct locking and direct locking.

(b) Grouping between direct locking and special locking.

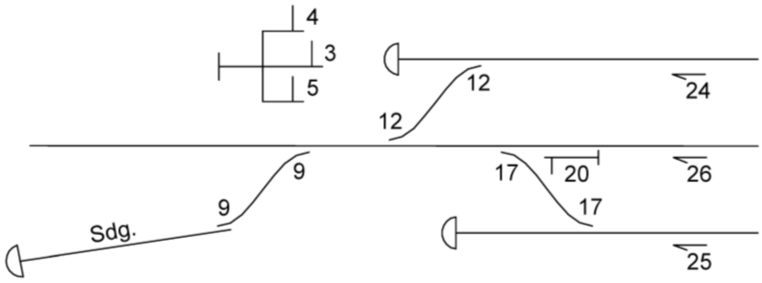
(c) Grouping between special locking and special locking.

6.13 GROUPING OF DIRECT LOCKING AND DIRECT LOCKING

(a) Example I.

3 x 9,12,17,24,25

26 x 9,12,17,24,25



In this case locking of lever No.3 and 26 is same. Therefore all these locks shall be grouped on the same bridle bar as shown below.

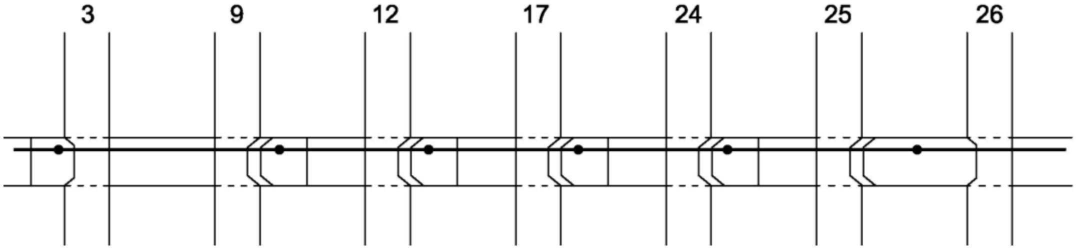


Fig.6.13 (i)

(b) In certain cases the locking of two or more levers may not be identical and only certain locking may be common, let us consider the following example:

Example II 3 X 9,12,17,24,25

20 X 9,12,17

26 X 9,12,17,24,25

As we see the locking of 3 and 26 is totally same, but 20 locks only 9.12.17 and 20 does have no locking relationship with 24.25. Therefore, it will not be correct to group the locking of 20 on the same bar of 3 and 26. It is possible to achieve by grouping the individual locking on individual bridlebars and common locking on another bar using lock butts. This can be examined after separating the common locking and the individual locking.

3,26 X 24,25 --------- individual locking.

20 X 9,12,17 --------- individual locking.

3,26 X 9,12,17 --------- common locking.

After separating the common locking and the individual lockings, the number of locking expressions will denote the number of bridle bars and lock butts required. i.e., one bar for common locking and another bar/bars for each individual locking. Hence to achieve the above locking we require two bridle bars say B1& B2 and one lock butt, because two bars can not be connected to a lock. Therefore lock butt has to be used on such locks and the connections should be as in fig. 6.13(ii).

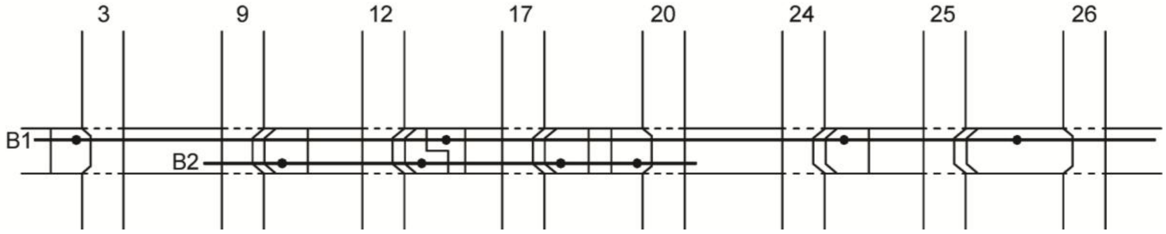
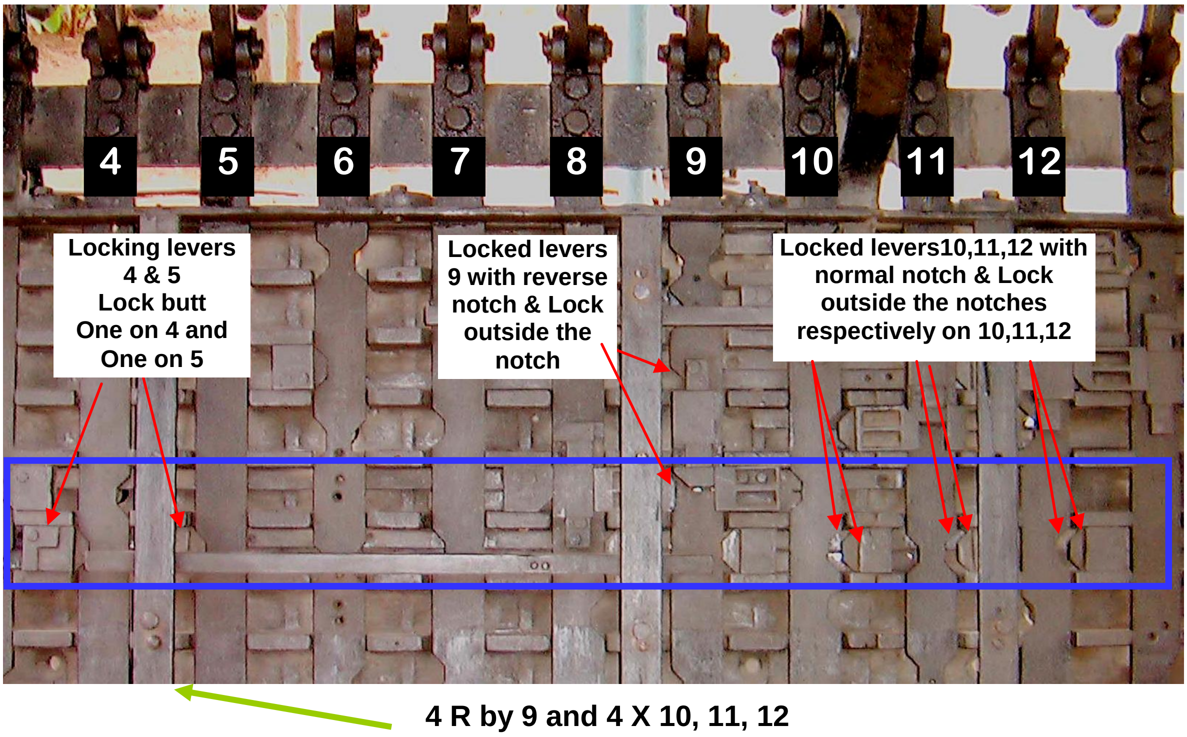


Fig.6.13 (ii)

After showing the connections, the locking is verified by imaginary pulling of locking levers, to ensure that the required locking is achieved and there is no foul locking,

So, Pull 20 ------- see that B2 bar only moves

Pull 3/26 ------- see both B1 & B2 bars move.



4 R by 9 and 4 X 10, 11, 12
5 R by 8 and 5 X 10, 11, 12

The above two examples I & II are enough to deal with the grouping of direct locking and the principles involved in the grouping.

(c) However, example shown in FIG.6.13(iii) deals with grouping of locking using bar butts which are generally used in the SMs slide control frame and not allowed in the interlocking frames. Because the area of contact of bridle bars is so small that in the course of time due to wear and tear and distortion of bar alignment and forced operation of levers may round off the butting surfaces and any time may cause failure of locking. This is risky, therefore bar butts and pushers are not recommended for using in the lever frames. Para 13.14.3 of SEM part-2 stipulates that the locking of the interlocking frames must be strong, durable, accurate, accessible and easy for inspection. Earlier pushers and bar butts were being used carefully on bottom bars, but later a difficulty was experienced while examining the wear and tear of these connections during periodical inspection, as these were all hidden and not easily accessible.

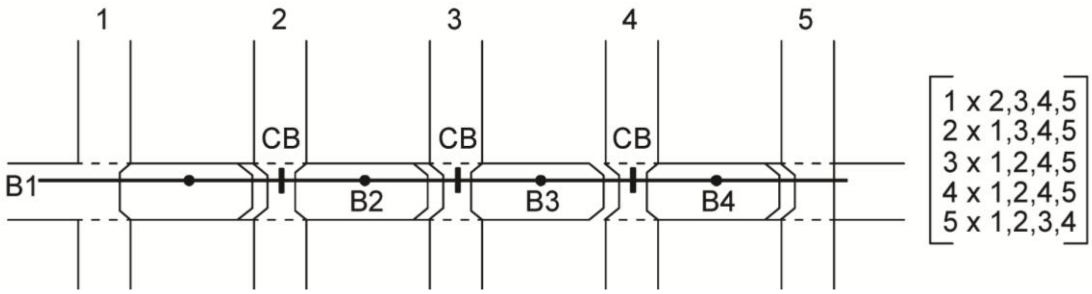


Fig.6.13 (iii)

(a) When number of levers locks each other they can be grouped using (n-1) bar butts.

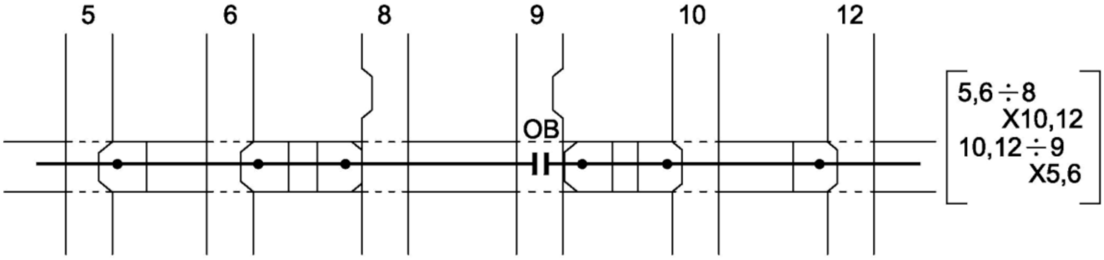


Fig.6.13 (iv)

(b) When locking lever and locked lever are released by other levers they can be grouped by using an open butt.

6.14 As mentioned in the earlier Para the swinger locks have to be used to achieve special locking. It was also stated that the number of swingers is equal to the number of condition imposing levers, and the swinger can be provided on any lever in the group to achieve the locking. This is of course true, but when special locking is being grouped with other lockings, the choice of providing swinger on any lever is getting restricted, and same time the number of swingers also can be minimised. Therefore it is necessary to decide first is:

(a) The minimum number of swingers and

(b) The swingers on which levers to be chosen.

In this context some guide lines are given as follows: -

6.15 MINIMUM NUMBER OF SWINGERS

(a) When locking lever / locked lever is same.

Total no. of swingers = Total no. of condition imposing levers (CIL)

6 x (8W 7R)
6 R by (11W7N)
6 x 7 B/W

One swinger

12 R by (18W13R)
12 Locks (24W15N)

Two swingers

7 Locks (20W10R)
6 Locks (20W12R)

Two swingers

8 R by (18W10N)
12 R by (18W10N)

One Swinger

15 R by (21 or 22)
18 R by 21

One swinger

(b) When locking lever and locked lever, all are different with one condition imposing lever common having same condition.

No. of swingers = No. of locking levers/locked levers (Whichever are less)

Because locking levers and locked levers are equal.

6 R by (18W10N)
18 R by (16W10N)

Two swingers

3 Locks (15W8R)
4 R by (12W8R)
5 R by (18W8R)

Three swingers

In the above rule (b) If conditioning imposing levers are more than one.

No of swingers = No of locking levers / No of locked levers (which ever is less)
+ Additional C.I.L.

Eg:

10 R by (15W11R12R)
14 R by (20W11R12R)

2 + 1 = 3 Swingers

10 R by (15W 12R)
8 R by (16,18W 12R)

Two swingers

Because locking levers are
Less than locked levers

8,9 R by (15,16W 12R)
3,4 R by (18W 12R)

Three swingers

because locked levers are
Less than locking Levers

Note: - There is no saving of swingers in these cases. Therefore, such lockings are rarely grouped.

6.16 LOCATION OF SWINGER

Generally swinger can be provided on any lever in the group of special locking. But,

(a) When there is only one common lever in the group, the swinger should not be provided on this common lever. (Whether the common lever may be a locking lever/locked lever/condition imposing lever)

6 Locks (8W7R)
6 Locks 18,19,20

One swinger on 7/8 but not on 6

Since common lever is 6.

7 locks (20W10R)
6 locks (20W12R)

Two swingers one on 7/10 other on 6/12,
but not on 20,

Since common lever is 20

8 R by (18W10N)
12 R by (16W10N)

Two swingers one on 8/18 other on 12/16,
but not on 10

Since common lever is 10

19 R by (16W18N)
17,21 R by 18

One swinger on 16/19
but not on18

Since common lever is 18

(b) When there are more than one common levers in the group, the swinger can be provided on the common levers except on any one of the common levers.(one of the common levers should not be provided with the swinger).

Note: -

(i) If the number of swingers required is less than the common levers, then the swinger must be on common lever.

(ii) If the number of swingers required are more than the common levers, it is economical to have swingers on the common levers (except one) and also on other levers of that special lockings.

6 Locks (8W 7R) 6 Locks 7 B/W	One swinger on 6/8 not on 7 (see note (i) above) And no swinger on 7 since 7 is involved as direct Locking other than conditional locking.

Here common levers 6,7

8 R by (18W10N) 12 R by (18W10N)	One swinger on 10/18 not on other levers [See note (i) above]

Here common levers 18,10

10 R by (15W11R12R) 14 R by (20W11R12R)	Three swingers on ------ 10/15 ------ 14/20 ------ 11/12 See note (ii)

However in certain cases while providing swinger on common levers, a choice has to be made between common levers to minimize the number of swingers.

6 Locks (25,26W10N) 7 Locks (25,26W10N)	One swinger on 10 only.

Here common levers 25,26,10

But we have to choose swinger on 10 only because two swingers are required if they are chosen on 25,26 two swingers are required and only one swinger if it is on 10. Therefore providing swinger on 10 is economical.

(c) When normal and reverse conditions are imposed on the same common lever, the swinger should not be provided on such common lever.

Note: -

(i) Such conditional locking can be grouped only when locking lever is same and

(ii) When grouped, the locking lever is locking the condition imposing lever both ways must have been included.

6 locks (8W7R)
6 R by (11 W7N)
6 locks 7 B/W

One swinger on 6 only not on 7 because 'N' & 'R' conditions imposed on 7

6,7 common levers

3 R by (16W 8R10R)

3 R by (18W 8R 10N)

Two swingers on 3 & 8, but not on 10 Because of 'N' & 'R' conditions imposed on 10.

3,8,10 Common levers

6.17 In certain cases although the lever is common, but locking can not be grouped, because the nature of locking is not the same, or condition is not the same. Therefore such lockings have to be done separately.

(a) Ordinary locking

6 R by 10
8 Locks 10
9 Locks 10 B/W

Can not be grouped

(b) Special locking

6 Rby (15W10N)

8 Rby (18W10R)

Can not be grouped
Ref 6.16(c) note (i)

6.18 It is now important to make some basic groups of special lockings, on the basis of which we can proceed further to add some more locking and decide the swingers and the lever on which swinger is provided.

Basic group 1

6Locks(8W7R)

6Locks18,19,20

one swinger on 7/8

Basic group 2

6Locks(8W7R)

6Locks 7 B/W

one swinger on 6/7

Basic group 3

6Locks(8W7R)
6Rby(11W7N)
6Locks 7 B/W

one swinger on 6 only

Examples:-

(a) 16Rby(13W15R)
16Locks 19,20,23
15Locks 9,10

one swinger on which lever

To decide the swinger to be on which lever, we have to find the common levers of the group. But in this case it will not be correct to find common lever for the whole group because it is not in the frame of basic group. We can say it is consisting of two basic groups.

i.e 16Rby(13W15R)

16Locks19,20,23

In this,

Swinger on 13/15
But not on 16 ———— (1) and

16Rby(13W15R)

15Locks 9,10

In this,

Swinger on 13/16
But not on 15 ———— (2)

But when we want to group both (1) & (2) swinger should be provided on 13 only

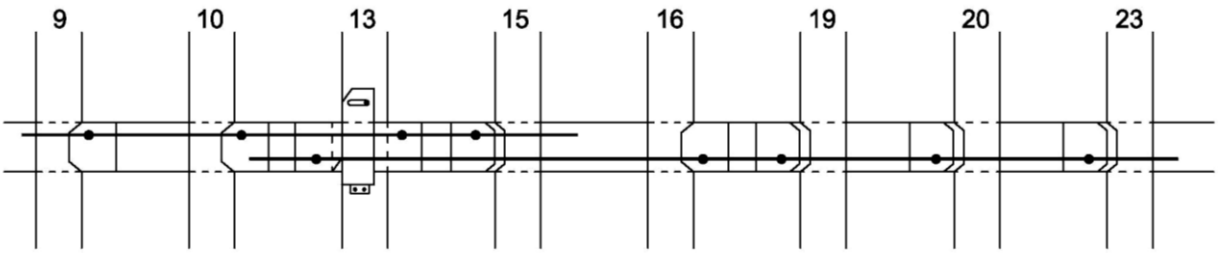


Fig: 6.18(a)

(b) Similarly

19Rby(16W18N)
19Locks 18 B/W
17,21Rby18

One swinger on ------- ?

19Rby(16W18N)

19 locks 18 B/W

In this,

Swinger on 16
But not on 18/19 ———— (1) and

19Rby(16W18N)

17,21Rby18

In this

Swinger on 16/19

But not on 18 ———— (2)

But when we want to group both (1) & (2) swinger should be provided on 19 only

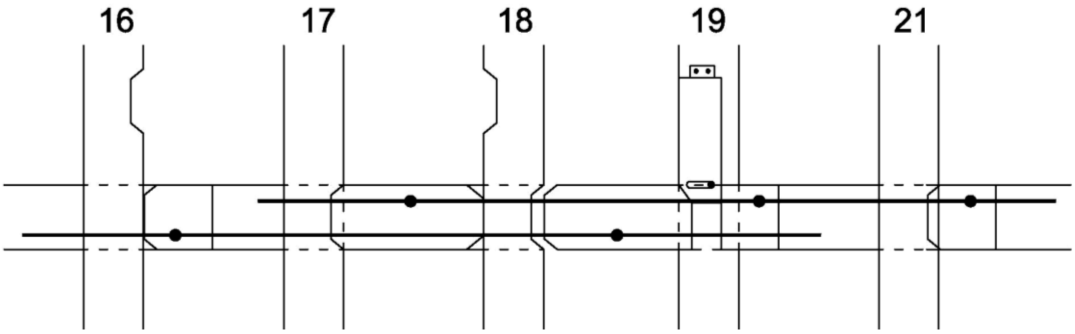


Fig: 6.18. (b)

(i) 3Rby(16W8R10R) requires 2 + 1 = 3 swingers.

3Rby(18W8R10N))

5Rby(16W10R)

5Rby(18W10N)

i.e.,

3Rby(16W8R10R) and 5Rby(16W10R)

3Rby(18W8R10N) 5Rby(18W10N)

So,

2 Swingers on 3 & 8 not on 10 and 1 swinger on 5 only not on other levers

Hence swinger to be provided on 3, 5 and 8

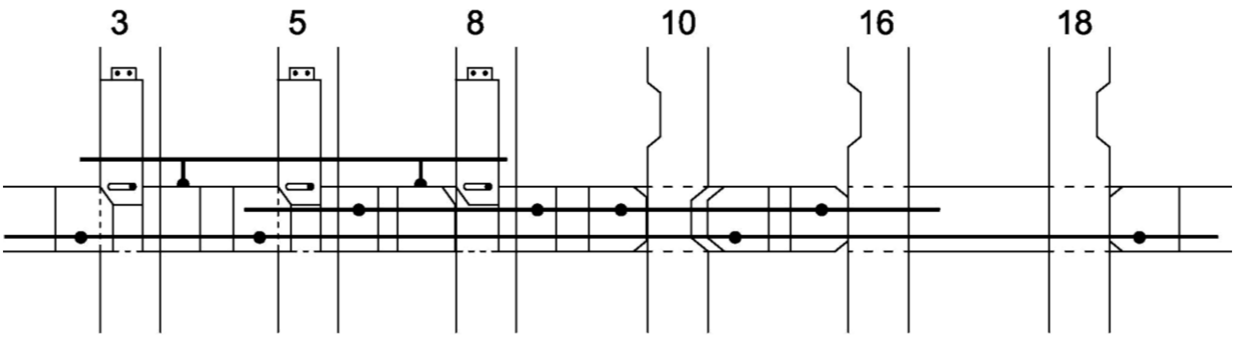


Fig: 6.18. (c)

(ii)

6R by (9W7R)
6R by (16W7N)
6 locks 7 B/W
6R by(18W7R10R)

1 + 1 = 2   Swingers on 6 & 10/18

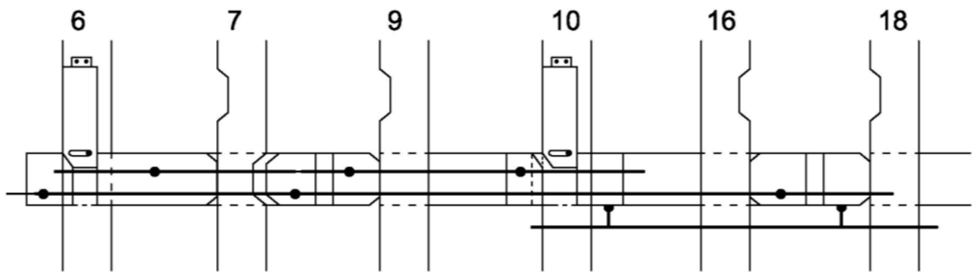


Fig: 6.18(d)

6.19 (a) In certain cases the swinger locks of conditional locking can be used to behave as an open butt lock, when locking lever and locked levers are released by some other levers of the conditional locking.

Example: -

6,7 R.by 10
6,7X(20W11N)
20Rby15
20X14

One swinger on 11

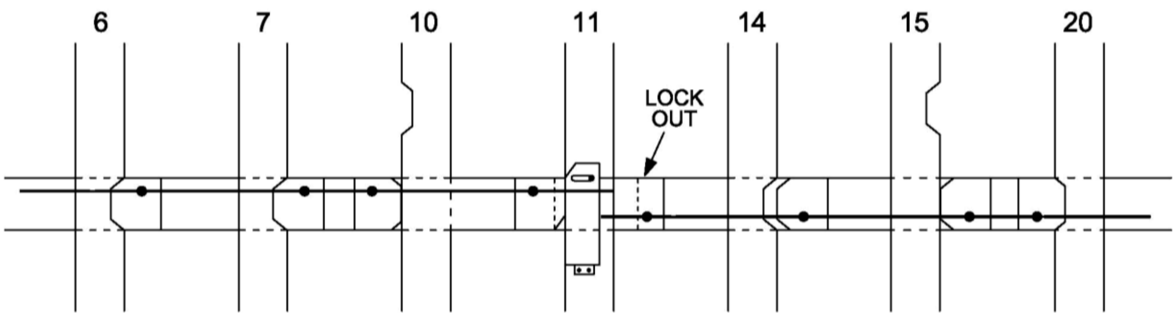


Fig: 6.19(a)

Note:- *Conventionally Lock 11 of swinger is shown in contact with the swinger while making the diagram, but in such cases it has to be shown clearly outside (in the line of tappet) whether swinger is used in normal/reverse.*

(i) Some typical Lockings:

2Rby(3or4or5)   2 Swingers

Economical to provide swingers on 3 and 4 only

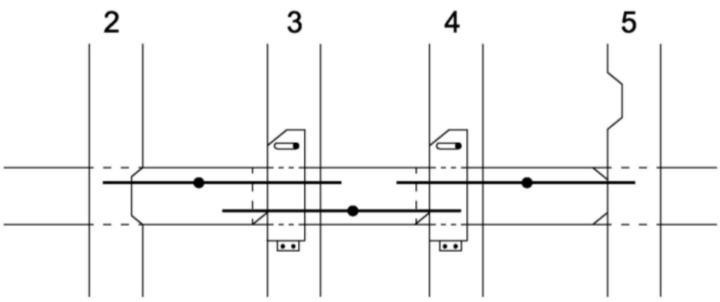


Fig: 6.19 b (i)

(ii) 6Locks(9W7 N) , 6Locks 7 B/W

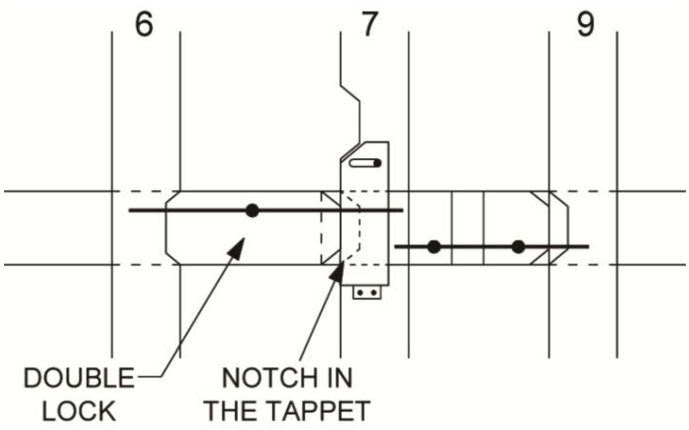


Fig: 6.19 b (ii)

(b) After the study of various methods of grouping, with what so ever the limitations (Para 6.17), the next is to prepare a locking diagram for the full lever frame as per the locking table. In mechanical locking, when a particular locking relation is provided, its converse is achieved automatically. Hence it is not required to be provided separately. Therefore an abstract of locking by grouping judiciously is first prepared, and then the locking diagrams have to be drawn, bearing in mind the following points.

(i) The swinger/ the top piece should not be provided in the first and the last channels.

(ii) Reverse swinger in the second channel and normal swinger in the last but one channel should not be provided.

(iii) Swingers/top pieces should not be provided in the adjacent channel on the same tappet.

(iv) Fouling of notches must be avoided (see Para 5.21)

(v) Space for the bottom bars should be utilized first, if third and fourth bars are required, use top bars and secure them under the straps.

(vi) The number of bridle bars at any given place of a channel should not exceed four.

(vii) An unconnected length of a bridle bar to a distance of more than 10 levers to be supported by a dummy lock.

(viii) Pusher and bar butts should not be used in the lever frame.

(ix) As far as possible avoid the use of cut locks, and cutting same notches both sides of the tappet for the same channel.

(x) Use of top pieces shall be the last alternative for avoiding the fouling notches.

(xi) Locking should be complete in all respect, standard, durable easy replaceable and easy for inspection, distributed suitably, (and not to be cramped in few channels and leave the space in other channels), and shall have the scopes for future additions.

6.20 FOULING NOTCHES

(a) A notch, which is meant for a lock, should not be available to any other lock during and after completing the movement of the tappet. This will occur when the notches are cut same side of the tappet for the locks of adjacent channels and the stroke of the tappet is equal or more than the pitch of the channel. In single wire catch handle type lever frame (SA1101/M) the pitch of the channel is 55 mm and the stroke of the tappet is 65 mm. Therefore some notches will foul which are illustrated in Fig. 6.20(a)

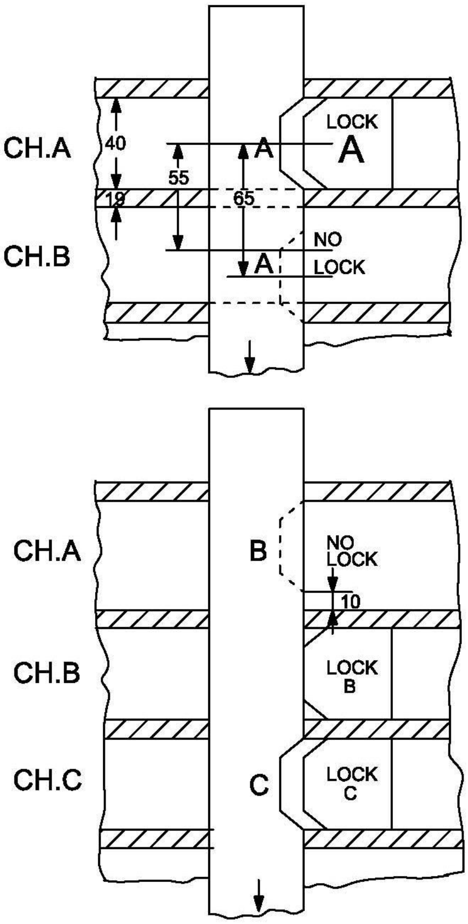


Fig.6.20 (a) FOULING NOTCHES. S.W.C.H. Lever Frame

When the lever is operated from normal to reverse the tappet moves down by 65 mm. Therefore, the notch A will pass through channel B, because pitch of the channel is 55 mm. If there is a lock same side in channel 'B'. The notch A will foul with this lock. Hence there should be no lock in 'B' channel of same side.

When a reverse notch is cut for a lock of B channel, the position of the notch is 10 mm overlapping to the channel A above. If there is a lock same side in channel 'A', this will foul.

Where as a reverse notch is cut for a lock of B channel. We can have lock same side and cut only normal notch in channel 'C' for lock 'C'. This is not fouling, hence allowed.

	Above Channel	**Below channel**
Fouling Notches	'N' notch	'N' notch
	'N' notch	'R' notch
	'R' notch	'R' notch
Notches not Fouling	'R' notch	'N' notch

(b) The fouling of notches have to be avoided first by staggering them in the adjacent channels, still if they are unavoidable top-piece as last remedial measure may be used. At that time the lock has to be placed down side up, to engage the notch of the top-piece as there is no notch on the tappet.

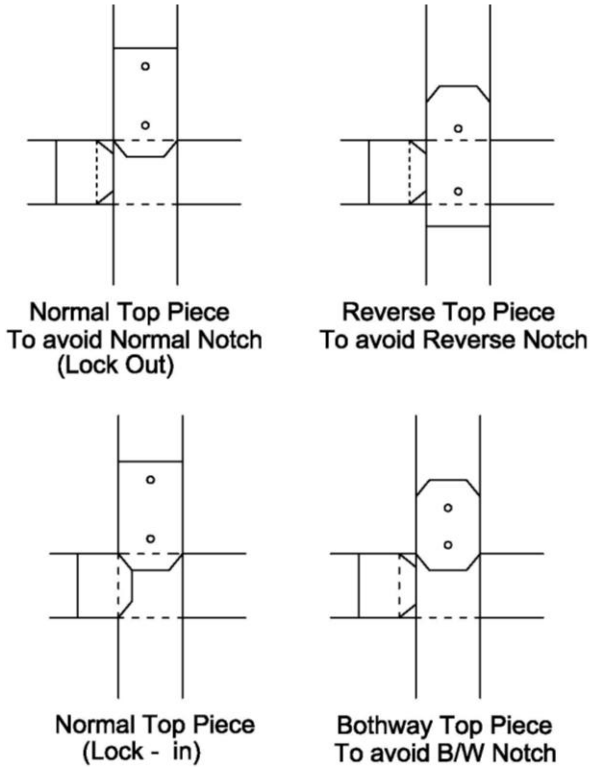


Fig. 6.20 (b) USE OF TOP-PIECES

6.21 HINTS FOR PREPARING LOCKING DIAGRAM

The locking diagram is to be prepared based on approved locking table. The following steps are to be followed for preparing the locking diagram.

Step 1: As the converse locking is automatically achieved in mechanical locking, the converse locking is to be deleted (striked out) from the locking table. As the converse locking of “Released By” column reflects in the “Releases” column, the entire “Releases” column can be deleted. In “Locks Normal” column, converse locking is to be cancelled carefully. “Locks both ways” column remains as it is since there is no converse locking for “Locks Both ways”.

Step 2: Grouping: The special locking (conditional locking) is to be brought out and written separately. Any direct locking, which can be grouped, with the conditional locking is to be written in the same group.

Step 3: Other Lockings are to be grouped properly duly applying the rules for grouping.

Step 4: Both ways locking is to be provided first in the locking diagram allotting the first channel for it as far as possible or in the last channel as second preference. This enables reduction of fouling.

Step 5: Then conditional locking is to be provided first as there are more restrictions for providing swingers.

Step 6: Other Lockings are to be provided duly taking care of fouling notches, fouling of swingers and all other guidelines as specified in Para 6.19(b).

Step 7: After completion, the locking diagram is to be checked with the Locking Table to find out any missed locking/duplicated locking.

6.22 A worked out example is given in the following figure 6.22

6.22.1

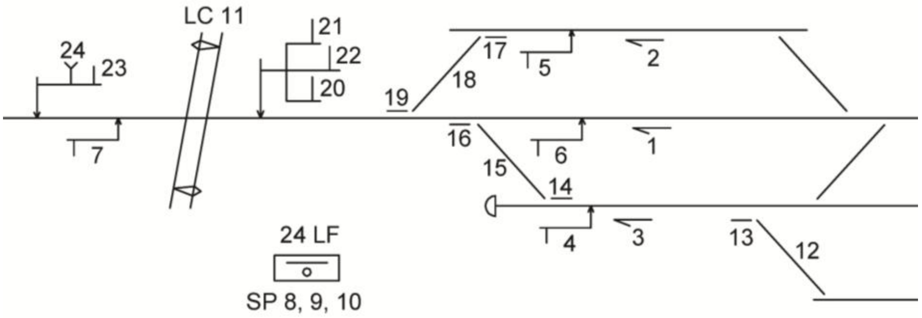


Fig. 6.22

Locking Table referred to 6.22

Sl. No	Released by	Locks Normal	Locks B/W	Releases
1.	--	3,15,16,18	--	--
2.	17	3	--	--
3.	14	1,2,12,22	--	--
4.	14,15	12	--	--
5.	17	--	--	--
6.	--	15,16,18	--	--
7	11	16,19	15,18	
8,9,10	Spare			
11	-	-	-	7,20,21,22
12	15	3,4,7,20	-	-
13	-	14	12	(16W15R)
14	-	13	15	3,4
15	-	1,6,18,22	-	4,12,20
16	(13W15R)	1,6,7	15	(19W18N)
17	18	19	-	2,5
18	-	1,6,15,22	-	17,21
19	(16W18N)	7,17	18	20,21,22
20	11,15,19	12	-	(23)
21	11,18,19	-	-	(23)
22	11,19	3,15,18		(23),24
23	(20 or 21 or 22)	-	-	24
24	22,23	-	-	-

Grouping:

1. First group conditional lockings as they are required to be provided with swingers.
2. Plan both ways locking to be provided in first and last channels to avoid fouling of notches.
3. Ignore the levers in releases column.
4. While doing the grouping strike out the levers with pencil to avoid duplicate grouping.

6.22.1 GROUPING

(a) Channel – A

$$\begin{pmatrix} 1,2 \times 3 \\ 7 \times 15 \;\; 18 \\ 14,16 \times 15 \\ 19 \times 18 \\ 13 \times 12 \\ 24 \div 22,23 \end{pmatrix}$$

(b) Channel –B

$$\begin{pmatrix} 2,5 \div 17 \\ 23 \div (20 \text{ or } 21 \text{ or } 22) \end{pmatrix}$$

(c) Channel – C

$$\begin{bmatrix} 1,6 \times 15,16,18 \\ 7 \div 11 \\ 20,21,22 \div 19,11 \\ 17 \times 19 \end{bmatrix}$$

(d) Channel – D

$$\begin{bmatrix} 3,4. \times 12 \\ 3,4 \div 14 \\ 19 \div (16\text{W}18\text{ N}) \end{bmatrix}$$

(e) Channel – E

$$\begin{bmatrix} 16 \div (13\text{W}15\text{R}) \\ 15 \times 18 \end{bmatrix}$$

(f) Channel - F

$$\begin{bmatrix} 4,12,20 \div 15 \\ 7 \times 16,19 \end{bmatrix}$$

(g) Channel – G

$$\begin{bmatrix} 17, 21 \div 18 \\ 13 \times 14 \end{bmatrix}$$

(h) Channel – H

$$\begin{bmatrix} 3,15,18 \times 22 \\ 12 \times 7,20 \end{bmatrix}$$

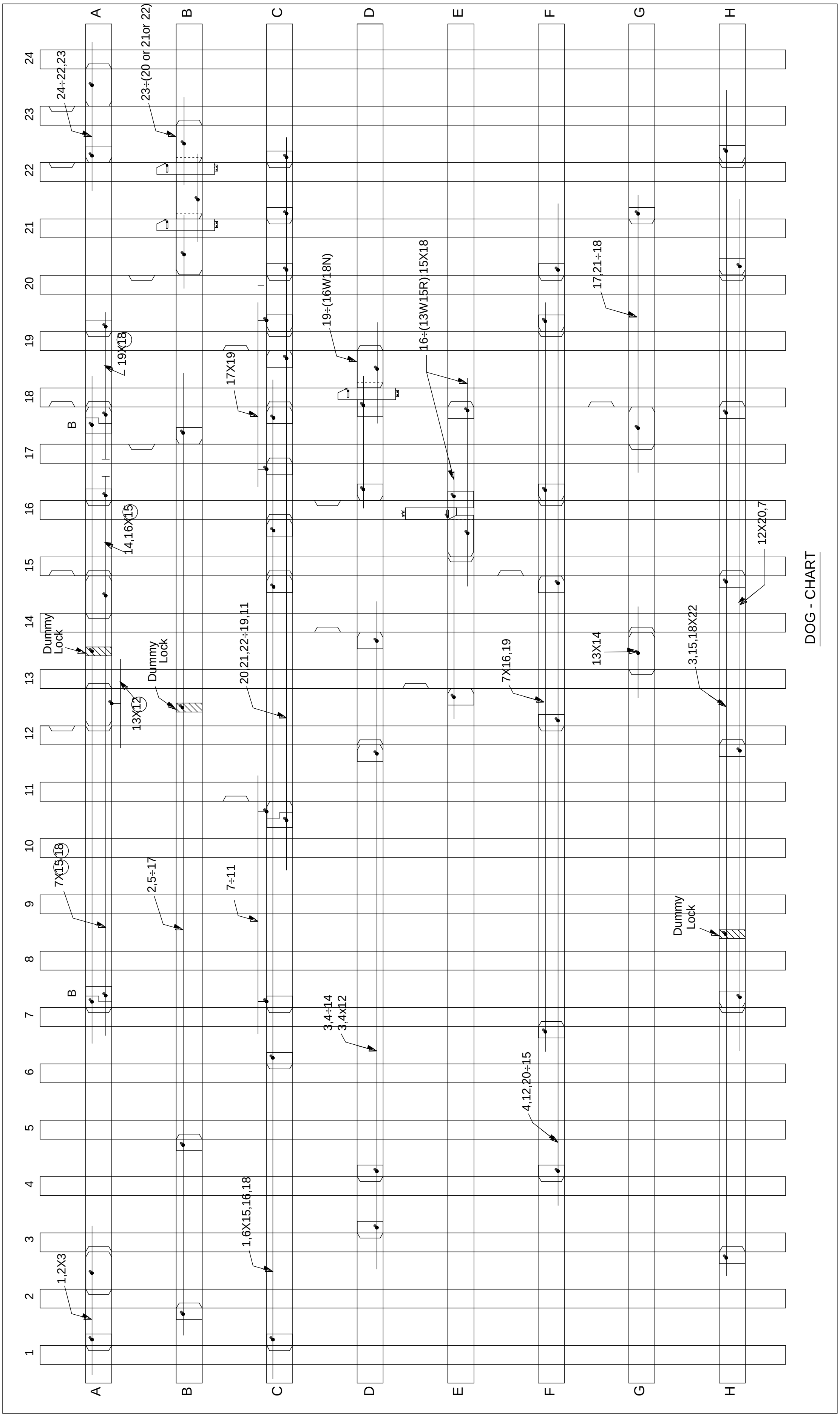


Fig 6.23 Locking Diagram for Locking Table (Refer to fig. 6.22)

CHAPTER – 7
TESTING OF LOCKING

7.1 Locking of interlocking frames must be tested at least once in a year or earlier. Locking should also be tested before opening new installations, and when any addition or alteration to the existing locking is carried out and also immediately after overhauling, prior to commencement of normal working, (Para 13.12 of SEM part-2).

7.2 Testing of locking is necessary to ascertain that the locking provided is correct and is in accordance with the locking table, Before commencing the testing, all the levers Must be placed in their normal position and this should begin from lever No.1 in the consecutive order. After testing a particular locking its converse must be tested immediately.

7.3 There are two methods of testing the lockings (Para 13.15SEM part-2)

(a) Against the interlocking table, and

(b) Against the Signalling plan

Preliminary test is done by a physical check marking the position of each lock and notch, lever wise and channel wise in the copy of approved interlocking diagrarn. When every thing is found correct as per the diagram, Pull test is conducted with reference to the locking table. By conducting pull test any hidden and false notch, which could not be noticed, or notches, which are out of phase to the locks, can be detected and correctness of locking is verified.

7.4 The number in which the locking is tested is explained below. (Keep all levers normal unless it is specified while testing).

(a) 1 Locks 2 statement

Action	Lever no	Result / inference
Pull	1	1is in Reverse
Try	2	2 is locked
Put back	1	1 is in Normal
Pull	2	2 is in Reverse
Try	1	1is locked
----	----	1 locks2 and 2 locks 1 verified

(b) 1Rby 2 (1 back locks 2) statement

Action	Lever no	Result / inference
Try	1	1 is locked
Pull	2	2 is in reverse
Try	1	1is free; 1is pulled
Try to put back	2	2 is back locked
Put back	1	1 is in normal
Try to put back	2	2 is free; 2 is in normal
--	--	1is Released by 2 (1 back locks 2 is verified)

(c) 1Locks 2 both ways

Action	Lever no	Result / inference
Pull	1	1 is in Reverse
Try	2	2 is locked in Normal
Put back	1	1 is in Normal
Pull	2	2 will come, 2 is in Reverse
Pull	1	1 is in Reverse
Try to put back	2	2 is locked in Reverse
Put back	1	1 is in Normal
--	--	1 Locks 2 both ways is verified

7.5 When the locking relation is between more than two levers then each relation must be tested separately, is explained below.

(a) 1 Locks 2,3,4

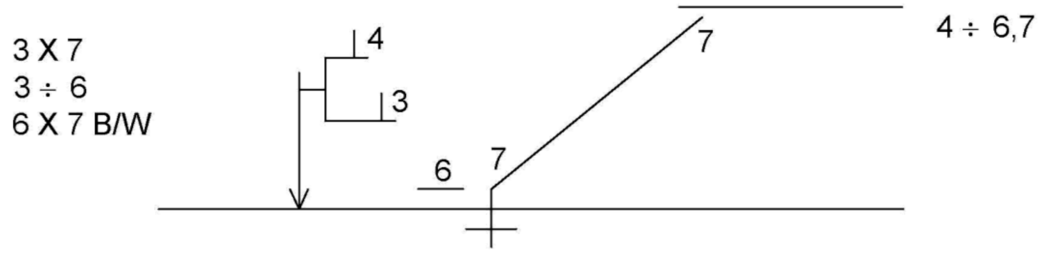
Action	Lever no	Result / inference
pull	1	1 is in Reverse
Try to pull	2,3,4 individually	2,3,4 are locked
Put back	1	1 is in Normal
Pull	2	2 is in Reverse
Try	1	1 is locked
Put back	2	2 is in Normal
Pull	3	3 is in Reverse
Try	1	1 is locked
Put back	3	3 is in Normal
Pull	4	4 is in Reverse
Try	1	1 is locked
Put back	4	4 is in Normal
--	--	1 locks 2,3,4 is verified and 2,3,4 locks 1 is verified.

(b) 1Rby 2,3,4

Action	**Lever no**	**Result / inference**
Try	1	1 is locked
Pull	2,3	2,3 are in reverse
Try	1	1 is locked
Put back	3	3 is in Normal
Pull	4	2,4 are in reverse
Try	1	1 is locked
Put back	2	2 is in Normal
Pull	3	3,4 are in reverse
Try	1	1 is locked
Pull	2	Now 2,3,4 are in reverse
Try	1	1 is free
Pull	1	1 is in reverse
Try to put back	2,3,4	2,3,4 are back locked
--	--	1 is released by (back locks) 2,3,4 is verified

7.6 From the above tests it may be noted that each locking is tested, by keeping other two levers in reverse position on rotation, so that only one locking relation exists at a time. For example if 3 and 4 are in reverse position then only 1 R by 2, locking exists. Similarly in case of normal locking as explained in 8.5 (a) above, other two levers on rotation have to be kept in normal position and only one lever is pulled at a time. Similar procedure has to be adopted to test each locking if the locking is extended to some more levers.

7.7 Locking table does not indicate name of the functions. Therefore, reference to the yard diagram is necessary as testing of locking between (i) signal and signals i.e., Warner is released by all relative main line signals and a signal locks the conflicting signals (ii) Signal and the points in the route etc. have to be essentially tested as given in 13.18.3 of SEM and this locking1 back locking can ordinarily be tested as explained in Para 8.5 above. But while testing locking between signal lever and point lever it is required to know whether point in the route of the signal is facing or trailing. If the point is facing then the locking between signal lever and the facing point lever can not be directly tested, for example 3 locks 7 can not be tested directly, because. Before 3, lever No.6 has to be reversed, after reversing 6 if 3 is reversed we can not say 7 is locked because of 3, when 6 has already locked it. In such cases the locking may be tested as below.



Keep all levers normal.

Try 3. 4. 6. And 7

3 and 4 are locked 6 and 7 are free

(a) Pull 6 try 3, 4 and 7

4 and 7 are locked. 3 is free, Pull 3

see that 6 is back locked

put back 3 then 6.

(b) Now Pull 7 try 3,4 and 6

3 and 4 are locked 6 is free

Pull 6 try 3, 4 and 7

3 is locked, 7 is back locked 4 is free

Pull 4 see that 6 is back locked.

Put back 4 then 6 and then 7.

7.8 TESTING OF CONDITIONAL /SPECIAL LOCKING

(a) 1 Locks (3W2N) (first satisfy the condition and test the locking)

Action	Lever no	Result / inference
--	--	2 is in normal
Pull	1	1 is in reverse
Try	3	3 is locked
--	--	1 locks 3 when 2 is in normal is verified
Pull	2	2 is in reverse (condition is destroyed)
Pull	1	1 is in reverse
Try	3	3 is free 3 is reversed
--	--	1 does not lock 3 when 2 is in reverse (since condition is destroyed)is verified

(b) 1 Locks (3W2R) (first satisfy the condition and test the locking)

Action	Lever no	Result / inference
pull	2	2 is reversed (create the condition first)
Pull	1	1 is in Reverse
Try	3	3 is locked
--	--	1 locks 3 when 2 is in reverse is verified
Put back	2	2 is in normal (condition is destroyed)
Pull	1	1 is in reverse
Try	3	3 is free; 3 is reversed
--	--	1 does not lock 3 when 2 is in normal (since condition is destroyed) is verified

(c) 1Rby(3W2N) (first satisfy the condition and test the locking)

Action	Lever no	Result / inference
--	--	2 is in normal
Try	1	1 is locked
Pull	3	3 is in reverse
Try	1	1 is free
Pull	1	1 is in reverse
--	--	1 is released by 3 when 2 is in normal verified
Try to put back	3	3 cannot be put back normal hence 1 back locks is verified
Put back	1	1 is in normal position
Put back	3	3 is in normal position

(d) 1Rby(4W2N3N) (If the condition imposing levers are two or more, first satisfy all the conditions then break the condition one by one).

Action	Lever no	Result / inference
--	--	2 is in normal,3 is normal
Try	1	1 is locked
Pull	4	4 is in reverse
Try	1	1 is free
Pull	1	1 is in reverse
Try to put back	4	4 is back locked (during 2 is in normal,3 is in normal verified)
Put back	1	1 is in normal
Try to put back	4	4 is free
Put back	4	4 is in normal
Pull	2	2 is in reverse, 3 is in normal
Try	1	1 is free; 1 is reversed 1 is not released by 4 during 2 is in reverse, 3 is in normal since condition of 2 is destroyed
Put back	1	1 is in normal
Put back	2	2 is in normal
Pull	3	3 is in reverse, 2 is in normal
Try	1	1 is free; 1 is reversed 1 is not released by 4 during 3 is in reverse,2 is in normal since condition of 3 is destroyed
Put back	1	1 is in normal

Note: - *Testing of 1Rby (2 or 3 or 4) is the same as 1Rby(4W2N.3N).*

7.9 The above examples of testing reveals the general principle involved in testing. Any wrong assumption may give the wrong inference being drawn from the test. For a large lever frame a pre-prepared test chart may be kept available to facilitate the testing and locking for all future dates to avoid Confusion (Para 13.19 SEM part-2).

* * *

ANNEXURE-1
LOCKING DIAGRAM - FOR DIRECT LOCKING TYPE LEVER FRAME
(SA530/M)

1. THE LOCKING TRAYS ARE AVAILABLE IN FOLLOWING SIZES

5 levers - 4 channels

7 levers - 4 channels

5 levers - 1 channel

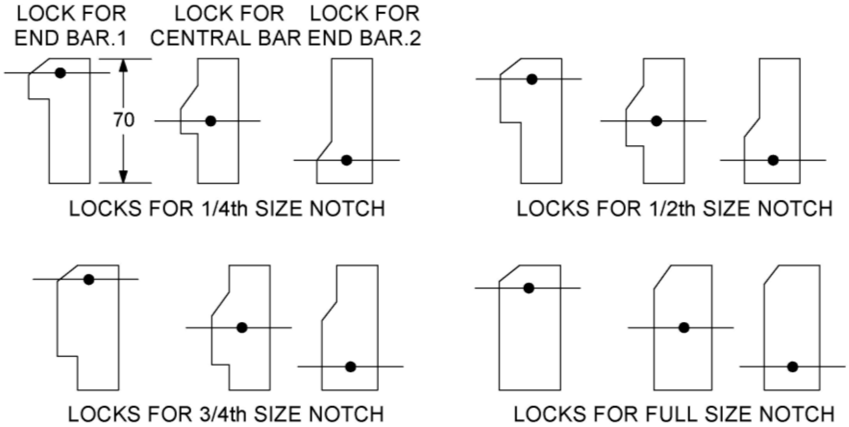
7 levers - 1 channel

If more channels are required, the trays can be placed in the front and rear of the lever frame. Hence the maximum number of channels that can be used is, 4 front and 4 rear, i.e., 8 channels from front to back with respect to leverman facing the lever frame. The stroke of the tappet is 346mm when the lever is operated from normal to reverse and the pitch of the channel is 110 mm. If a notch is cut in the first channel this will pass through all the remaining three channels. There are various types and shapes of locks, the locks having locking face one side is referred to as "single lock", and that which has locking faces both sides, to be used in between adjacent tappets is a "double lock". The length of a lock is 70 mm (i.e., width of the channel) allowing the use of a maximum of three stops of 1/3 size in a channel and the thickness of lock is 16 mm same as the tappet. The number of bridle bars is 6 (i.e., 3 top - 3 bottom). All these salient features of direct locking type lever frame, give better scope for grouping and economising of lockings. Therefore the locking diagram is all-together different from Single wire catch handle type.

2. TO AVOID THE FOULING NOTCHES

(a) If the notches and locks in all the channels are of same size then the notches will be dead fouling. To avoid this 4 different sizes of notches are cut corresponding to their channels. Viz. 1/4, 1/2, 3/4 and full size of the channel width and to suit the size of the notch the size of the locking face of a lock is also designed to 4 sizes and the position of locking face depends upon the bridle bar connection (whether it is connected to the end bar 1, central bar or end bar 2) which decides the shape of the locks, top bar / bottom bar makes no difference as the locks are reversible. See fig. 7.2 (a) the locks shown in the figure are "single lock", for "double locks" the locking face is both sides their position depends on bridle bar connection and size depends on the channel in which it is fitted. They are large in numbers, hence figures for all types of locks not illustrated.

(b) To avoid the fouling of notches these 4 different sizes are so designed that the bigger notch should not pass through -the smaller face of the lock, whereas smaller notch can, pass the bigger face of the lock. Fig 7.2(b) shows the arrangement to avoid the fouling in case of normal locking and release locking.



All locks are of reversible type, can be used for normal locking or release locking, on top bars or bottom bars (to save the duplication of store).

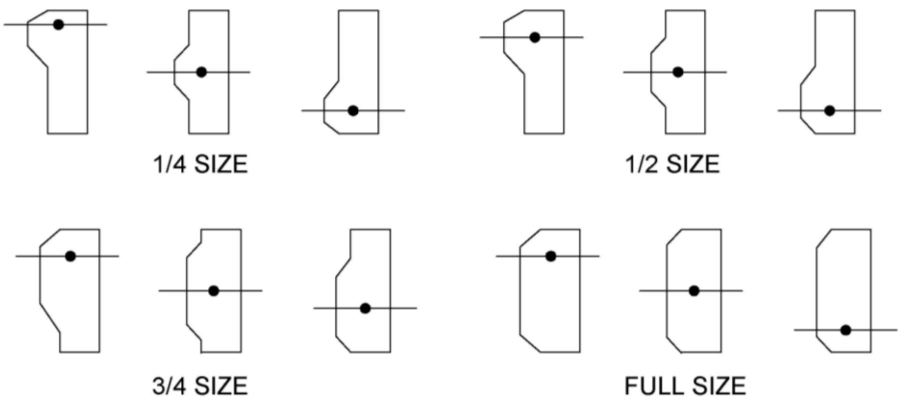


Fig.7.2 (a) LOCKS FOR BOTHWAY LOCKING

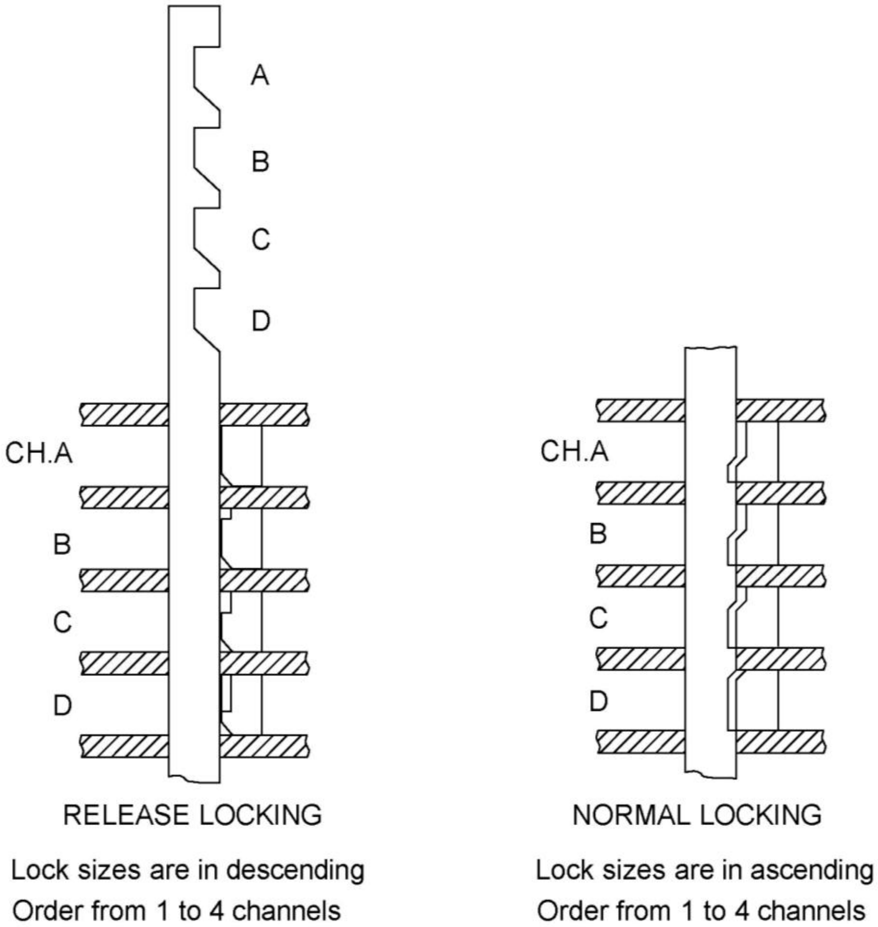
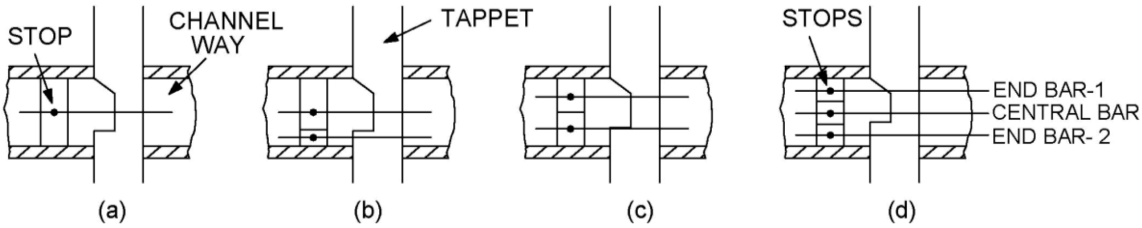


Fig: 7.2 (b) AVOIDING FOULING OF NOTCHES

3. For economising the interlocking, an arrangement similar to lock butts in catch handle type locking, but with certain modifications, are used. In direct type interlocking these are called as "Stops". These stops can be used on "Single Locks" only. These stops are of four different sizes viz. 1/3, 1/2, 2/3 and full as compared with the width of the channel. Each stop can be riveted to one briddle bar only**.** Similar to a lock butt, there is no rigid connection between a stop and the full lock, but by virtue of their closeness to each other, they may or may not actuate each other depending upon the direction of their respective movement, The necessity for different sizes of stops is to ensure that the channel width, adjacent to the lock, is fully occupied and the stop would not go out of alignment due to bending of bridle bar.



For example (see figures above)

(a)	One stop only to be used (can be riveted to end bar/ central bar)	Full size stop
(b)	Two stops connected to middle bar and one of the end bar	2/3 stop1,1/3 stop1
(c)	Two stops - connected to the two end bars	1/2 stops – 2 no
(d)	Three stops - connected to three bars	1/3 stops – 3 no

A Maximum number of 3 stops only can be used on any single lock.

Lever pitch	125 mm
Pitch of channel	110 mm
Width of channel	70
Width of tappet	45
Thickness of tappet	16
No. of briddle bars	3+3=6 per channel 16x12mm size

4. THE DIAMOND SPECIAL

In the Direct Locking Type Lever Frame (SA 530/M) diamond specials are used to achieve the special locking. Seven locks (671 A-G) have been designed to make different combinations. (See Fig. 7.4 a&b) The diamond special consists of six locks in which diamonds D&E are common and so placed in the centre that they have four locks at all the 4 sides and these four locks do not have direct contact to each other, therefore, they do not actuate directly, but by pressing of the diamonds. The diamonds together with other 4 locks are placed in the clear space between two adjacent tappets in a channel. As shown in figure below, various combinations namely B.C.C.C and B.C.A.C and F.C.C.G. can be used. Out of these, F.C.C.G is used when diamond special is between locking lever and condition lever when they are adjacent and the locking is in compression. For proper actuation of these diamond locks it has to be ensured that

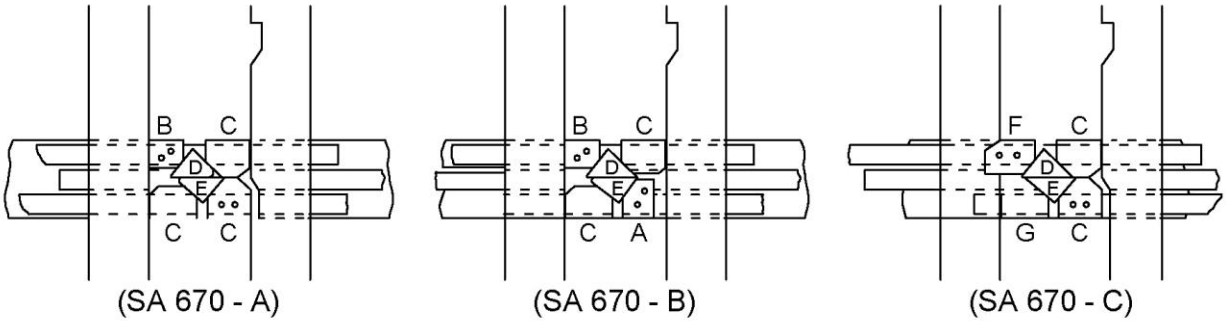


Fig: 7.4 (a) DIFFERENT COMBINATIONS OF DIAMOND SPECIALS

(a) They should have all the three bottoms bars underneath.

(b) When any lock is pressing the diamonds (D&E) at that time one lock among the other three locks should be allowed to move, and other two should be constant.

(c) All the locks around the diamonds (D&E) should always remain in contact with the diamonds.

(d) There should not be any such situation, where due to the position of related levers, which may give way for two or three locks to move at the same time. If it is so, then this will create unwanted space between the locks and the diamonds. Thus the diamonds may slip from their positions and get entangled with the locks around it.

For example: -

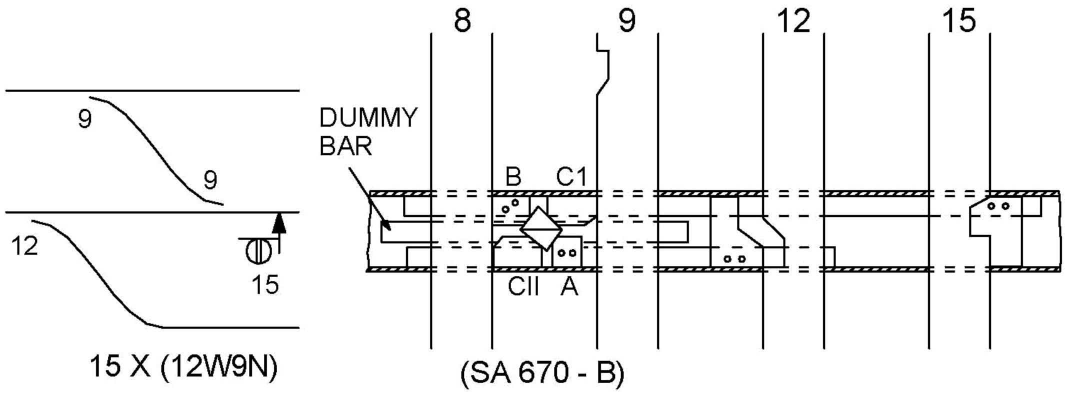
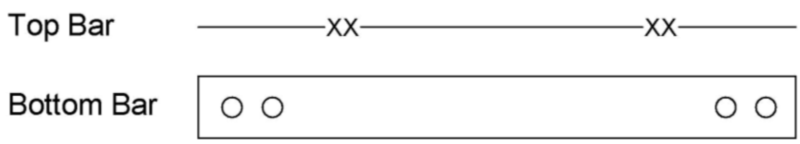


Fig: 7.4 b

When lever No. 15 is reversed the lock 'B' is pressing the diamonds. When 9 is normal at that - time locks 'C-I' and 'C-II' both are constant and lock 'A' will have full actuation of 12mm. Thus 15 x 12 is effected, conversely when 12 is reversed the lock A should press back the diamonds and 'B' lock should return back to its original position and Lock 15 normal. This is possible only when 'C-I' and 'C-II' remain constant. Supposing if lever 12 is in normal and lever 9 is reverse, the locks 'CI' and 'A'/B', two locks at a time are free, if they move away from the diamonds, the diamonds may loose their positions as explained above. However, this situation is obviated if there is interlocking between 9 & 12 as 9 R.by 12 in the same frame is provided. Otherwise instead of 'A' lock, 'C' lock with a normal notch on 9 has to be used and at that time 15 lock 9 B/W is achieved which might be redundant are if already provided elsewhere, can be repeated.

5. The general principles for making a locking diagram, grouping economising of locking is same as the C.H. type lever frame except for the difference in selecting the locks and notches of different sizes according to the channel and according to the bar connection. The purpose of using "stops" is same as using lock butts. Because lot of leverage is acting on locks and on bridle bar, distant lockings shall preferably be connected in tension. In the event of wrong operation of lever forcibly causes buckling of bar keeping opposite locks outside the notches and failure of locking will be Unsafe.

6. This lever frame is not designed to use swingers, but in place of "swinger locks" "Diamond Locks" are used. Adopting the same formulae that, number of diamond locks is equal to number of condition imposing levers, usually diamond locks are used in the second channel or in single channel tray, taking care of fouling notches, because size of diamond locks can not be altered to suit the size of the notch. All the three bottom bars must be provided underneath the diamond locks, if any lock is not connected must be secured by connecting dummy bar. In the locking diagrams bottom bar and top bar connections are shown as below.



* * *

ANNEXURE - 2
INTERLOCKING IN DOUBLE WIRE SIGNALLING

1. SIZE OF LEVERFRAME AND NUMBERING THE FUNCTIONS

2. Like single wire installations as discussed in the chapter-1 of section 'A' of this notes, complete signalling arrangements for D.W. Lever frame to suit standard of interlocking, class of station etc. as required are first shown in the plan then the correct size of the lever frame is decided. While deciding the size of lever frame the following additional points have to be borne in mind.

3. (a) Number of levers required for operating / controlling the functions

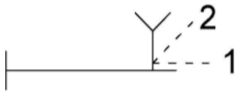
(b) The type of lever to be used

(c) Coupling of levers (Pull - Pull or Push - Pull) to save the wire transmission.

The above three factors for signals, points and detectors etc. may be decided as explained in the following examples.

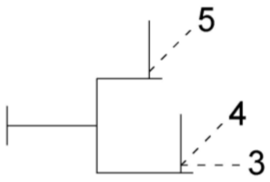
4 . SIGNALS

For each 'OFF' aspect, one lever is required. After the introduction of electric signal reversers, signals are operated by direct levers only. If unless there is a detector in the signal transmission clutch lever is used.



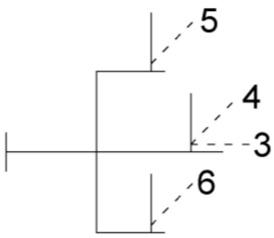
DISTANT SIGNAL

Two direct levers, one coupled Transmission (Pull - Pull or Push - Pull) (0-45-90) or (45-0-90) (see Para 9.4.3)



2 DOLL

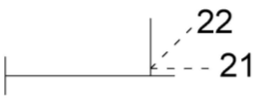
3 direct levers and 2 transmissions
One single for signal 5 (0-0-45) one coupled for signal (3&4) Pull -Pull (0-45 -90)



3 DOLL

HOME SIGNALS

4 direct levers and 2 coupled transmissions (3&4) Pull - Pull(0-45-90)
(5&6) Push pull (45-0-45) (See Para 9.4.1)



MAINLINE STARTER

2 direct levers and 1 coupled transmissions.
i.e., (21&22) Push - Pull (45-0-90)

LOOP STARTER

1 direct lever and 1 single transmission.
i.e.,(0-0-45)

***Note:-**Two Loop starters which are on separate posts and on separate lines can be coupled provided that,*

(a) The physical distance between the two signal mechanisms is not exceeding 73 meters.

(b) *There is no detector in their transmission*.

1 direct lever and single transmission (0-0-90)

ADVANCED STARTER

4.1 COUPLING OF SIGNAL TRANSMISSIONS

The main line home 45 and 90 aspects are operated with pull-pull coupling. Push-pull coupling is not adopted for this signal because of the following reasons. In certain cases of run through trains, it may be necessary to take the main home signal to 45 only and then from 45 to 90 after the receipt of line clear for the section ahead. If push-pull coupling is adopted the signal has to be first put back to 'ON' in the face of an approaching train before taking 'OFF' the same to 90. This requires that the distant also should be put back to 'ON' because of the interlocking between Distant and Home signals. This would cause much confusion to an approaching Loco Pilot. This would not be necessary when pull-pull coupling is adopted in which case the signal could be taken to 90 from 45 without being put back to 'ON'.

4.2 The main line starter is generally coupled push-pull in which case 45 aspect is used for shunting and 90 is used for dispatch.

4.3 In the case of distant signal either pull-pull or push-pull coupling may be used. The advantage and disadvantage in either case is as follows: -

When the distant signal is coupled pull-pull the interlocking would be as given below.

Main line Home 45 aspect and its own 45 aspect release distant 90 aspect and 45 aspect is released by any one of the Home signals 45 aspect.

From the above it may be seen that if the cabin man does not operate the 90 aspect of the distant signal when main line home is taken 'OFF' the aspects displayed by Home and Distant signals would be misleading (i.e., Distant would show attention aspect when main home is OFF). This is a disadvantage.

The advantage in this case would be easy operation of the signal as the stroke of two levers is available to clear the distant signal from 0 to 90 due to successive operation of two levers. In the case of push-pull coupling the interlocking would be distant 90 aspect is released by main Home 45 aspect and distant 45 aspect is released by any one of the loop line homes 45. The advantage in this case is the aspects displayed by home and distant signals would correspond with the line on which the train is being received (i.e., distant - would show 90 aspect only when main home is taken OFF and attention where a loop home is taken 'OFF').

The disadvantage would be that the distant signal might work hard as it has to be directly operated from 0 to 90 with stroke of one lever and due to loss of stroke in the long transmission, the distant may not reach to 90.

5 POINTS

In D.W. installations points can be operated by wire transmission using economical facing point mechanism, or by rod transmission using rack & pinion lever. When the points are operated by D.W., for each mechanism one clutch lever and separate wire transmission is required. The point levers can not be coupled. In this arrangement the point and its associated Lockbar is operated by same lever and both ends of the crossover are in locked position whether the point is normal or reverse.

9.5.1 Now a days due to increasing demand of longer loop lines to accommodate longer trains, the central cabin working for operation of points, signals etc., became unsatisfactory. As per Para 7.60 of SEM part-I "In all new installations points, locks and bar shall not be operated by wire" and Para 7.61 "Points when mechanically operated shall not be locked by the same lever". So considering these factors in the mechanical yards, end cabin working with points and Lockbars operated by rodding using separate rack & pinion levers, signals & detectors operated by double wire is the present day practice. This will eliminate the key transmitting arrangement for route holding while using electric Lever Lock / route lever key between cabin & SM. This can be simply achieved by providing holding bar if necessary and successive lockbar locking.

6 DETECTORS

Unlike single wire installations wherein the detectors of facing points are connected in series of the concerned signal transmission, separate levers have to be used for operating the detectors in double wire. This is due to the limitation that more than one detector can not be connected in signal transmission, and also the limitation on maximum permissible distance between the signal mechanism and the detector to be within 215 meters. The provision of detectors given in the standard of interlocking as minimum requirement, should be clearly understood and indicated in the signalling plan or by a table of detection.

6.1 There are two types of detectors in D.W

(a) Single wheel detector, which proves the correct setting of switch rail to the stock rail, but does not prove the position of point normal or reverse.

(b) The double wheel detector, which proves the correct setting of switch rail to the stock rail and also proves the point normal or reverse(i.e.,route).

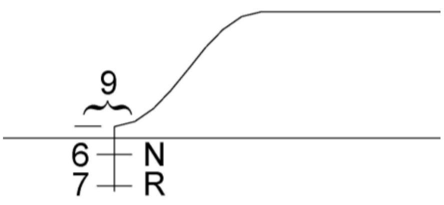
6.2 The requirement of detectors is as given below

(a) Where points are operated by D.W. clutch levers. All such points whether facing or trailing in the route of a running signal have to be detected and the points which maintain isolation are also to be detected.

(b) Where points are operated by rodding, only facing points in the route of running signals have to be detected.

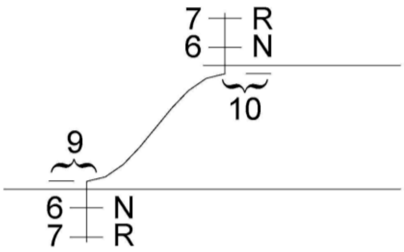
(c) Where facing points are already provided with facing point lock need not be detected for shunt signal.

6.3 IN ECONOMICAL FACING POINT LAYOUTS



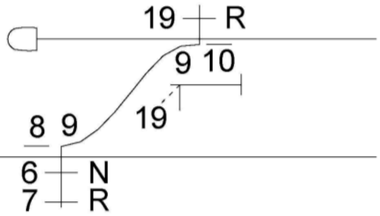
NON-ISOLATED LINES

No. of detectors	1
Type of detectors	Double wheel
No. of clutch levers	2
No. of transmissions	1 (Push - Pull)



(a)

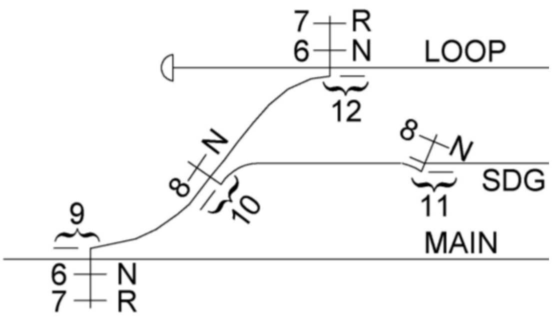
No. of detector	2
Type of detectors	Double wheel
No. of clutch levers	2
No. of transmissions	1 (Push-Pull)



(b)

Note: - Although Point No. 10 is required Reverse only for all movements over 10, But required to be proved in normal for Isolation (fig. a)

ISOLATED LINES



(c)

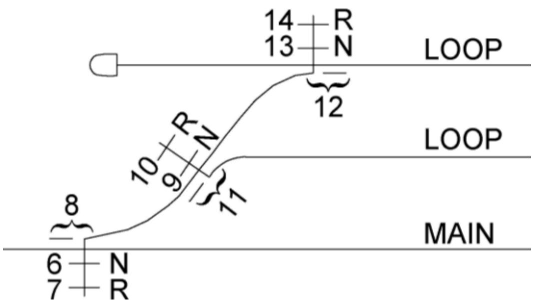
No. of detectors	2 + 2 = 4
Type of detectors	2 SW+ 2 DW
No. of clutch levers	3
No. of transmissions	2(1 coupled, 1 single)

Note:-

(a) Siding points 10 & 11 are not provided with R detector because the point is required reverse for shunting only.

(b) Points 9.10.12 are required to be detected in the route of the running signals whereas point 11 has to be proved in 'N' for isolation.

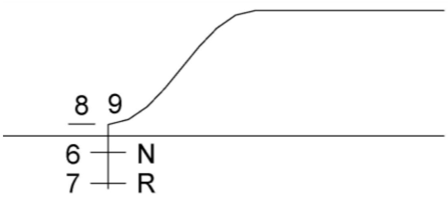
(c) As per the diagram below Since detectors are not to be operated while shunting therefore it is feasible to operate both the double wheel detectors of point No.9 & 12 by the same levers. Otherwise there may be an occasion when the point No. 8 is reverse and point 12 is normal. At that time it is impossible to operate the detectors of both sides by same levers.



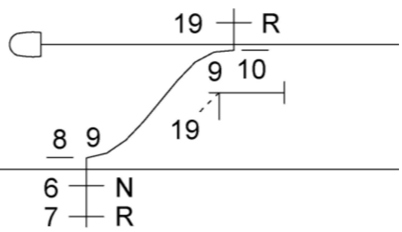
No. of detectors	3
Type of detectors	Double wheel
No. of clutch levers	6
No. of transmissions	3 (coupled)

Note: *In this layout when point 8 and 11 are reversed point No. 12 remains normal. Therefore double wheels of point No. 8 and same levers cannot operate point No. 12.*

6.4 IN NON-ECONOMICAL F.P.LAYOUTS

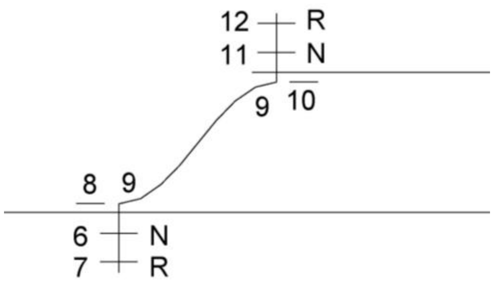


No. of detectors	1
Type of detectors	Double wheel
No. of clutch levers	2
No. of transmissions	1 (coupled)



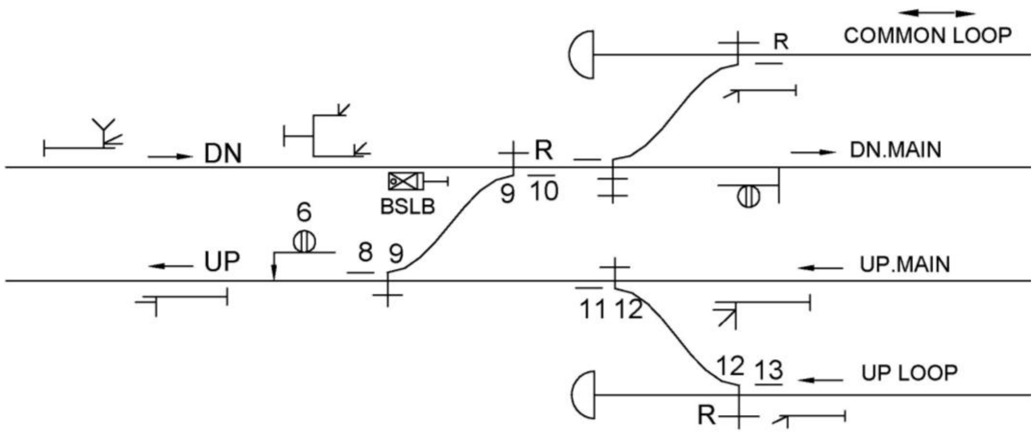
No. of detectors	1+1 = 2
Type of detectors	D.W & 1 S.W
No. of clutch levers	2
No. of transmissions	1(6&7) Push - pull

Note: -*'R' detector of point No. 9 on the loop line is in the transmission of signal No. 19. Since points are rod operated, detection of trailing point in the route is not compulsory.*

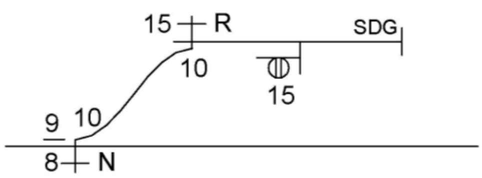


No. of detectors	2
Type of detectors	Double wheel
No. of clutch levers	4
No. of transmissions	2 (Push Pull)

Note :-*It is better to operate the doublewheel detectors of both ends of point No. 9 by separate levers because only facing end is locked and the trailing end is not locked, (detector can move only after the point is set and locked).*



Point No. 9 & 12 on up line are trailing points for all running signals but facing for shunt signal No.6. So lockbars 8 and 11 are provided instead of detecting the points for shunt signal on the running lines (See Para 7.63 of SEM part-1)



Facing point No.10 from siding end it is desirable to detect by the relative shunt signal (single switch detection is enough) (See Para 7.63.3. of SEM part-1)).

7 In a single line MAUQ installations the home signal is at 300 meters from the first facing point which it protects. In accordance with Para 7.83.1 of Signal Engineering Manual (1988)(as explained in Section 'A' of the notes) special methods for route holding are necessary as the distance between the point and the signal is more than 180 meters. As discussed earlier where the points are operated by double wire transmission the points and the associated Lockbar is operated by one lever and hence successive Lockbar locking is not possible. Therefore, other methods are adopted for holding route in such cases. One method of achieving this is by providing a separate route lever for reception on each road. After operating the points and detector lever for reception on any particular road the corresponding route lever is operated to the reverse position. Due to interlocking provided between these levers, the reversal of route lever locks the points and detector levers in the position in which they are already set.

Only after operating the route lever to the reverse position a route key can be extracted from the route lever, the extraction of which locks the route lever in the reverse position. The route key is then taken to the station Master's Office and is inserted in the Station Master's lock up box, only, after which the corresponding Home Signal Key can be taken out from this box. The removal of the Home Signal Key locks up the route key in the lock up box. The Home Signal lever can be reversed only after it is unlocked by the Home Signal Key and when the Home Signal Lever is reversed the Home Signal Key gets locked in the lever. To alter the position of point the sequence of operation has to be gone through in the reverse order and the time involved in the operation is large enough and by the time the point could be altered, the train would have cleared the route.

7.1 Another arrangement adopted for holding the route is to provide one route lever for reception from each direction, the route lever being common for all roads. The interlocking between the route lever and the points and the detectors is similar to what is described in the case above. The only difference is that, after all the point levers and corresponding detector levers are correctly operated for any given route, then only it will be possible to operate the route lever to reverse position. Once the route lever is operated to reverse position, the electric lever lock which is provided on the route lever locks the lever in that position. To put the route lever back to 'Normal' position, one of the slides of the SM's control nominated for this purpose should be operated so as to release the Electric lever lock and then only the route lever can be normalized. The SM should operate the control slide only after ensuring that the complete train has arrived.

7.2 The ultimate purpose of any of these arrangements is to ensure that once a train has passed a signal in the OFF position, it should not be possible to alter the route before the train has cleared the points.

7.3 Due to interlocking provided between route lever and points it will not be possible for altering the route unless the route lever is put back first. In this way route holding is ensured.

7.4 Because of the dual control involved in normalizing the route lever, it is expected that the time involved in exchanging messages between the Cabin man and the SM and the actual operation of the SM's Control slide (or exchanging of keys in case of key interlocking box arrangement), route lever etc, will give sufficient time for the train to clear the points before any attempt could be made to alter the points. Also, since the cooperation of the Cabin man and SM is necessary to alter the route, the possibility of attempting to alter the route due to one man's fault is eliminated and route holding is ensured.

7.5 As route lever requires no transmission and is required only for purpose of interlocking with points, detector and signal levers, a miniature lever is provided for this purpose, where independent route levers are provided for each road a two position miniature lever can be used for each one of the routes or a three position miniature lever can be used for two routes the push position of the lever for one route and the pull position for the other. Where common route levers are used for all roads one lever is provided for up direction and another lever for down direction. If simultaneous reception facility is not available then one 3-position miniature lever can be used as route lever for reception of trains of both up and down directions on all roads.

7.6 In double wire installations having end cabins, the points and FP locks are generally operated by separate levers by rodding transmission. In such cases Lockbar to Lockbar locking is possible. Therefore, route holding is achieved by providing route-holding bars wherever necessary.

8 Unlike the single wire lever frame where all the levers are of the same type, double wire lever frames can have the following four types of levers:

(a) Clutch lever

(b) Direct lever

(c) Miniature lever (Three position or two position)

(d) Rack and Pinion lever

8.1 While numbering a yard the type of lever that is provided for the various functions should also be specified. The practice on the Railways may be slightly different from each other. Rough guidelines for choosing the type of lever for the different functions are as under:

8.2 As described in detail in the notes on double wire and as described in Chapter I0 of this notes, a clutch lever can detect the out of correspondence between the positions of the operating lever and the operated function. The out of correspondence can be transfered into a locking stroke on the locking plunger of the lever and consequently can be made use of for interlocking purposes. For example, if the transmission of a point lever is defective, say broken, the operation of the point lever may not result in the correct operation of the point. If the interlocking is between levers only, then by virtue of the position of the point lever the signal lever can be taken 'OFF' with the point incorrectly set, which is obviously unsafe. To obviate this difficulty, the interlocking has to be extended to ensure the position of the function also and in such cases a clutch lever can be used which has a stroke on its own locking plunger when there is out of correspondence between the position of the lever and the function. This locking stroke of the plunger can be used to lock up the dependent signal lever and prevent the signal from being taken to OFF position. Therefore, to operate a signal lever to reverse position, the relevant point, as well as the clutch lever operating the point should be in their respective correct positions. Any one of them in the incorrect position causes the signal lever to be locked up. Therefore, it is said that by using a clutch lever, the interlocking is extended right up to the function.

8.3 Normally the points and detector levers are clutch levers as not only the operating lever, but also the operated function has to be in the correct position before the signal lever can be operated to reverse, i.e., the locking in the signal lever has to be effective if either the position of the lever or the position of the point is incorrect. Also, a signal having a detector in its transmission is operated by a clutch lever.

8.4 The practice followed by different railways for signal levers are as under:

(a) Clutch levers are used for main line home caution aspect and loop line home caution aspect only and direct levers for all other signals. (OR)

(b) Clutch lever is used for main line home caution aspect only and direct levers for all other signals, (OR)

(c) Direct levers are used for all signals.

8.5 The reasons for the above three different methods lies in the fact that clutch levers are used where the out of correspondence between the lever and the function has to be made use of in interlocking. The distant signal should be capable of being taken to the 'OFF' position only if the loop or main home is showing the 'OFF' aspect. With the transmission of the main or loop home caution aspects defective, the home signal may not go to the caution aspect even though the signal lever may be reversed. Since the home signal caution aspect lever is in the reverse position, the distant signal can be taken 'OFF' if the interlocking between the home signal caution aspect and the distant signal is confined to the positions of the levers only. This will be the case when direct levers are used for the home signal caution aspects. The Loco Pilot coming across a situation where the distant signal is 'OFF' and the home signal is at 'ON' is likely to be confused and he may have to apply emergency brakes causing discomfort to Passengers. To avoid this, the distant signal should be taken to the 'OFF' position only when the home signal is actually showing 'OFF'. This is possible only if a clutch lever is used for the caution aspect of the home signals.

8.6 Since the distant signal shows 'attention' aspect when the reception is on loop line, the Loco Pilot would be approaching the home signal at a restricted speed when signaled for reception on loop and as such, the train may easily be controlled even if the loop home is at 'ON' with the distant at 'attention'. This may not be the case when the reception is on main line where the Loco Pilot would be approaching the home signal at a high speed by virtue of the clear aspect on the distant signal and as such will not find it easy to stop at the home signal if the home is at 'ON'.

8.7 The argument for the use of clutch levers for the caution aspect on home signals is that this prevents an anomalous situation of distant showing 'OFF' aspect with the home at 'ON' aspect. But if the transmission of the home signal breaks after the distant signal is taken 'OFF' the same anomalous situation described above would arise as the design of the signal mechanism is such as to replace the signal to the 'ON' position when the transmission breaks. The provision of clutch lever can not prevent this from happening. This can be avoided only by providing electrical slotting between the home signal and the distant signal. As the use of clutch levers for the caution aspect of home signals affords only limited protection certain railways do not see the necessity of providing clutch levers for the caution aspect of home signals, especially when electrical slotting is provided.

8.8 Miniature levers can be used for those functions which do not require any mechanical transmission, but which nevertheless require a lever for purposes of interlocking. Miniature levers can be used for point and signal functions when they are operated electrically. Gate control lever, route levers slot levers and siding control levers are invariably miniature levers.

9.1 A double wire lever frame, having more than 18 levers, has to be supported by providing additional intermediate stanchions between the two end stanchions. The number of additional intermediate stanchions depends upon the size of the lever frame and is as shown under: -

No. of levers (total capacity)	No. of end Stanchions	No. of Intermediate Stanchions	Total No. of spans in the lever frame
1-18	2	-	1
20-36	2	1	2
38-54	2	2	3
56-72	2	3	4
74-90	2	4	5

9.2 Having decided the number of Intermediate stanchions to be provided, the next step is to determine their positions. It is not possible to have a mechanical transmission where there is a stanchion. Therefore, a lever, which does not require a transmission such as a miniature lever, can only be provided in the space above the stanchions; otherwise, the space above the stanchions should be left as spare space.

9.3 The position of Intermediate stanchions is determined as indicated below:

$$\frac{\text{No. of levers in the frame}}{\text{No. of spans}} = \text{‘X‘ (omit fraction)}$$

Position of 1st Inter stanchion is	x+1
Position of 2nd Inter stanchion is	2x+1
Position of 3rd Inter stanchion is	3x+1
Position of 4th Inter stanchion is	4x+1 and so on.

For example, the positions of intermediate stanchions for a 46 and 64 lever frames are determined as shown below:

9.4 LEVER FRAME SIZE – 46 LEVERS

From the table given in Para 9.9.1 above the number of intermediate stanchions for this size of the lever frame is 2 and the number of spans is 3.

$$X = \frac{\text{No. of levers}}{\text{No. of spans}} = \frac{46}{3} = 15\tfrac{1}{3}$$

Omitting the fraction,	X = 15
Position of 1st inter stanchion is	X + 1 = 15 + 1 = 16
Position of 2nd inter stanchion is	2X + 1 = 30 + 1 = 31

Lever 16 and 31, which will be mounted over the intermediate stanchions, can not have transmissions

9.5 Lever frame size - 64 levers. From the table given in Para 9.9.1 above the number of intermediate stanchions for this lever frame is 3 and the number of spans is 4.

$$X = \frac{\text{No. of levers}}{\text{No. of spans}} = \frac{64}{4} = 16$$

Position of 1st inter stanchion is	X + 1 = 16 + 1 = 17
Position of 2nd inter stanchion is	2X + 1 = 32 + 1 = 33
Position of 3rd inter stanchion is	3X + 1 = 48 + 1 = 49

In this case levers 17, 33 and 49 can not have transmissions. It may be observed here that in any one span the number of levers does not exceed 18.

10 NUMBERING

10.1 The numbering of functions in a layout of D.W. installation is done as per the "GROUP-CUM- GEOGRAPHICAL" method as explained in section-2.8 of this notes. In central cabin working where all the functions are operated by D.W, the Yard has to be divided into two halves. If total number of levers in a frame are 48, then lever No.1 to 24 should be utilized for first half, and from lever No.25 to 48 for the functions of other half of the yard and each half of the functions are divided into three groups say group I, group II and group III and then number the functions in each group geographically as it is done for catch handle type lever frames.

10.2 In the end cabin working where points and lockbars are operated by rodding and signals detectors operated by D.W. the detector levers which are required to be pulled for the signals of the group I. should be numbered first in the group II and those detectors that are to be pulled for the signals of group III should be numbered last in the second group, so that in the lead-out it does not become alternate transmissions of wire and rod.

10.3 In the case of a single wire lever frame, care has to be taken while numbering, so as to avoid the necessity of pulling a lever in between two pulled levers. This precaution, however, is not necessary in a double wire lever frame.

10.4 Figure 3 shows the numbering of a double wire layout with central cabin. In this case separate route levers are used for reception of trains on each road. It can be seen from the figure that each end of the yard is considered separately for numbering.

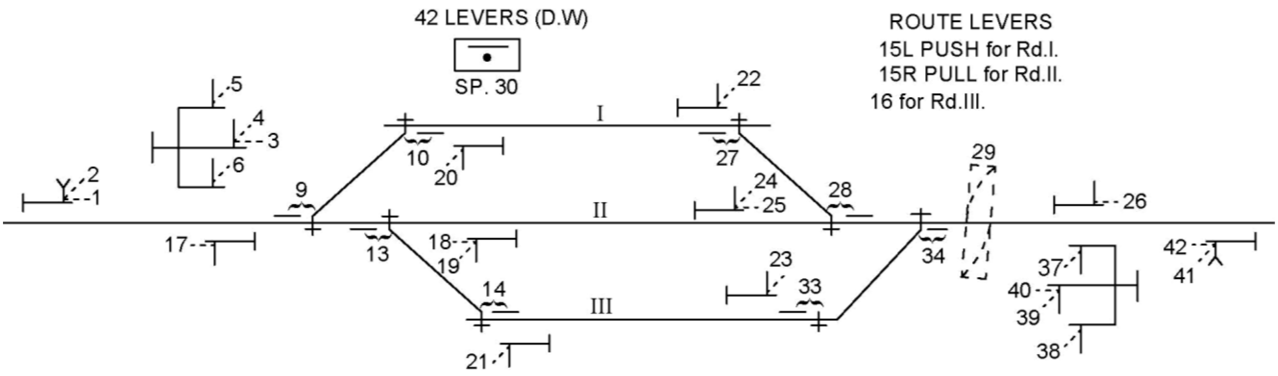


Fig.3 (Refer Locking table 1) page 90

DETECTION TABLE

LEVER No	POINTS	
	NORMAL	REVERSE
7	9,10	--
8	--	9,10
11	13,14	--
12	--	13,14
31	--	27,28
32	27,28	--
35	--	33,34
36	33,34	--

DESCRIPTION OF LEVERS

Clutch Levers: 4,7,8,9,10,11,12,13,14,27,28,31,32,33,34,35,36,39	
Direct Levers: 1,2,3,5,6,17,18,19,20,21,22,23,24,25,26,37,38,40,41,42	
Miniature Levers: 3 – Position: 15	
2 – Position: 16,29 (Stanchion Levers: 15,29)	
Coupled Levers:	
Pull-Pull:	(3&4) (39&40)
Push-Pull:	(1&2),(5&6),(7&8),(11&12),(18&19),(24&25),(31&32),(35&36),(37&38),(41&42)

10.5 Figure 4 shows the numbering of a double wire layout with central cabin in which common Route levers are provided for all roads. One lever is used for up direction and another lever is used for down direction.

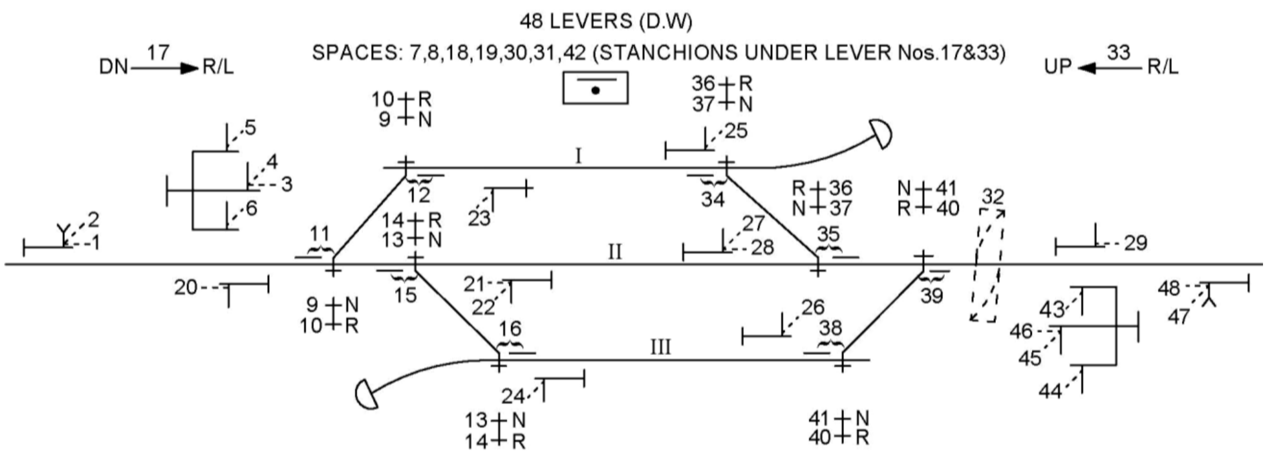
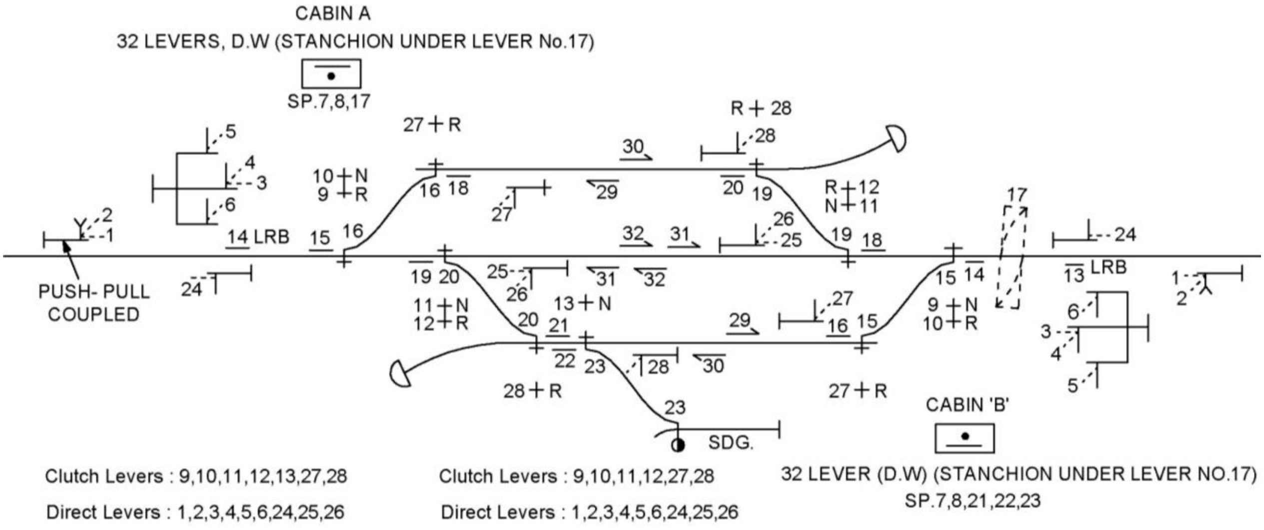


Figure 4: (Refer locking table No.2) page 91

DESCRIPTION OF LEVERS

Clutch Levers:	9,10,11,12,13,14,15,16,34,35,36,37,38,39,40,41
Direct Levers:	1,2,3,4,5,6,20,21,22,23,24,25,26,27,28,29,43,44,45,46,47,48
Miniature Levers: 2 - Position	17,32,33

10.6 Figure 5 shows the numbering of a double wire layout with end cabins. Here rack and pinion levers are used for operation points and lockbars by rodding transmission.

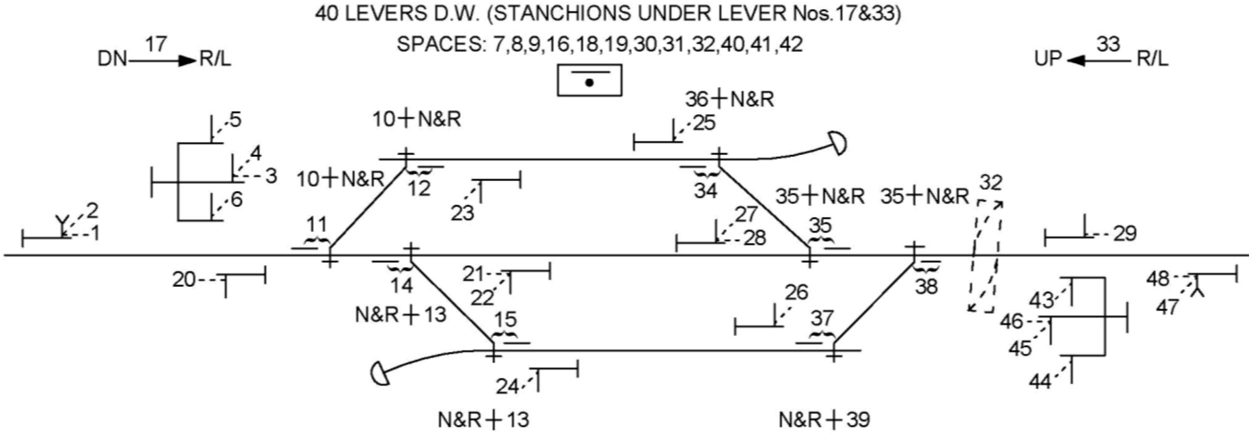


Description of Levers

'A' Cabin	'B' Cabin
Clutch Levers : 9,10,11,12,13,27,28	Clutch Levers: 9,10,11,12,27,28.
Direct Levers: 1,2,3,4,5,6,24,25,26.	Direct Levers: 1,2,3,4,5,6,24,25,26.
R & P Levers: 14,15,16,18,19,20,21,22,23.	R & Pinion Levers: 13,14,15,16,18,19,20.
Miniature Levers: 2 – Pos. 29,30,31,32.	Miniature Levers: 2 - Pos. 17,29,30,31,32.

Fig: 5 **(**Refer locking table No.3) page 92

10.7 Figure 6 shows the numbering of a double wire layout in which only one detector lever is used for each crossover. It may be noted that electrical detection is provided to ensure the 'Normal' and 'Reverse' Position of the points.



Description of levers

Clutch levers	10,11,12,13,14,15,34,35,36,37,38,39.
Direct levers	1,2,3,4,5,6,20,21,22,23,24,25,26,27,28,29,43,44,45,46,47,48
Miniature Levers: 2 – Position	17,33.

Fig: 6 (Refer Locking Table No.4) page 93

* * *

ANNEXURE - 3
TIGHT AND LOOSE LOCKING

1. It is seen from the proceeding chapter that by using a clutch lever interlocking can be extended right up to the function. The integrity of the wire transmission can not be taken for granted and therefore there is a possibility of the function not responding to the action of the lever. The lever and its function may be out of correspondence with each other.

2. When a clutch lever is used and when there is out of correspondence between the lever and its function or when the transmission is defective, the lever drum alone is made to rotate and the lever is said to trip. The rotation of the drum results in a stroke on the locking plunger.

3. The stroke on the locking plunger can be caused either by the tripping of the lever if the lever happens to be a clutch lever or by the operation of the lever, the stroke in the two cases being 1/2" (12mm) and $1^{1/2}$ " (40 mm) respectively. As the movement of the plunger can be made use of to lock another function, the movement due to the out of correspondence between the function and the lever can also be used to lock another function, i.e., the interlocking is extended right up to the function.

4. For example, let the locking relationship between two levers 1 and 2 be such that 1 locks 2. With the transmission of lever No.1 becoming defective, it may so happen that while lever No.1 is in the normal position the function No.1 may not be in normal position. It is desirable to lock lever No.2 in normal position if either the lever No.1 is not in normal position or the function No.1 is not in normal position. To achieve this, a Clutch lever has to be provided for function No.1. In this case in a situation when lever No.1 is in normal position and function No.1 is not in normal position lever No.1 would trip causing a tripping stroke on plunger No.1, which can be made use of to lock lever No.2. In the notes on double wire, it has been explained that the stroke on the plunger due to tripping action is in the same direction in which the plunger moved last. In figure No.7 operation of lever No.1 from N to R, causes a 1 1/2"(40 mm) downward displacement of its lock plunger while tripping of lever in N position will cause a 1/2" (12 mm) upward displacement thereby also displacing the lock and locking the lever No.2. (The displacement is upwards because the last operation was from reverse to normal when the lock plunger would have moved upwards and the displacement due to tripping is in the same direction as the direction in which the plunger moved last). Similarly, by providing a Clutch lever for function No.2, lever No.1 can be locked either when lever No.2 is operated or when lever No.2 has tripped.

When the tripping action of a lever results in the locking of another lever it is known as tight locking (+)

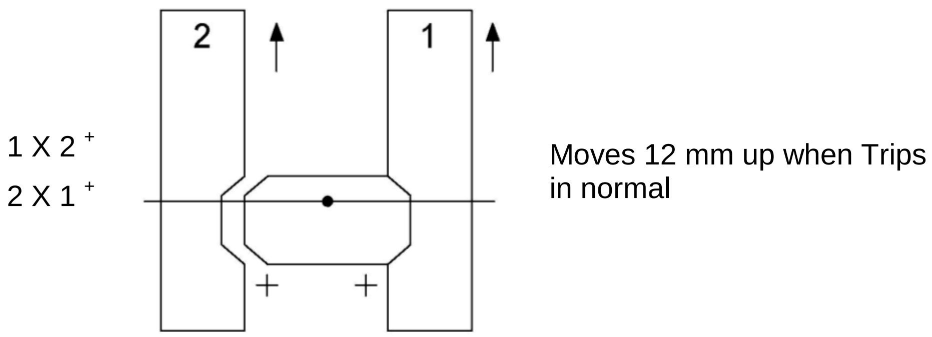


Fig. 7

5. The above, where not only the position of the lever, but also the position of the function is proved, seems to be a desirable feature and calls for universal application. But there are certain limitations.

6. It can be seen from Fig.8 and the explanation given in succeeding paragraphs that the advantage of locking due to tripping can be made use of only once in a group of related levers. Let us consider the relationship between three levers 1, 3 & 5. Let the locking relationship be 1 x 3, 5. Supposing it is desired that the tripping action of 1 should also lock 3 and 5. Let the sequence of operation between 3 and 5 is Such that 3 is operated first before 5 is operated. If the transmission of 1 goes defective with both levers 3 and 5 in normal position, then plunger No.1 will have the tripping stroke, and it will lock plunger 3 and 5. But if the transmission of 1 goes defective after lever No.3 is operated, lock plunger of lever No.1 can not move, even though the lever might trip as the lock plunger of lever No.1 is locked by the operation of lever No.3 and therefore locking of lever No.5 can not be achieved. In other words tripping of lever No.1 will result in locking of lever No.5 only with lever No.3 in the normal position. But 5 may be an important function and it may be necessary to have the tripping of 1 to lock lever No.5 even with lever No.3 operated to reverse position.

X Direction of Plunger movement when lever No.1 trips in normal position

Y Direction of Plunger movement when lever No.1 trips in reverse position

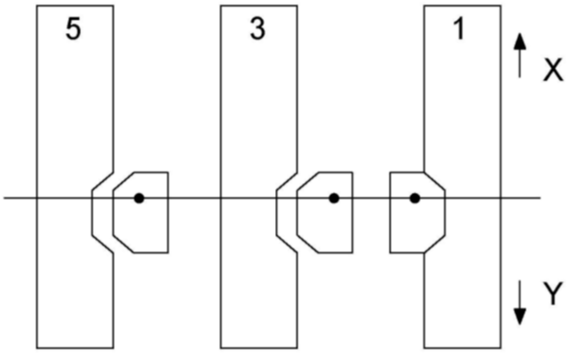


Fig.8

7. From Fig.8, it is evident that if this is to be achieved, locked plunger No.1 should be free to have its upward displacement due to tripping even with lever No. 3 in the reverse position. If this is to happen the notch on the lock plunger No.1 for the locking 1 x 3 and 1 x 5 should be separate and also the notch pertaining to 1 x 3 should not be of the same size as the lock (as shown in figure 8) but should be wider in the bottom by 1/2" (12 mm) (since the stroke due to tripping is 1/2" (12 mm) (as shown in fig.9). In this case, if lever No.1 trips after lever No.3 has been operated to reverse, plunger No.1 will still have the full upward displacement in the event of its tripping. This will displace the lock on channel C resulting in the locking of lever No.5.

The notch, which is not exact to the size of the lock, is termed as a "loose notch". The notch which is exact to the size of the lock is termed as a "tight notch".

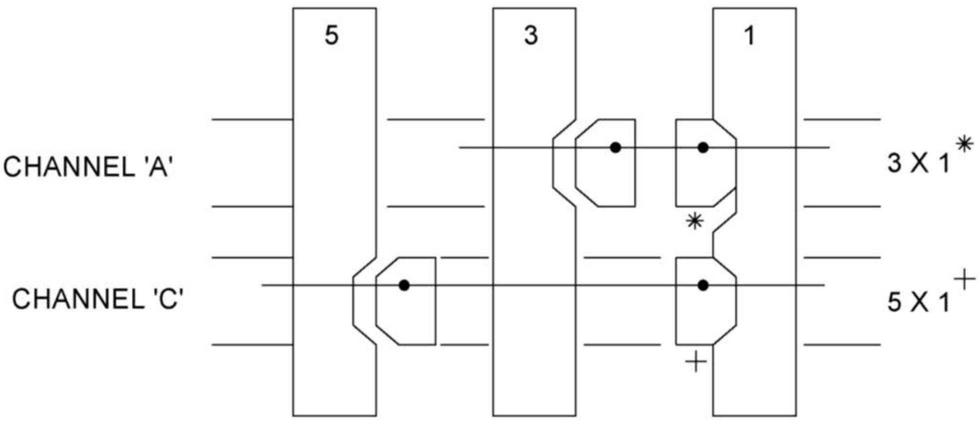


Fig.9

The notch on lever no.1 in 'A' channel is loose therefore even after lever no.3 is reversed the plunger of lever no.1 is allowed to move up if it trips, thus locking lever no.5 as lock of lever no.1 in ‘C’ channel is displaced due to tripping.

8. Cutting the notch wider than the size of the lock does not in any way affect the locking due to lever action. This is evident from fig.9. Once lever No.3 is reversed lever No.1 is free to trip but not free to operate from the normal position, as the plunger can not move downwards due to the top portion of notch on Channel 'A' being exact to the size of the lock. Similarly, when lever No.1 is operated to reverse position the lock is moved to the right thereby locking lever No.3. But cutting the notch 'loose' in the bottom in A channel of plunger No.1 will not lock lever No.3 in the event of lever No.1 tripping in normal.

9. When the tripping results in the locking action of another lever, the locking is said to be 'tight' ($^+$) and when the tripping does not result in the locking action of another lever, the locking is said to be loose (*).

10. To sum up, if tripping of lever No.1 should lock up lever No.5 then the notch on plunger No.1 for the relationship between levers 1 and 3 should be loose. In this case tripping of lever No.1 will not lock up lever No.3. On the other hand if the tripping of lever No.1 should lock up lever No.3 then the notch on lever No.1 for the relationship between 1 and 3 should be tight. To realize this, the notch on lever 1 for the locking between 1 and 5 should be loose, which means that tripping of lever No.1 will not lock up lever No.5. Hence we can say that in a group of related levers the advantage of tight locking can be made use of once only.

Therefore, as far as locking action due to tripping of lever No.1 is concerned a choice has to be made between levers 3 and 5. If it is to be available for lever No.5, it should not have been made use of for lever No.3 and if it has been made use of for lever No.3 it is not to be available for lever No.5. In such cases, the choice normally lies on the lever which is more important for safety.

11. Another limitation is brought about due to operational necessity. If safety is not jeopardized, then in the interest of flexibility, loose locking may be provided. As an example consider the relationship between a trailing point in the overlap and a signal. Safety will not be jeopardized even if the signal is taken 'OFF' with the point incorrectly set. The provision of a tight locking in this case will result in a signal failure if the point lever trips due to defective transmission, incorrect setting or some such cause.

Therefore, to prevent a signal failure, loose locking may be provided if safety is not jeopardized.

12. Doubt may now arise as to why at all a clutch lever should be provided if the tripping action is not to be made use of. Even though loose locking may be provided for the relationship with certain levers, in view of the two limitations indicated above, there may be certain other levers with which the relationship should be tight, in the interest of safety. In the case considered in Para 10.10 above, the point may be a facing point lying in the portion traveled by a train and governed by another signal and the relationship with this signal has to be a tight relationship as the positions of the point lever and the point function are very important as far as this signal is concerned. Tight locking should be provided in this case. Since the same point requires a loose as well as tight relationship, a clutch lever has to be provided.

13. In the case of a direct lever, there is no question of tripping and therefore, there is no choice of 'loose' or 'tight' locking. All the notches in the plunger of a direct lever are exact to the size of the lock.

14. A tight locking is indicated by the sign **$^+$** and loose locking by the sign ***** in the locking tables and in the locking diagrams. For example, if the relationship between levers 4 and 5 is Such that 4 locks 5 and if tripping of lever No.4 should lock lever No.5 the relationship is expressed as 5 x 4$^+$. Similarly, if the tripping of lever No.4 is not to lock lever No.5, the relationship is expressed as 5 x 4*. The sign $^+$ represents that the notch on lever No.4 is 'tight' and the * represents that the notch on lever No. 4 is 'loose'.

* * *

ANNEXURE - 4
LOCKING TABLE (Double Wire)

1. The principles which govern the preparation of interlocking table in a double wire installation will be similar to the one as followed in single wire installations. However, where clutch levers are used, the following principles should be observed.

2. The relationship of a signal with other clutch lever functions in the yard can be as indicated below:

(a) In the actual path of the train, the signal locks (Normal or reverse or both ways, as the case may be) all the clutch lever-operated functions such as points and detectors, whether for facing or trailing-tight.

(b) In the overlap, the signal locks (normal or reverse or both ways) all the clutch lever operated functions falling in the overlap-loose.

(c) Exception to (b) above is the facing derail switch falling in the overlap, in which case, the signal locks or back locks the derail switch - tight.

(d) If conflicting signal is operated by a clutch lever, the signal locks the conflicting signal loose.

(e) The signal is released by a clutch lever signal - tight/loose, depending upon safety.

(f) The converse locking of the above, which is effective on the signal lever, will be loose locking if operated by a clutch lever i.e., Point to signal, detector to signal, signal-to-signal etc., the locking will be loose.

(g) Where the isolation is mandatory, signal shall lock the isolation point tight.

3. To make the above tight locking effective the locking relations between detector, points etc. have to be made loose as given below: -

(a) Detector locks (Normal, reverse or both ways as the case may be) the point loose.

(b) Point locks (Normal or reverse as the case may be) another point loose.

(c) Point locks normal a detector or releases a detector loose.

(d) Route lever locks (Normal, Reverse or both ways as the case may be) the point or route lever released by concerned detector loose.

4. Loose locking between points is for safety and flexibility

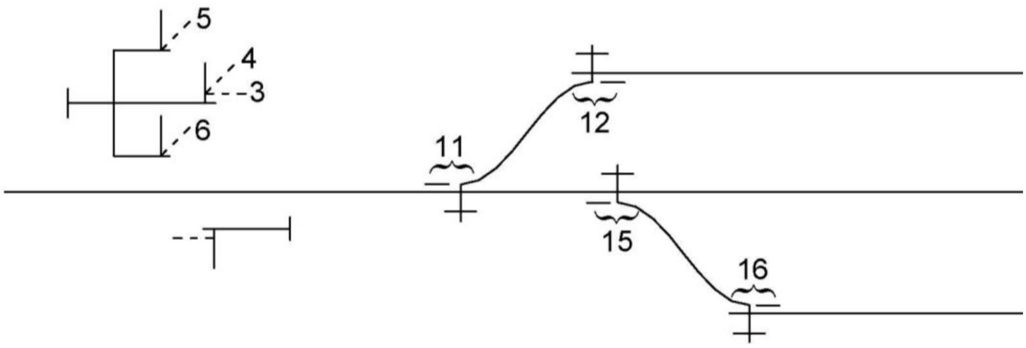


Fig No:11.4

In the above diagram11 x 15* and 15 x 11* is provided. The purpose of loose locking on 11 and 15 is as follows, Considering 15 locks 11+ is provided, after operation of 15 to reverse, locking plunger of lever No.11 can not move (trip) in the event of transmission of 11 goes defective. In that case signal No.6 would be free to operate which is UNSAFE. To overcome such a situation loose locking is provided on lever No.11 (i.e 15 x. 11*) allowing locking plunger of 11 to move in the event of 11 tripping even after 15 is operated to reverse. Tripping of 11 would prevent the taking 'OFF' of signal No.6 through locking 6 x 11+. Therefore, 15 x 11* i.e., loose locking on 11 is provided to achieve safety.

Now consider providing 11 x 15+. In this case if lever No.15 trips in normal position lever No.11 would get, locked in normal position and movement on first loop would not be possible. As the movement on 1st loop does not involve traveling over point No.15 this reduces the flexibility of the yard, Therefore, 11 x 15* is provided which allows operation of point No.11 to reverse even if 15 trips in 'N' position. Thus it may be seen that loose locking of 15 (i.e., 11 x 15*) is necessary for flexibility of the yard.

Note: *So far as loose & tight locking between levers is concerned the above principles are generally adopted. Exceptions might exist due to site conditions or due to procedures adopted on individual railways.*

5. The level crossing gate can have relationship only with the signal which protects the level crossing gate, and the relationship will be the same as indicated in section ‘A’.

6. The preparation of locking table will be on the same lines as indicated in Single wire signalling Refer figure 3 for a typical locking-table.1.

The following precautions have to be taken in canceling out locking due to redundancy.

7. Where Lockbar to Lockbar locking is not available the locking between conflicting signals of same line does not become redundant as in the case of single wire installations and as such has to be provided Ex.4 x 17.19.39* (see layout Fig.3).

8. Even though the locking between certain levers may suggest redundancy, yet the locking may have to be provided due to the necessity of tight locking (as explained below).

9. Refer layout in Fig.3 relationship between 9 and 10. is 10 released by 9*. For signal No.5 both 9 and 10 have to be reversed and as 10 can not be reversed unless 9 is first reversed the relationship between 5,9 and 10 may be given as 5 released by 10^+ on the assumption that 5 released by 9 is redundant due to the relationship 10 released by 9*. This assumption is perfectly valid in the case of a single wire installation and also in the case of D.W. installation if the relationship between 5 and 9 is 5 released by 9* i.e.,, the interlocking between 5 and confined only to the position of levers. But as the position of the point is important and has to be proved in the interlocking, 5 Released by 9^+ is required, and as this relationship does not become redundant on account of the relationship 10 released by 9* and 5 released by 10^+ and 9^+ is also to be provided. A signal must have direct locking relationship with all the clutch lever operated functions coming in the path of the train and the locking must be tight. It should not depend upon indirect interlocking.

10. Similarly, 10 is required in normal to maintain isolation when signal No.3 is cleared, For signal No.3, point No.9 is required in normal and since Point No.10 can not be operated to reverse unless Point No.9 is first operated to reverse, it may be argued that 3 x 10^+ is redundant. This may be true if what is desired in the locking is only the position of lever 3 and 10, but if the position of point No. 10 has to be proved in the relationship between 3 and 10 then 3 x 10^+ has to be provided.

11. 15pull x 28* 4 is Rel. by 15pull, 4 x 28*. In this case what is desired in the relationship between 4 and 28 is only the position of lever No.28 and not the position of point 28. The position of lever No.28 is already provided for in the relationship between 15pull and 28 Since 4 is R.by 15R. 4x28* is redundant and therefore, need not be provided.

Locking table No.1 (Refer layout in Figure 3) page 82; [15L= 15 push],[15R = 15 pull]

Lever No.	Released by	Locks Normal	Locks Both ways	Releases
1.	4^+	--	--	--
2.	(5 or 6)	--	--	--
3.	4*,25	$10^+,14^+,27^+,33^+$	--	--
4.	$7^+,11^+$,15R,29	$9^+,13^+$,17,19,24,39*	--	1,3
5.	$8^+,9^+,10^+$,15L,27^+,29	17,20,37	--	(2)
6.	$7^+,12^+,13^+,14^+$,16,29,33^+	9^+,17,21,38	--	(2)
7	--	9*	--	4*,6,15R,16,18, 19,21
8.	10*	--	--	5,15L,20
9.	--	4*,6,7*,13*,18,19,21	--	5,10*,20
10.	9*	3,40	--	5,8*,20,37
11.	--	13*	--	4*,15R,18,19
12.	14*	--	--	6,16,21
13.	--	4*,9*,11*,18,19	--	6,14*,21
14.	13*	3,40	--	6,12*,21,38
15R	7*,11*,32*,36*	--	--	4*,39*
15L	8*,31*,36*	--	--	5,37
16.	7*,12*,35*	--	--	6,38
17.	--	4*,5,6,19	9*,10*,13*,14*	18
18.	$7^+,11^+$,17	$9^+,13^+$,24,25	--	40
19.	$7^+,11^+$	4*,$9^+,13^+$,17,24,25,39*	--	--
20.	$8^+,9^+,10^+$	5,22	--	--
21.	$7^+,12^+,13^+,14^+$	6,9^+,23	--	--
22.	$27^+,28^+$,29,$31^+,36^+$	20,34^+,37	--	--
23.	29,$33^+,34^+,35^+$	21,38	--	--
24.	29,+$32^+,36^+$	4*,18,19,26,$28^+,34^+$,39*	--	--
25.	26,$36^+,32^+$	18,19,$28^+,34^+$	--	3
26.	29	24,37,38,39*	27*,28*,33*,34*	25
27.	28*	3,40	--	5,22,31*,37
28.	--	24,25,32*,34*,39*	--	22,27*,37
29.	--	--	--	4*,5,6,22.23,24, 26,37,38,39*
30.	SPACE			
31.	27*	--	--	15L,22,37
32.	--	28*	--	15R,24,25,39*
33.	34*	3,40	--	6,23.35,38
34.	--	22,24,25,28*,36*,37,39*	--	23,33*,38
35.	33*	--	--	16,23,38,36
36.	--	34*	--	15R,15L,22, 24,25,37,39*
37.	10^+,15L,$27^+,28^+$,29,$31^+,36^+$	5,22,26,34^+	--	(41)
38.	14^+,16,29,$33^+,34^+,35^+$	6,23,26	--	(41)
39.	15R,29,$32^+,36^+$	4*,19,24,26,$28^+,34^+$	--	40,42
40.	18,39*	$10^+,14^+,27^+,33^+$	--	--,
41.	(37 or 38)	--	--	--
42.	39^+	--	--	--

12. Another typical layout is shown in Fig 4. Here simultaneous reception facility is provided and one route lever in each direction is provided which is common for all the three roads. It may be noted that pulling of detector lever is made Compulsory for facing points in overlap and optional for trailing points in overlap. All signals are worked by direct levers. The typical locking table is shown in Locking Table No.2.

Locking Table No.2 Refer layout in Figure 4 (page 83)

Lever No.	Released by	Locks Normal	Locks Both ways	Releases
1	2,4.	--	--	--
2	(4 or 5 or 6)	--	--	1
3	4,28	$12^+,16^+,34^+,38^+$	--	--
4	$9^+,13^+$,17,32	$11^+,15^+$,20,22,27,35*, 39*,45	--	1,(2 spl),3
5	$10^+,11^+,12^+$,17, (32W34*R), (36* or 37*)	20,23,43	--	(2 spl)
6	$9^+,14^+,15^+,16^+$,17,32,38^+,40*	11^+,20,24,44	--	(2 spl)
7,8	SPACE			
9	--	11*	--	4,6,(17spl), 21,22,24
10	12*	--	--	5,(17spl),23,43
11	--	4,6,9*,15*,21,22,24,45	--	5,12*,23
12	11*	3,46	--	5,10*,23,43
13	--	15*	--	4,(17spl W11*N), 21,22,(44spl)
14	16*	--	--	6,(17spl W 11*N). 24,(44 spl)
15	--	4,11*,13*,21,22,45	--	6,16*,24
16	15*	3,46.	--	6,14*,24
17	(9*or10*),(13*or14*W11*N)	--	--	4,5,6
18,19	SPACE			
20	--	4,5,6,22	11*,12*, 15*,16*	21
21	$9^+,13^+$,20	$11^+,15^+$,27,28	--	46
22	$9^+,13^+$	4,$11^+,15^+$,20,27,28,45	--	--
23	$10^+,11^+,12^+$	5,25	--	--
24	$9^+,14^+,15^+,16^+$	6,11^+,26	--	--
25	32,$34^+,35^+,36^+,41^+$	23,39^+,43	--	--
26	32,$38^+,39^+,40^+$	24,44	--	--
27	32,$37^+,41^+$	4,21,22,29,$35^+,39^+$,45	--	--
28	29,$37^+,41^+$	21,22,$35^+,39^+$	--	3
29	32	27,43,44,45	34*,35* 38*,39*	28
30,31	SPACE			
32	--	--	--	4,(5W34*R),6,25, 26,27,29,43,44,45
33	(36* or 37* W 39* N), (40*or 41*)	--	--	43,44,45
34	35*	3,46	--	25,36*,43
35	--	4,27,28,37*,39*,45	--	25,34*,43
36	34*	--	--	(5spl),25, (33 splW39*N),43
37	--	35*	--	(5spl),27,28, (33splW39*N),45
38	39*	3,46	--	6,26,40*,44
39	--	4,25,27,28,35*,41*,43,45	--	26,38*,44
40	38*	--	--	6,26,(33spl),44

Lever No.	Released by	Locks Normal`	Locks Both ways	Releases
41	--	39*	--	25,27,28,(33spl), 43,45
42	SPACE			
43	10*,12$^+$,32,34$^+$,35$^+$,36$^+$,41$^+$, 33	5,25,29,39$^+$	--	(47 spl)
44	(13*or14*),32,33,38$^+$,39$^+$,40$^+$	6,26,29	--	(47 spl)
45	32,33,37$^+$,41$^+$	4,11*,15*,22,27,29,35$^+$, 39$^+$	--	46,(47spl),48
46	21,45	12$^+$,16$^+$,34$^+$,38$^+$	--	--
47	(43 or 44 or 45)	--	--	48
48	45,47	--	--	--

13. Typical layout with end cabins using rodding transmission for points and locks is given in figure 5. Locking table for cabin 'A' is given in locking table No.3.

Locking Table No.3 for Cabin 'A' of layout in Figure 5 (page 84)

Lever No.	Released by	Locks Normal	Locks Both ways	Releases
1.	4	--	--	--
2.	(5 or 6)	--	--	--
3.	4	--	--	--
4.	9$^+$,11$^+$,14	30	--	1,3
5	10$^+$,14	--	--	(2 spl)
6.	9$^+$,12$^+$,13$^+$,14	--	--	(2 spl)
7,8.	SPACE			
9.	15	16	--	4,6
10.	15,16	--	--	5
11.	19	20	--	4
12.	19,20	--	--	6
13.	22	23	--	6
14.	15	--	--	4,5,6
15.	(19W16N)	18,24	16	9*,10*,14
16.	--	9*,20,25,26,31	--	10*,18
17.	SPACE			
18.	16	15	--	27*,29
19.	(22W20R)	24,26,31	20	11*,12*,(15W16N)
20.	--	11*,16,25,26,31	--	12*,23,28*
21.	--	22	20	28*,30
22.	--	21	23	13*,(19W20R)
23.	20	13*,24,28*,30	--	--
24.	--	15,19,23,26	16,20	25
25.	24	16,20	--	32
26.	--	16,19,20,24,31	--	--
27.	18	--	--	--
28.	20,21	23	--	--
29.	18	30	--	--
30.	21	4,23,29,31	--	--
31.	--	16,19,20,26,30	--	32
32.	25,31	--	--	--

14. Another typical layout in which only single wheel detectors are used is shown in figure 6. It may be noted that electrical detection is provided to prove the "Normal" and "Reverse" setting of points. The locking table is given in locking table No.4

Locking Table No.4 for layout in Figure.6 (page 84)

Lever No.	Released by	Locks Normal	Locks B/W	Releases
1	2,4	--	--	--
2	(4or 5or 6)	--	--	1
3	4,28	12$^+$,15$^+$,34$^+$,37$^+$	--	--
4	10$^+$,13$^+$,17	11$^+$,14$^+$,20,22,27,35*, 38*,45	--	1, (2spl)3
5	10$^+$,11$^+$,12$^+$,17,36*	20,23,43	--	(2spl)
6	10$^+$,13$^+$,14$^+$,15$^+$,17$^+$,37$^+$,39*	11$^+$,20,24,44	--	(2spl)
7, 8, 9	SPACE			
10	(12*W11R)		--	4,5,6,17,21, 22,23,24,43
11	--	4,6,14*,21,22,24,45	--	5,12*,23
12	11*	3,46	--	5,(10*W11*R),23,43
13	(15*W14*R)		--	4,6,(17W11*N),21, 22,24,44
14	--	4,11*,21,22,45	--	6,(13*W14*R),24
15	14*	3,46	--	6,(13*W14*R),24
16	SPACE			
17	10*,(13*W11*N)	--	--	4,5,6.
18. 19	SPACE			
20	--	4,5,6,22	11*,12* 14*,15*	21
21	10$^+$,13$^+$,20	11$^+$,14$^+$,27,28	--	46
22	10$^+$,13$^+$	4,11$^+$,14$^+$,20,27,28,45	--	--
23	10$^+$,11$^+$,12$^+$	5,25	--	--
24	10$^+$,13$^+$,14$^+$,15$^+$	6,11$^+$,26	--	--
25	34$^+$,35$^+$,36$^+$,39$^+$	23,38$^+$,43	--	--
26	37$^+$,38$^+$,39$^+$	24,44	--	
27	36$^+$,39$^+$	4,21,22,29,35$^+$,38$^+$,45	--	--
28	29,36$^+$,39$^+$	21,22,35$^+$,38$^+$	--	3
29	--	27,43,44,45	34*,35*, 37*,38*	28
30.31.32	SPACE			
33	(36*W38*N),39*	--	--	43,44,45
34	35*	3,46	--	25,(36*W35*R),43
35	--	.38*,45	--	25,34*,43
36	(34*W35*R)	--	--	(33W38*N),43,45
37	38*	3,46	--	6,26,(39*W38*R), 44
38	--	4,25,27,28,35*,43,45	--	26,37*,44
39	(37*W38*R)	--	--	6,25,26,27,28,33, 43,44,45
40.41.42	SPACE			
43	10*,12$^+$,33,34$^+$,35$^+$,36$^+$,39$^+$	5,25,29,38$^+$	--	(47spl)
44	13*,33,37$^+$,38$^+$,39$^+$	6,26,29	--	(47spl)
45	33,36$^+$,39$^+$	4,11*,14*,22,27,29, 35$^+$,38$^+$	--	46,(47spl),48
46	21,45	12$^+$,15$^+$,34$^+$,37$^+$	--	--
47	(43 or44or45)	--	--	48
48	45,47	--	--	--

ANNEXURE - 5
LOCKING DIAGRAM (Double Wire)

1. The preparation of locking diagram is on similar lines as indicated in Chapter-6 of Section 'A' with the following deviations.

2. In a single wire lever frame the locking tray is mounted below the lever frame. As one faces the locking tray the sequence of numbers is from left to right. Plunger No.1 is to the left of Plunger No.2 Plunger No.2 is to the left of plunger No.3 and so on. In the case of a double wire lever frame, the locking tray is mounted in rear of the lever frame. As one looks at the locking tray the sequence of numbers is from right to left. Plunger No.1 is to the right of Plunger No.2 Plunger No.2 is to the right of plunger No.3 and so on. As a plan or document is read from left to right; in order that the positioning of the plungers would tally with the diagram, the plungers in the locking diagram is numbered, serially from right to left (Refer figure below).

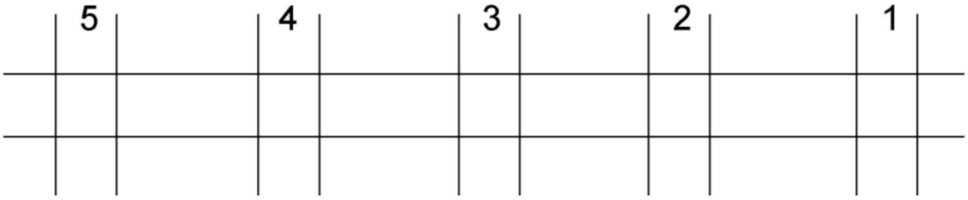
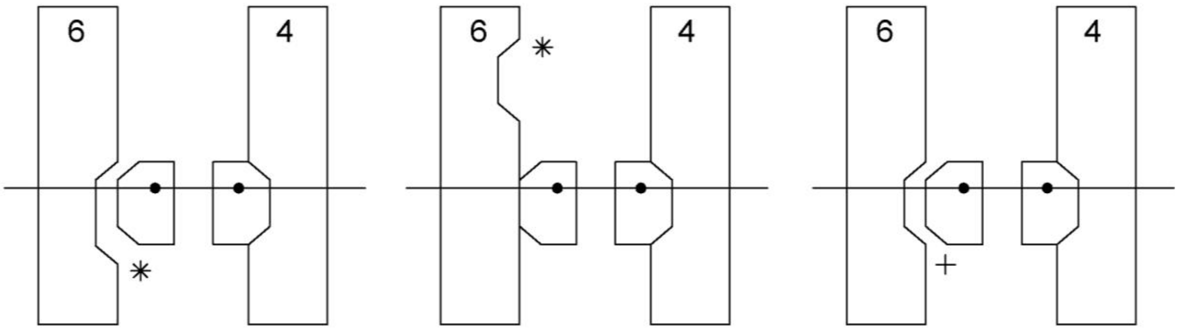


Fig.12.2

3. In the case of a single wire lever frame all notches are exact to the size of the locking dogs. But in double wire installations, for clutch levers, certain notches have to be made wider than the dog size to facilitate 'loose locking'. The locking diagram has to indicate the loose notches and also the side on which the notch is cut "wider". This is done indicating the sign* on the side of the notch which has to be cut wider. To avoid any misunderstanding the notches, which have to be cut exact to the size of the lock, are indicated with the sign$^+$. However, in the case of direct, miniature and rack and pinion levers the notches are all exact to the size of the lock and as such, there is no need to Put the + sign on the notch.

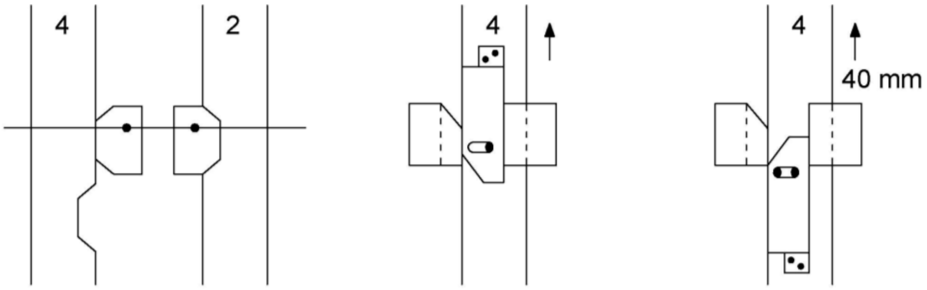
4. The extra wideness is provided in the notch to enable the movement of the tappet when the lever trips, if the tripping takes place with the lever in the normal position, the tripping stroke on the locking tappet would be upwards and if loose normal locking is to be provided the notch has to be made slack in the bottom. Similarly, if tripping takes place with the lever in the reverse position, the tripping stroke on the locking tappet would be downwards and if loose locking is to be provided the notch has to be made slack in the top. Figure (a) gives the arrangement for 4 x 6*, figure (b) gives the arrangement for 4 released by 6* and figure (c) gives the arrangement for 4x6$^+$.



(a) 4 X 6* (b) 4 ÷ 6* (c) 4 X 6$^+$

Fig.12.4

5. When a 2 Pos. miniature lever is operated from 'Normal' to reverse the tappet moves 40 mm in upward direction. Hence the reverse notch on a tappet of 2 Pos. miniature levers should be shown on the bottom side i.e., below the channel [see figure (a)]. When a swinger is provided on a 2 Pos. Miniature lever the position of the swinger should be suitable to the movement of the tappet [see figure (b) & (c)].

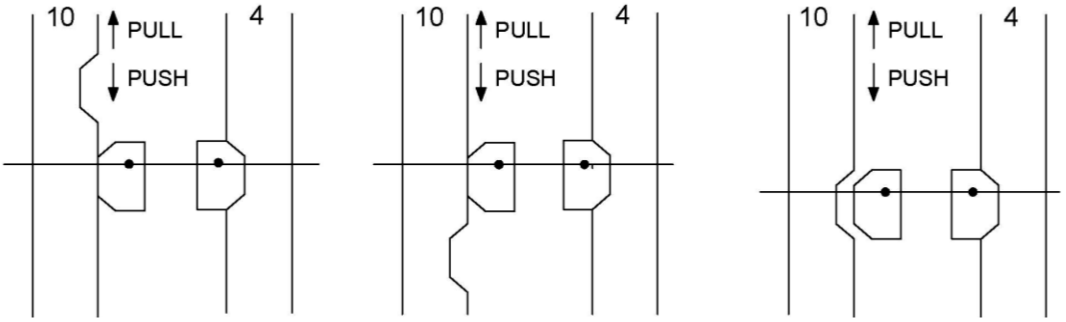


(a) 2 R.by 4 (b) Normal Swinger (c) Reverse Swinger

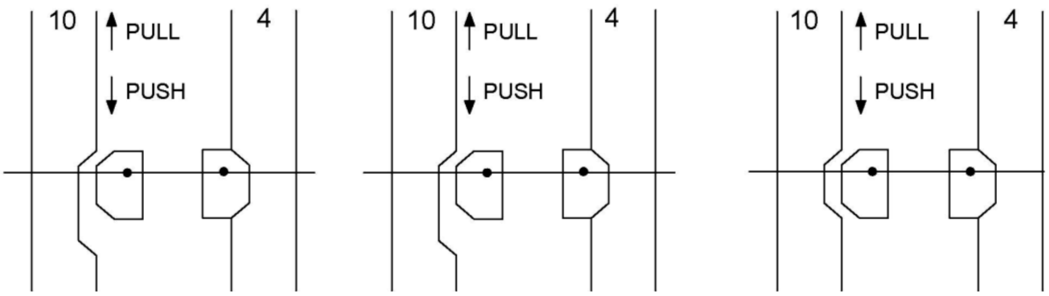
Fig: 12.5

6. When a 3 Pos. Miniature lever is operated from Normal (mid position) to 'Push' position the tappet moves 20 mm in downward direction and when it is operated from normal to 'pull' position the tappet moves by 20 mm in upward direction. Hence the notches for different locking should be shown to suit the movement of the tappet. For example, for locking 4 R by 10 push the reverse notch on tappet No.10 should be shown on the top side he above the channel since movement of the tappet is downward and for locking 4 R by 10 pull the reverse notch on tappet No.10 should be shown on the bottom side i.e., below the channel since the tappet movement is upward; for locking 4 R by 10 push or 10 pull reverse notches should be shown on both sides of the channel, In the case of 4 locks 10 push the normal notch on plunger No.10 should be cut 20 mm wider on the bottom side since the lever No.10 should be free for operation to 'pull' position. Similarly, for locking 4 locks 10 pull the normal notch on lever No.10 should be cut 20 mm wider on top side to make the lever free for operation to push position. For locking 4 locks 10 push and 10 pull an ordinary 'Normal' notch will be sufficient on plunger No.10. The above arrangements are shown in Fig.12.6

3 Position Miniature lever



(a) 4 R.by PUSH (b) 4 R.by PULL (c) 4 R.by (10 PUSH or PULL)



(d) 4 X 10 PUSH (e) 4 X 10 PULL (f) 4 X 10 PUSH

Fig: 12.6

Fig,12.7 The swingers of IRS design are suitable for loose locking. If a swinger is to be used on a clutch lever with tight notch special arrangements are to be made to achieve tight locking.

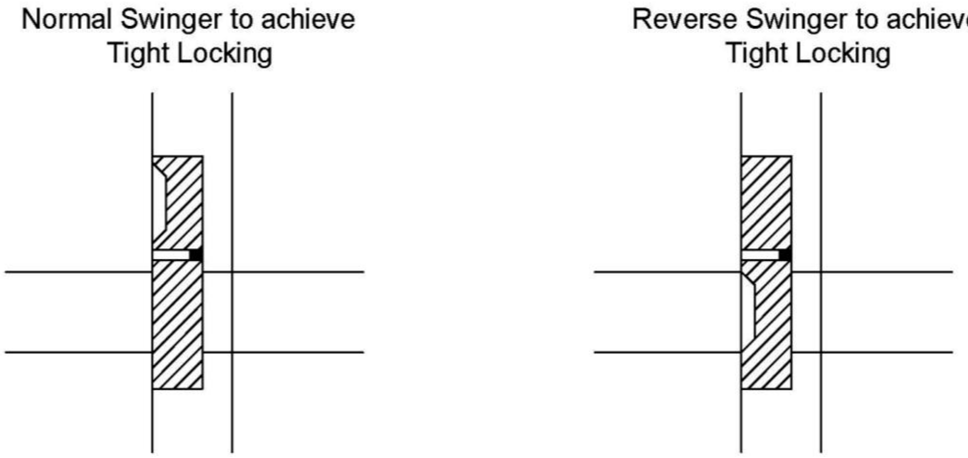


Fig: 12.7

7. Fouling of notches do not occur for levers other than clutch levers in double wire locking, On Clutch levers fouling of notches occur as the tripping stroke also should be added to the operating stroke. Hence care should be taken to avoid fouling of notches on clutch levers. However, certain Railways avoid notches in adjacent channels on all levers to avoid confusion.

* * *

ANNEXURE-6
TESTING OF LOCKING (Double Wire)

1. Testing of locking in a double wire lever frame will be on similar lines as the testing of a single wire lever frame. However, the only difference is the necessity to test tight and loose locking.

2. To test 5 locks 6*

Action	Lever no	Result / inference
Pull	5	5 is in Reverse
Try	6	6 will not come
Try to trip	6	6 can be tripped
Put back	5	5 is in Normal
Pull	6	6 is in Reverse
try	5	5 will not come
Put back	6	6 is in Normal
Trip	6	6 is tripped in Normal
try	5	5 will come
--	--	Tripping 6 will not cause locking of 5 and locking 6 will not prevent from tipping which enhances flexibility in the yard

Since the relationship is a loose one, tripping of lever No.6 in the normal position should not lock 5. To test this with lever No.5 and 6 in normal position, lever No.6 is tripped with resetting handle. After doing this pull 5, 5 will come and hence, it can be concluded that tripping of 6 does not lock lever No.5. Normalize the tripping on 6.

3. To test 5 locks 6^{+}

The relationship 5 locks 6 is tested as above. The relationship that is to be tested is the locking of lever No.5 in normal position when lever No.6 trips in normal, so keep 5 & 6 normal, trip lever No.6 with the resetting handle. Try to operate 5 to reverse 5 will not come. Normalize the tripping on lever No.6. Now try to operate lever No.5. 5 will come. This proves that tripping of lever No.6 locks lever No.5 in normal position.

* * *

REVIEW QUESTIONS

Subjective:

1. What is interlocking and why required?
2. How can you choose size of the lever frame?
3. What is the method followed for numbering the yard and how numbering done?
4. Write essentials of inter locking.
5. What is route holding? Why it is necessary?
6. How route holding is achieved? Explain with examples?
7. Write interlocking between various functions?
8. What are the methods adopted for preparation of locking table and what are the columns in locking table?
9. What are the rules for preparation of locking table for electro-mechanical yard?
10. What is special locking? How it is acheived flexibility in the yard?
11. What are the main fundamentals to prepare locking diagrams? Why grouping of locking required?
12. What are the rules for preparing locking diagrams?
13. What is fouling of notch? How it is avoided in catch handle lever frame?
14. How can you avoid fouling of notches?
15. What is diamond special locking?
16. What are the methods of testing the lockings and test the following lockings?
    (a) 1 x 2
    (b) 3 x 7.8.10
    (c) 4 R/by 8.10.12
    (d) 6 x 8W7N
    (e) 4 R/by 6W8R
    (f) 2 R/by 3 or 4 or 5
17. How can you decide the size of lever frame and how numbering of a lay out?
18. What is intermediate stranchion and where they are provided? Give one (or) two examples?
19. What is tight locking and loose locking?

Objective Questions:

2.6.2.1.1 Write "T" for True & "F" for False

1. Any swinger/top piece can be used in the first and the last channels. ( )
2. Reverse swinger can be used in the second channel ( )
3. Normal swinger can be used in the last but one channel . ( )
4. Swinger always shall used in the adjacent channel on the same tappet. ( )
5. Fouling of notches can be over looked ( )
6. The numbering of bridle bar at any given place of a channel may be more than exceed four if required. ( )
7. Dummy Lock need to be provided if an unconnected length of a bridle bar to a distance of more than 10 levers. ( )
8. Use of top pieces shall be a last alternative for avoiding fouling notches. ( )
9. Warner is released by Outer & Main Line Home ( )
10. Outer is released by Adv. Starter ( )

B. Fill up the Gaps with works or figures

1. Outer Signal releases ____________ Signals.
2. Home Signal releases ____________ Signals.
3. Main line Home Signal Locks Loop lines slot having __________overlap.
4. A Running Signal ___________ shunt Signal below it (in same post).
5. A slot having separate overlap must _______ all others Slots.
6. Size or width of Channel is ____________ mm (SA 1101).
7. Width of tappet is _______ mm (SA 1101).
8. Size of Bridle Bar is _________ x _________ (SA 1101).
9. Space between two Tappet is _________ mm (SA 1101).

* * *