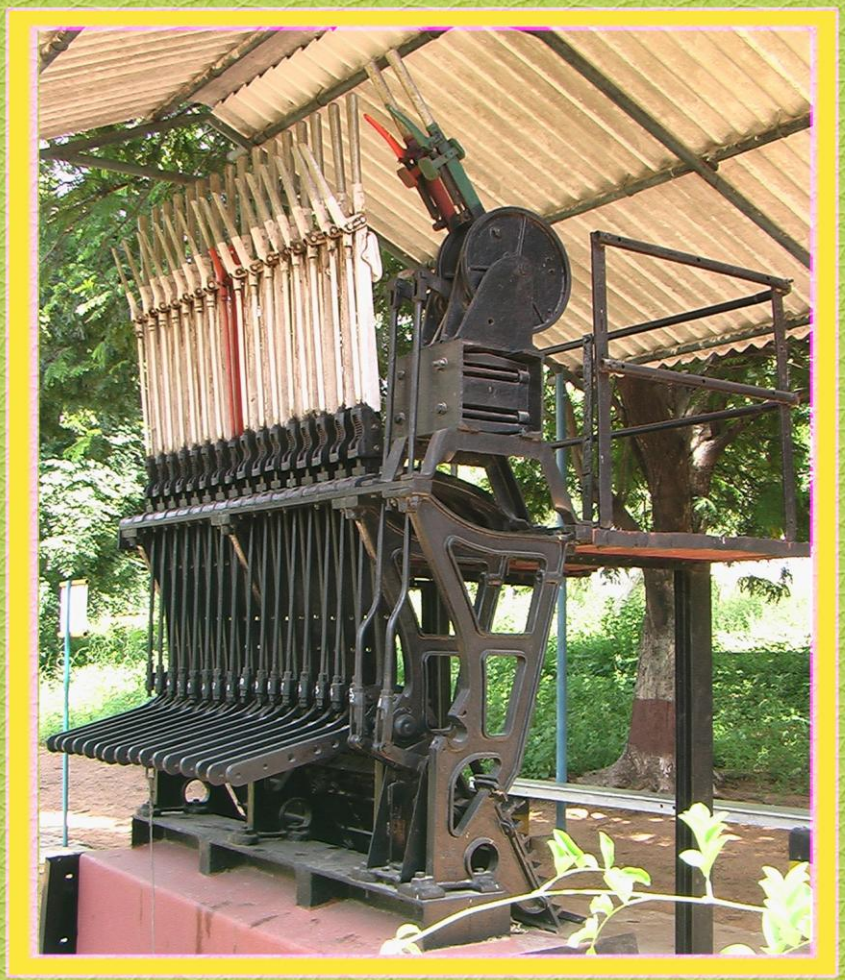
इरिसेट IRISET

S 3

MECHANICAL SIGNALLING
SINGLE WIRE & RODDING



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

S-3

MECHANICAL SIGNALLING
SINGLE WIRE & RODDING

VISION :	TO MAKE IRISET AN INSTITUTE OF INTERNATIONAL REPUTE, SETTING ITS OWN STANDARDS AND BENCHMARKS
MISSION :	TO ENHANCE QUALITY AND INCREASE PRODUCTIVITY OF SIGNALLING & TELECOMMUNICATION PERSONNEL THROUGH TRAINING

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

Issued in March, 2014

S-3
MECHANICAL SIGNALLING - SINGLE WIRE & RODDING

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CHAPTER - 1: LEVER FRAMES

1.1 Levers

A lever is a rigid bar; straight or bent, capable of turning about a fixed point called the fulcrum. The perpendicular distance from the lever fulcrum F to the lines of action of effort and load are called the arms of the lever. The former is called the effort arm and the latter the load arm.

1.2 Levers are classified into three orders

(a) 1st order: Fulcrum lies between the load and the effort

(b) 2nd order: Load lies between the fulcrum and the effort.

(c) 3rd order: Effort lies between the load and fulcrum

For any of these types of levers, if effort just balances the load, we have

$$L \times AF = E \times BF$$

$$\frac{L}{E} = \frac{BF}{AF} = \frac{\text{Effort arm}}{\text{Load arm}}$$

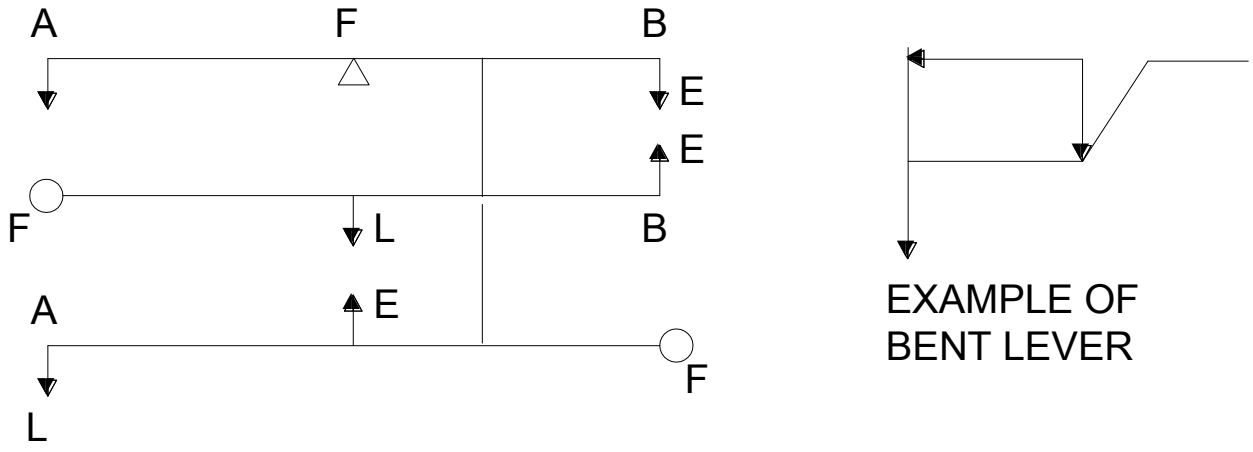


Fig.1.1

When power and load impressed on a simple machine keep it in equilibrium the ratio of the load to the power is called the mechanical advantage. Obviously then if the effort arm FB in the lever of 1st order is longer than the load arm AF the mechanical advantage will be greater than unity. i.e., it will be possible to work a signal or interlocking gear with much smaller force than what is actually required without the help of any machine. These types of levers are, therefore, extensively used all over.

1.3 Direct lever locking interlocking frame (SA 530) See Fig 1.3

Main parts of the direct locking type interlocking frame (SA 530) & Drawing numbers are given in Annexure –B (Page – 153)

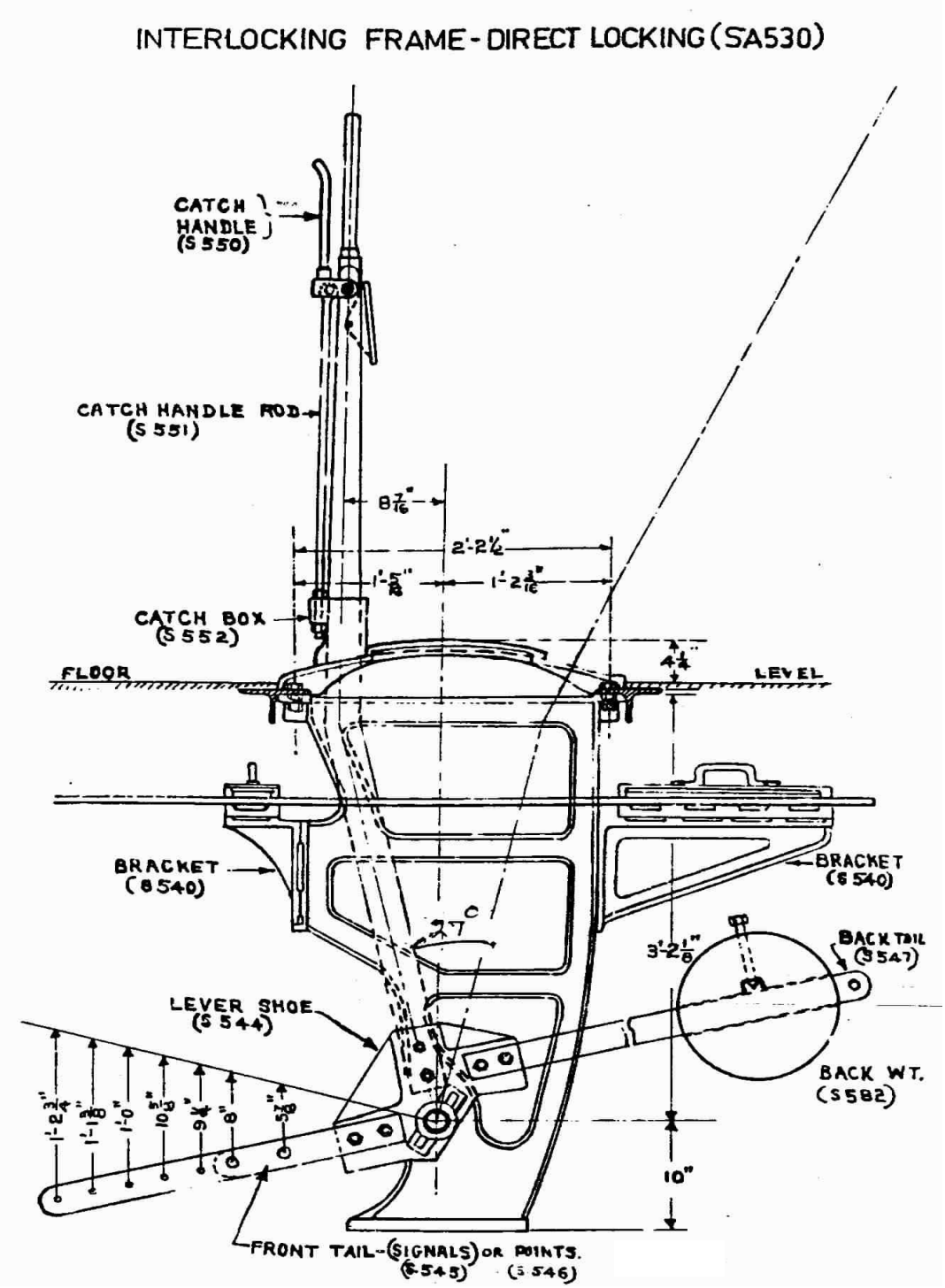


Fig.1.3

(a) A flat bar of mild steel called a tappet is attached to each lever with its free ends resting in locking boxes which are carried on brackets bolted to the frame standards one in front and the other in the rear of standard. Throughout the length of the locking box, slots called tappet ways are cut opposite each lever and when a lever is pulled the tappet slides through the slot without any lateral movement.

(b) The whole frame is supported on steel girders fixed in the cabin basement. The levers will project into the top room to a height convenient for pulling. Cast iron standards are fixed outside the first and last levers and at regular intervals throughout the frame, say, after every seven or five levers. These are connected together by two quadrant support T bars one at the front and the other at the back. On which the levers work.

(c) A catch rod connected to box of SA 530 type frame is actuated by gravity, and therefore, it has been made quite heavy. Catch rod is also connected to a handle called the catch handle. The catch handle is itself connected to the lever near the top end. On grasping this, catch box is raised clear of the projection and the lever can be pulled. When the lever is reversed the handle is released and the catch box drops and gets engaged against a similar projection on the quadrant in the reverse position.

(d) The Locking Box

The locking box is divided into several slots or tappet ways in which the plungers move. The locking box is also divided into channels. Standard direct lever interlocking frame of SA 530 type has locking boxes for five and seven levers only, and these are available either for one channel or for four channels. The pitch of the channels is 110 mm and the width at the bottom is 60mm and at the top of channel is 70 mm.

The channels are meant for housing the locks and the interlocking bars working the locks. Two sets of locking boxes one in the front on the other in the rear are fitted on brackets which in turn are fitted to the standards. These brackets are also available in two types one for 4 channels and the other for one channel only. Each channel accommodates three top and three bottom interlocking bars of size 16 mm X 12 mm. The other parts of interlocking box of SA 530 type frames are cover handle, cover plate, plunger and strap and through at the two extreme ends of the locking boxes, it is fitted up with 'locking box right end' (S 560) and locking box left end (S 559).

The tappet used in SA 530 type interlocking frame is 45.94 mm wide and 16 mm thick and is supported on the two locking boxes one in the front and the other in the rear, the lever engages with the tappet at a slot cut in the tappet. The tappet is a good sliding fit in the tappet way without any lateral movement. A sloping notch is cut in the side of the tappet and a lock fitting in the notch is placed against the tappet in a suitable channel or is sometimes fitted into the notch.

Thus for example in the sketch below a lock R is put in the channel ‘A’ butts against side face of plunger 1, and engaged in the notch of lever 2 tappet. In this position lever 2 cannot be pulled unless lever 1 is pulled and the notch N comes opposite the lock R. When lever 1 is pulled over the notch N comes opposite lock R and lever 2 can be pulled over and then it will not be possible for lever 1 to be put back, since by then lock R has entered notch N and side face of plunger 2 is against lock R. This interlocking is expressed as lever 2 is released by lever 1, or lever 2 back locks lever 1. In this manner interlocking between levers is achieved by suitably choosing the notches and locks satisfying desired conditions.

(e) Conflicting Notch

In direct lever locking interlocking frame of SA 530 type point at which the plunger is connected to the lever imparts about 346 mm tappet stroke. In a multiple channel box, this means if two lock notches are out in tappet 4 in A and B channels (as shown in the figure) and if the lever 4 is pulled, the notch of 'A' channel will travel beyond B channel and the lock of B channel can be pushed into it. Consequently the lever 3 would be released and the lever 4 would get locked in an intermediate position. This is not correct since it may lead to undesirable

conditions and is called a conflicting notch. To avoid such a situation the notches are cut in different sizes and shapes. The notches for normal locking in the upper channels are cut smaller than the notches in lower channels so that during the travel of the plunger the smaller top notch of the plunger passes safely the bigger locks of the lower channels. To enable different sizes locks, to be cut, the size of the lock is large, the width being 69.80/69.9 mm. The large size of locks however, reduces considerably the space available for locking. Different sizes of notches cut in a direct locking lever tappet.

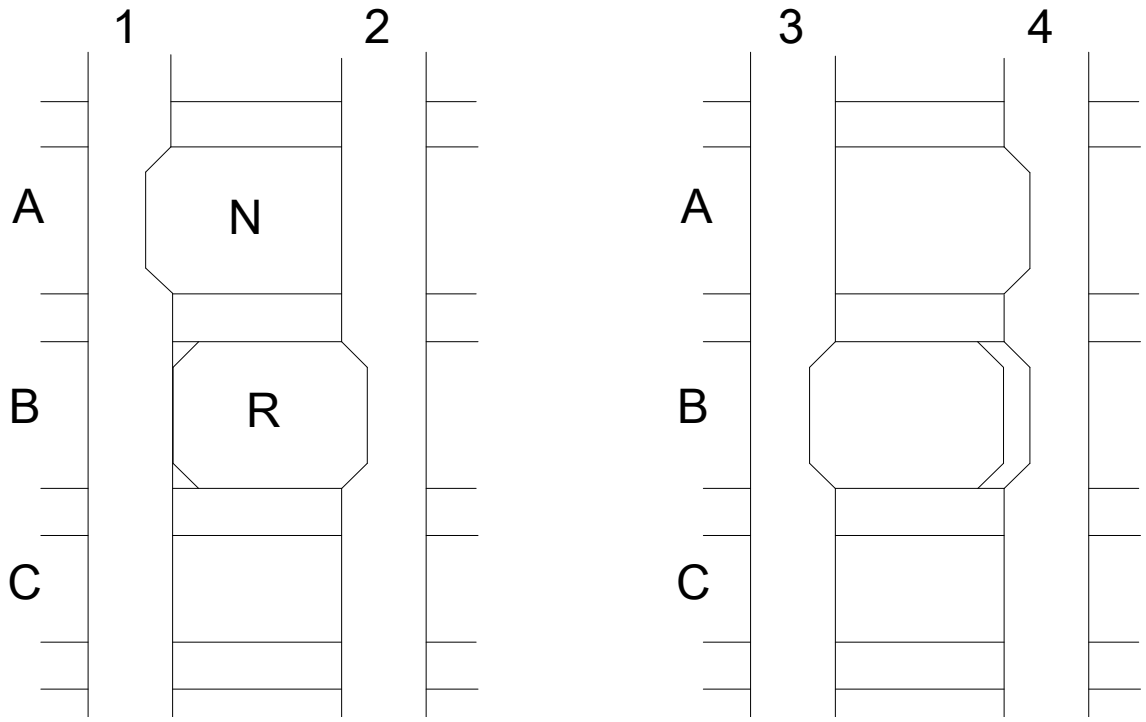


Fig. 1.3.1

1.4 CATCH HANDLE INTERLOCKING LEVER FRAME (SA 1101)

The catch handle differs from that of direct lever locking type and is connected through the catch handle rod to a spring loaded catch block which extends further down in the shape of a catch handle rod tends into a threaded end. A catch rod lug is fitted into the threaded end of the catch handle rod and is held in between two adjusting nuts. A pair of wrought iron links (called link A) is pivoted to the lever with a common pin, the lever itself flanked on either side of the catch rod and is connected to it through a pin. The other end of these links is placed on either side of short malleable cast iron link (called link B) and is joined to it with a common pin. The link 'B' is again connected to the plunger which works in the locking box fixed to the standards at an inclination of 30 deg. to the vertical.

Note: Main parts of the catch handle interlocking frame SA 1101 are given in Annexure 'C' Page No:154.

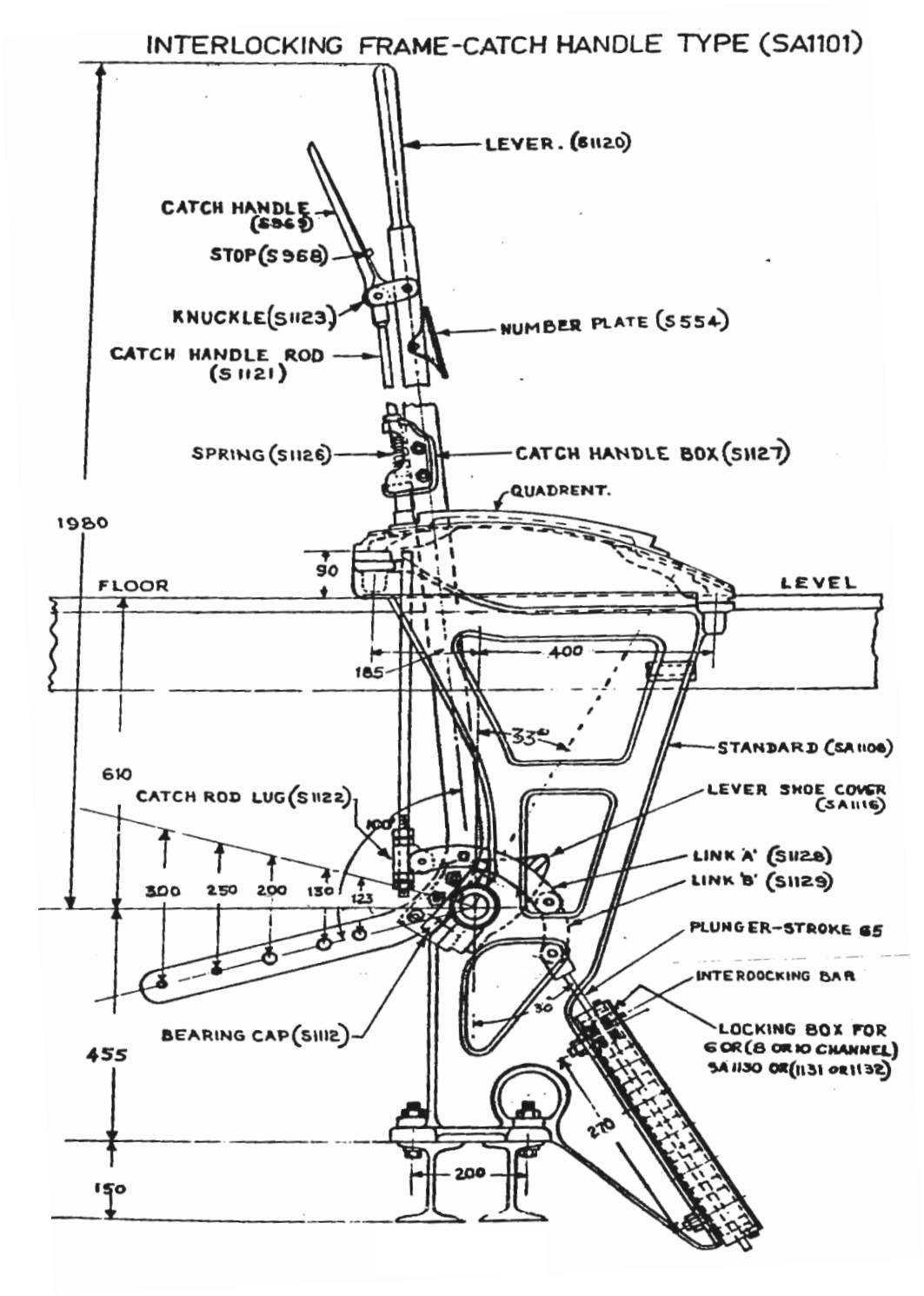


Fig. 1.4

Frames manufactured to Drg.No.SA 1101, have been standardised on Indian Railways. The general arrangement of the frame assembly is similar to that of the direct lever frame, although none of their parts are interchangeable. In this type, the standards used are of different types and the lever shaft is placed at a distance of 450 mm from the supporting girders. The levers are of length 1980 mm and have on angular throw of 33 deg. The levers shoes are of different type and do not need extra collars for maintaining the lever pitch which, in this case, is of 100 mm**. The locking boxes are available for 8 levers and 10 levers in the bay of 6, 8, 10 channels**

Interlocking bars used are of section 16 x 12 mm. When more than 10 No. of channels are required two or more locking boxes are secured one below the other on two angle irons one or each side of the locking box and the whole assembly along with the angle irons are then fixed to the standard brackets. Locking Box Details are as under.

Pitch of channel	55 mm
Width of channel	40 mm
Depth of channel	15 mm
Size of tappet	40.90x10 mm

1.5 Actuation of Locking

As soon as the catch handle is pressed, the catch rod is actuated and lifts the link ‘A’ near the catch rod lug. This causes the link 'B' to be pressed downwards imparting 31 mm downwards movement to the tappet. During operation the tappet move down by 10 mm. & up by 7 mm and farther move down by 31 mm when catch is released in the reverse position of the lever. The tappet giving a total movement of 65 mm. The tappet stroke of 65 mm is more than the channel pitch of 55 mm and hence, in this type of frame there is a possibility of conflicting notches to occur unless notches are cut judiciously.

1.6 Advantages of catch handle locking interlocking frame

(a) With the catch handle locking type interlocking frames it is not possible to press the catch handle of a lever when the same is locked in the lever frame; consequently, the lever man comes to know immediately he grasps that the lever is locked.

(i) The limit of locking that is required to be inserted can be considerably increased with the addition of locking boxes.

(ii) It is capable of accommodating much more locking in less space.

(iii) No. of channels available for locking is many more.

(iv) Tight locking do not effect the effort to pull the lever, as the tappet hardly moves during lever travel.

(v) Conflicting notches are almost completely avoided.

(vi) Sections of locks are made smaller rendering the locking arrangements more compact.

(vii) The design ensures more mechanical advantage of levers than the levers of direct locking type.

(viii) Locking box being far from the floor level and also at an angle of 30 deg. to vertical, it is easy to inspect the work on locking.

All the above mentioned facilities could only be possible because of the tappet being attached to the catch handle rod at a point very closed to the lever fulcrum.

1.7.1 As difficulties are experienced in operating signals by single wire transmissions, especially the outer and Warner signals which have long transmissions, some Railways have adopted D.W. Transmissions for operation of outer and Warner and even the advance starters.

1.7.2 Double wire levers can be installed on catch handle type interlocking frame (SA 1101). The arrangements are shown in the following IRS drawings. Suitable notch on the channel has to be provided for wire run from the D.W.lever.

The first D.W. lever is placed at 195 mm from the last lever in the case of R.H. extension and 155 mm in the case of L.H. Extension. The D.W.lever is mounted in the intermediate position by removing one lever and fixing the brackets (LH and RH) on the intermediate quadrant. Bushes (S 1182) are provided between the quadrant and the bracket.

D.W.LEVER ON SINGLE WIRE LEVER FRAME (CATCH HANDLE LOCKING TYPE)
FIXING IN END POSITION (R.H.) (SA 1171 A-B)

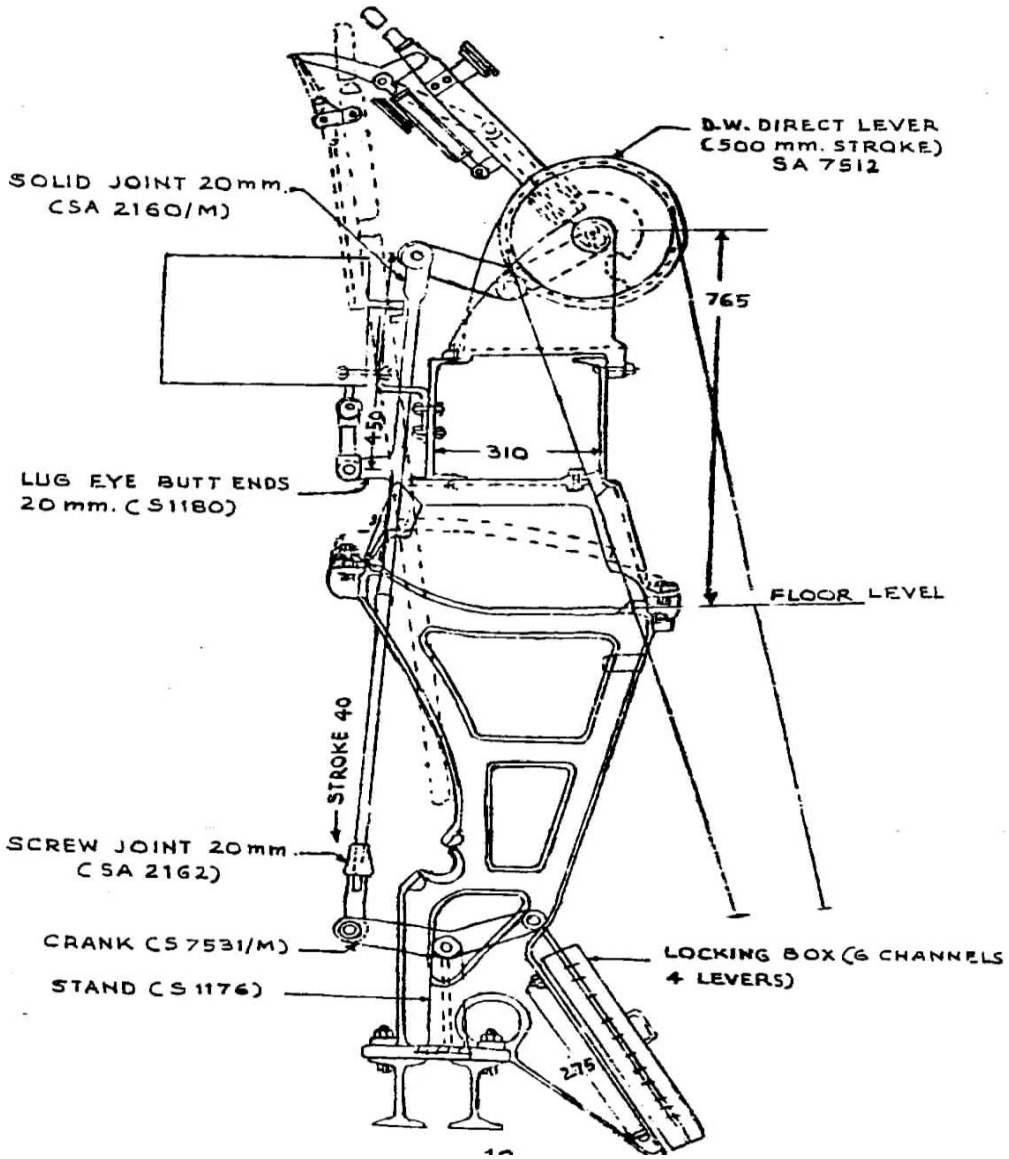


Fig.1.7.2

1.7.3 The arrangements are similar to the end mounting. The D.W. levers are fixed on the channels mounted on the brackets. The lever so mounted will be at 90 mm from one lever and 110 mm from the other instead of 100 mm (pitch of levers).

1.8 Ground Frames

Drg.No.	Description.
SA 921 A/M	Interlocking frame without key lock extension 6 levers
SA 921 A/M	Interlocking frame with key lock extension 6 levers
SA 922 A/M	Interlocking frame 1 lever
SA 923 A/M	Interlocking frame 2 lever
SA 924 A/M	Interlocking frame 3 lever
SA 925 A/M	Interlocking frame 4 lever
SA 926A/M	Interlocking frame 5 lever
SA 928 A/M	Interlocking frame 10 lever (Tie Rod)
SA 990 A/M	Interlocking frame 15 lever

Interlocking frames are installed almost at the ground levels are called ground frames. There are many types of these in use on Indian Railways, but the one that has been standardised is shown under Drg.No.SA 923-926 for GF2 to 5 levers SA 922 for GF1 lever SA 921 for GF6 levers. The 6 levers GF has facilities for fixing E type key locks.

The standard is mounted on the two rigidly fixed channel irons almost at the ground level. The lever shoe in this case is not a split shoe and the lever has got an angular throw of 52 deg the lever pitch is 100 mm and the tappet is 278 mm. The locking box has only four channels with channel pitch of 65 mm the size of the interlocking bars is 16 x 12 mm. To allow for the free radial action of the lever without causing a binding of the tappet the lever has a oblong hole at the point where the tappet is connected to the lever. The lever is capable of imparting strokes of 150 mm and 200 mm and the mechanical advantage for 200 mm strokes is about 6.2 and the length of lever is only 1425 mm . Ground frames are generally installed for operation of points in marshalling and goods Yards. Sometimes it may become necessary to operate signals from ground frames. There is no standard arrangement for operation of signals from ground frames. One of the methods adopted is as follows:

A rod is connected at the 200 mm hole on the lever to the other end of this rod a draft wheel is connected. The signal wire is anchored near the lever frame on a pulley stake and the other end of the wire is carried over the draft wheel to the signal as shown in the Fig. No.1.8.2.

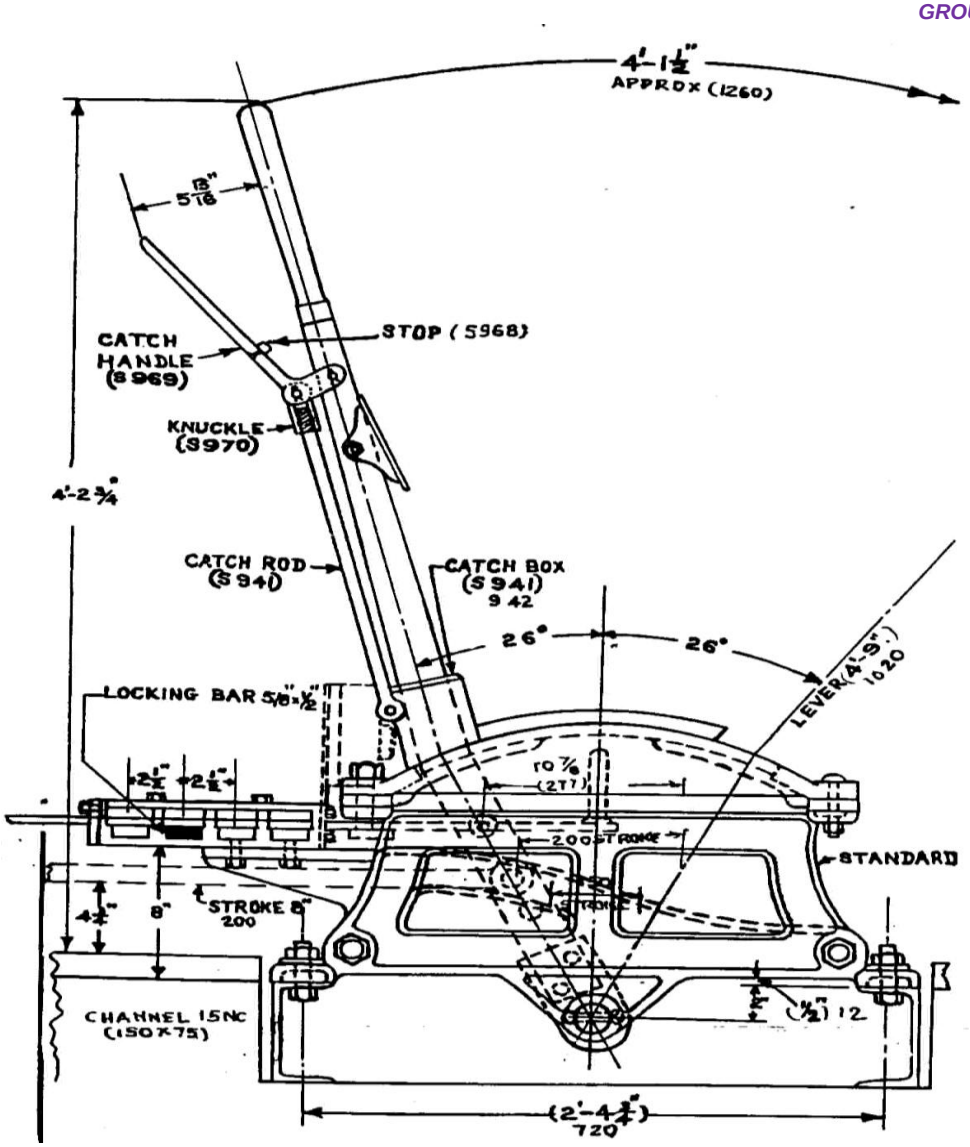


Fig.1.8.1 INTERLOCKING FRAME – GROUND TYPE (SA 923 TO 926)

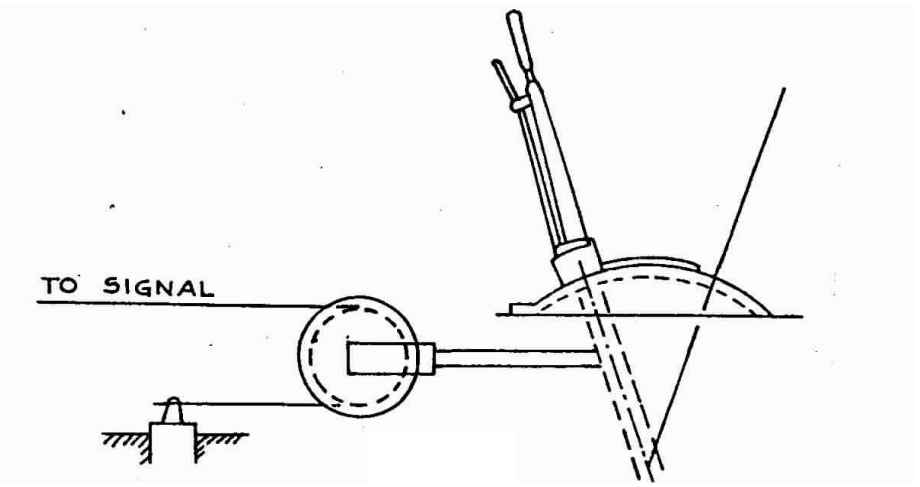


Fig.1.8.2

Note: Ground Frames: SA 921 to 926. *Main parts of the Ground Frames are given in Annexure-D, Page No.155.*

1.9 Assembly

(a) Having ascertained by means of a spirit level that the foundation joists or bed is in level and true both length wise and crosswise the standards would be positioned by means of a steel tape in accordance with the dimensions, given to them. The standards should be placed exactly right angles to the girders or joists. The fixing holes are marked off and drilled and the standards, fixed in position with bolts left finger tight.

(b) The lengths of the angles which go between the standards and support the heads of the tappet are now fixed together with the 50 mm (2") diameter bearing shaft and the quadrant supports connecting the standards at both the front and back of the frame, all loosely bolted.

(c) No1 quadrant is then placed in position on the quadrant supports and No1 lever fastened to the shaft by means of lever shoe provided for this purpose, and plumbed Necessary adjustments are made at the lever shoe. The quadrant is then bolted in position; No2 quadrant is then placed and bolted. Each lever is then fixed to the shaft and plumbed and its quadrant fastened down. When all the levers and quadrants have been fixed and levers are erected, so that they are in straight line from end to end, any adjustment required being made to their catch handles for the same reason. The frame is now ready to receive the interlocking.

(d) The correct locking trough are now assembled on the standards, the tappets are attached to the levers and passed through the locking box via the tappet ways. Suitable pieces of locking bar extending as far as possible throughout the length of the frame are then inserted with their respective plungers to check the correct alignment, minor adjustment if necessary being made to the position of the standards before tightening down their fixing bolts.

(e) The locking trough having been correctly aligned and firmly bolted to the standards and angle between the standards and the quadrant supports are similarly secured in position.

(f) The locking trough may consist of 6, 8 or 10 channels. The locking is comprising of more than one trough, is dispatched from the makers works securely bolted together on two angles, it is most important that these locking troughs sections should be erected on the frame as one unit and not separated. Considerable unnecessary work is otherwise involved in realigning the channels.

1.9.1 Locking

Mechanical locking must be assembled strictly in accordance with approved interlocking charts. Approval must be obtained for any alteration, constructional or technical, found essential during the course of assembling locking some important instructions for assembling locking are detailed below.

(a) Locking boxes should be correctly aligned.

(b) All pin joints should be made a proper fit with no slackness. This is of particular importance in catch handle type of locking where a number of pin joints are provided to work the locking through the catch handle. For newly fitted locking frames there should be practically no lost motion in connections or locking.

(c) Notches should be marked off in accordance with the interlocking chart. Marking should be done with the help of templates and the outline should be punch marked. In the case of catch handle locking, it is most important that the catch rod and links should be in correct position before marking.

It is a good practice to operate the catch handle several times, both in the normal and in the reverse position, in the case of catch handle locking and operate the lever several times in the case of direct lever locking before the notches are actually marked while doing so, the catch block should be properly held against the quadrant.

(d) Notches should be cut to proper sizes and shapes as marked. Clearance may be allowed as under

(i) Normal and reverse notches for point levers and those signal levers which have back tails or long leads may be cut with a small clearance up to 1 mm.

(ii) Notches of straight edge locks may have a clearance up to 3 mm from the straight edge of the lock.

(e) Joints in bars interlocking should be avoided. Where necessary the joints should be made by smithy welding. The welded bars should be kept truly straight and perfect in shape without kink and twist.

(f) All locks and driving pieces should be securely fixed square to the bar interlocking Locks must have free movement in the channels of the locking box.

(g) Long interlocking bars and loose locks should be provided with dummy pieces to keep them in position and guide their movement.

(i) Long interlocking bars (longer than 10 levers) should be provided with dummy pieces (Carrier locks).

(ii) Loose locks should be provided with small pieces of interlocking bars to keep them in position and to guide their movements.

(h) Each assembled bar interlocking should be checked and tested to see that:

(i) It is in accordance with the approved interlocking chart,

(ii) The locking provided through each bar is in accordance with approved interlocking table, and

(iii) The lost motion of a lever, which is locked, should be such that the lever cannot be moved more than 12 mm over the lever quadrant in the case of locking operated directly by the lever. In the case of catch handle operated locking, it should not be possible to raise the catch handle block more than 10 mm.

(i) Tappets, bars interlocking and locks should be marked as detailed in Para 1.11.(c) and (d).

(j) Holding down strips, where provided, must be in accordance with approved plan.

(k) Locking box covers should be securely fixed so that it is not possible to force the locking by displacing the locks or bars.

(l) After assembling locking, it should be carefully checked and compared with the approved interlocking chart.

(m) All bottom locking can now be placed in the trays in accordance with the numbering or lettering stamped on the bars and locks, and in agreeing with the locking diagram. Lever tappets are then fitted and connected to the lever.

(n) Bottom locking is then tested by working the catch handles and levers and care must be taken to see that the catches drop freely both in the Normal and in the Reverse positions.

(o) Top locking is then fitted and the covers are screwed down into the locking troughs to keep the top bars in position. Mechanical locking can then be tested against approved locking tables.

1.10 Adjustment of catch blocks and tappets

(a) Catch blocks and tappets can be adjusted as follows

(i) Catch block must not lift more than 3 mm (1/8") above the top of the quadrant and this can be adjusted through the facility provided in the catch rod for adjustment.

(ii) Catch block lift to permit operation of the lever must not be less than 20 mm (3/4"). This can be done by adjusting the depth of quadrant notch by filing and chipping etc and again adjusting the catch rod.

(iii) **Tappets:** The correct actuation of locking SA 1101 type of frame depends upon the correct travel being given to the links and tappets, any loss of travel may set up locking conditions not desired. In order to obtain in the correct travel it is imperative that the lever links must be tightened up on the stop provided when the lever is normal and catch is latched. If on reversing the lever, it is found that under the same conditions the links do not bear against the stop, the reverse notch on the quadrant plate should be filed as necessary. Then the links can be brought to stops by use of the catch rod adjustment provided. But when readjusting a catch rod to take up wear, care has to be taken to maintain the proper distribution of tappet stroke.

1.11 Checking and adjusting travel of Tappet of SA 1101 type frame

Following is the method of adjusting travel of locking tappet of a standard catch handle locking frame (SA 1101).

(a) When a lever is Normal, the links must butt against the stops provided when the catch handle is latched; the travel of tappet must be 65 mm (2-15/32") before taking measurement it must be ensured that the links bear against the stop in the reverse position.

(b) This travel is obtained by means of the catch rod adjustment provided, but, if full travel cannot be thus obtained the link stop must be filed or coated as necessary. The thickness of the material cut or added to the stop will be half of the change in stroke required.

(c) When wear has reduced travel of tappets to 55 mm travel must be readjusted to get 65 mm.

(d) If after tappet has been readjusted notches are not in their correct position, it must be drawn or jumped as necessary or new tappet provided. A 1 mm clearance is normally allowed between the locking faces of the tappet notch and lock. This clearance may be increased, particularly in the case of heavy working points.

Please refer data for lever frames in the Annexure-H6, Page No.164.

CHAPTER - 2: CRANKS

2.1 A crank is defined as a lever on an axis used to change the direction or magnitude of a force or both. The support forming the axis of the crank is termed the crank arms. The cranks are also sometimes used for changing the direction of motion of locking tappets (e.g., in the case of Double Wire and continental type interlocking frames see figure 2.2(a).

2.2 Types of Cranks

(a) **Accommodating Crank**

It is a two equal armed crank with vertical axis, one arm of which is curved to facilitate connection to accommodate cranks placed adjacent to it. These are available in three heights.

Sl. No	Description	Drg. No	Pitch	Height
1	Low Crank	SA5852	100 mm	75 mm
2	Low Cranks	SA5856	125 mm	75 mm
3	Medium Crank	SA5853	100 mm	140 mm
4	Medium Crank	SA5857	125 mm	140 mm
5	High Crank	SA5854	100 mm	200 mm
6	High Crank	SA5858	125 mm	200 mm

The height of crank is measured from bottom of base to centre of crank. The lengths of the crank arms are 300 mm X 300 mm & 350 mm X 350 mm. 300 mm X 300 mm cranks (S5855) are used with interlocking frames having 100 mm lever pitch and 350 mm X 350 mm cranks (S 5855) are used where the lever pitch is 125 mm. Accommodating cranks are generally used in crank type Lead Outs and at rodding diversion where a group of rodding more than three in number, is required to be diverted by 90 deg· The curved arm of the accommodating crank should always be connected to the cabin side rodding, the curved arm of the crank accommodated placing of a higher crank immediately in front of it facilitating its movement for eight inches.

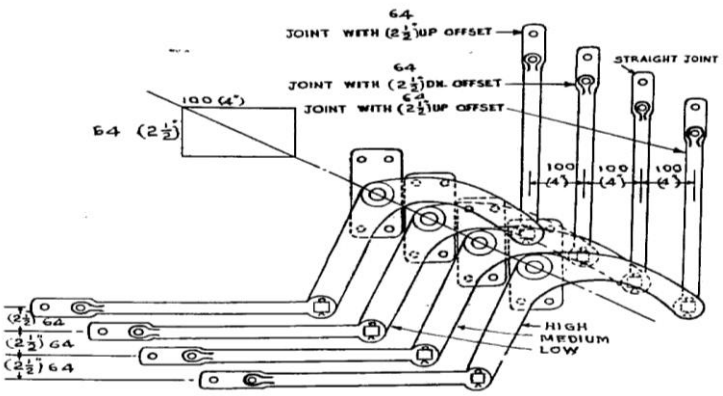


Fig. 2.2(a)(i) ACCOMMODATING CRANKS
(SA 5852, SA 5853, SA 5854, SA 5856, SA 5857, SA 5858)

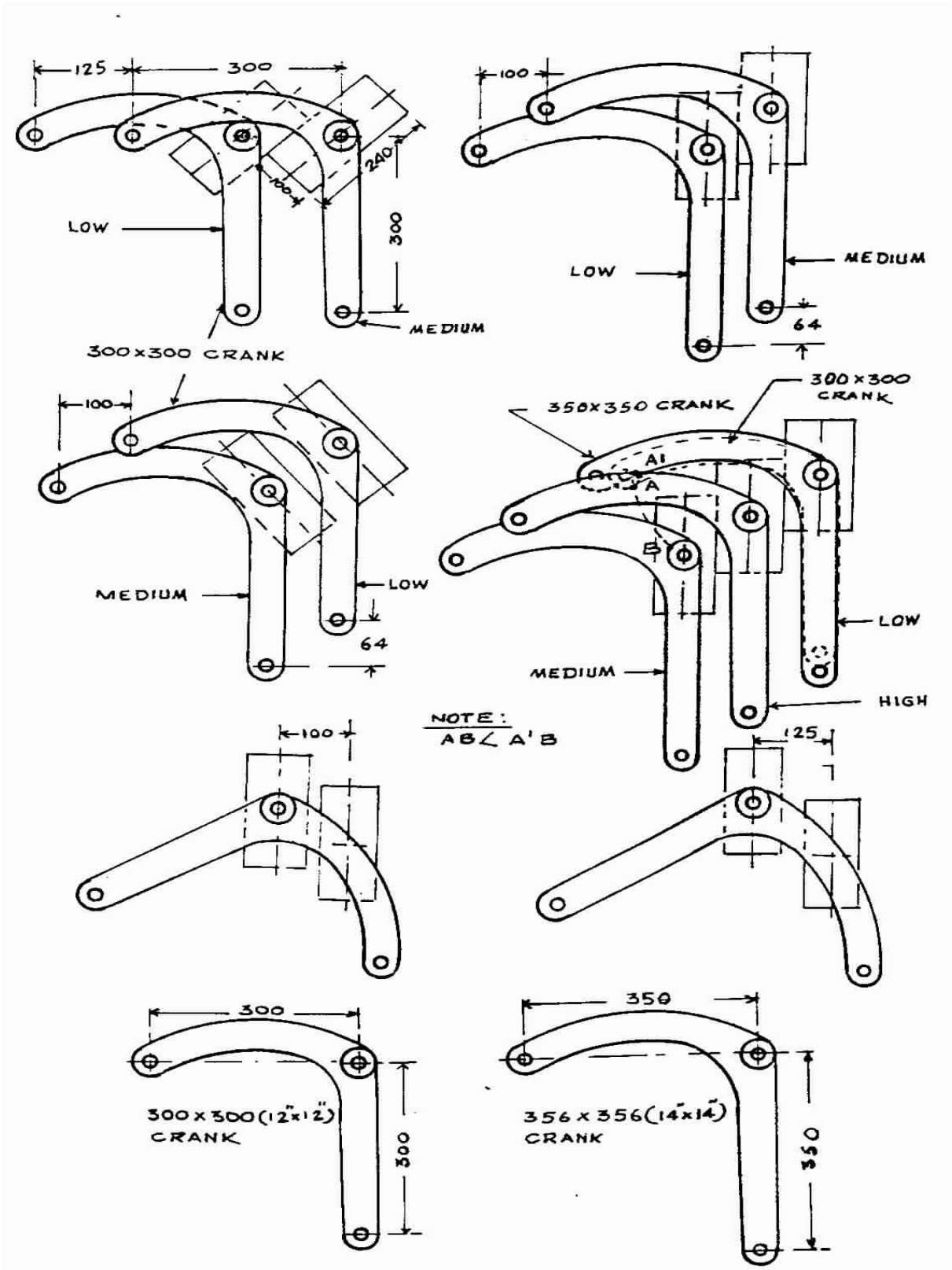


Fig.2.2 (a)(ii)ACCOMODATING CRANK (S 5851/M, S 5855/M)

(b) **Adjustable Crank(SA 3416)**

It is a right angled crank with a vertical axis one arm of which is provided with means for varying, its effective length. The length of the arms are 300 mm X 450 mm. 450 mm arm being the adjustable one and is manufactured in accordance with the drawing number SA 3416. The adjusting sleeve can be shifted in steps of 12 mm whenever it is required to be adjusted. Since there is always some loss of stroke at the end of a rodding transmission and the connected apparatus requires definite stroke, it is often necessary to adjust the stroke suitably at the adjusting crank, before finally transmitting the stroke to the concerned apparatus. Therefore, an adjustable crank is always the last crank of a rodding runs (see Fig.2.2 (b)).

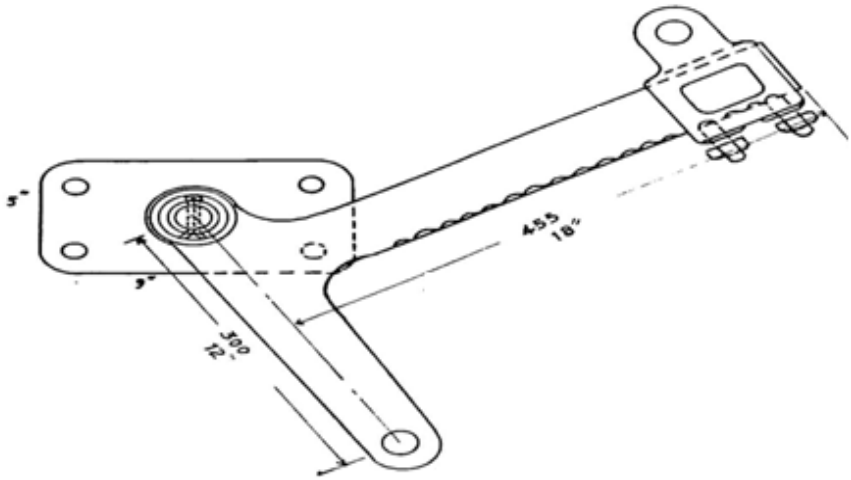


Fig.2.2 (b) ADJUSTABLE CRANK (SA 3416)

(C) **Adjustable Straight Crank (SA 3417)**

It is a two arm crank with a vertical axis, the arms of which subtend an angle of 180^{o}. The longer arm of the crank is provided with means for varying its effective length. The lengths of the arms are 300 mm X 450 mm. There is an adjusting sleeve provided in the arm 450 mm. The provision of this type of crank enables us to bring the adjusting unit very close to the apparatus to be operated, which, otherwise would have not been possible with an ordinary adjustable crank and the cross rod connecting the operating unit would be too long. Care should be taken to see that the adjusting sleeve does not approach the end of the adjustable arm, as this denotes undue loss of stroke in the run, the points are harder to work, and there is less holding power to keep this tongue rail pressed against stock rail (See Figure 2.2(c).

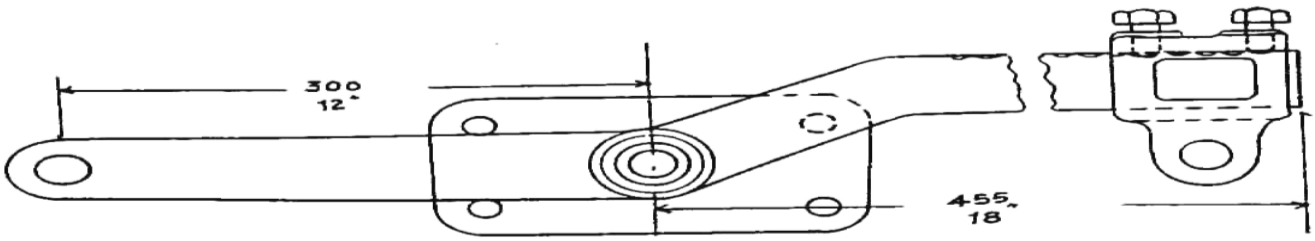


Fig. 2.2(c) ADJUSTABLE STRAIGHT CRANK (SA- 3417)

(d)**Straight Arm Crank (SA 6134, SA6135)**

It is a two arm crank, the arms of which subtend an angle of 180 deg. This arm generally available in sizes 250 X 250 mm and 300 X 300 mm, and are used in point's assembly and in reversing the motion and changing the alignment of a rodding run.

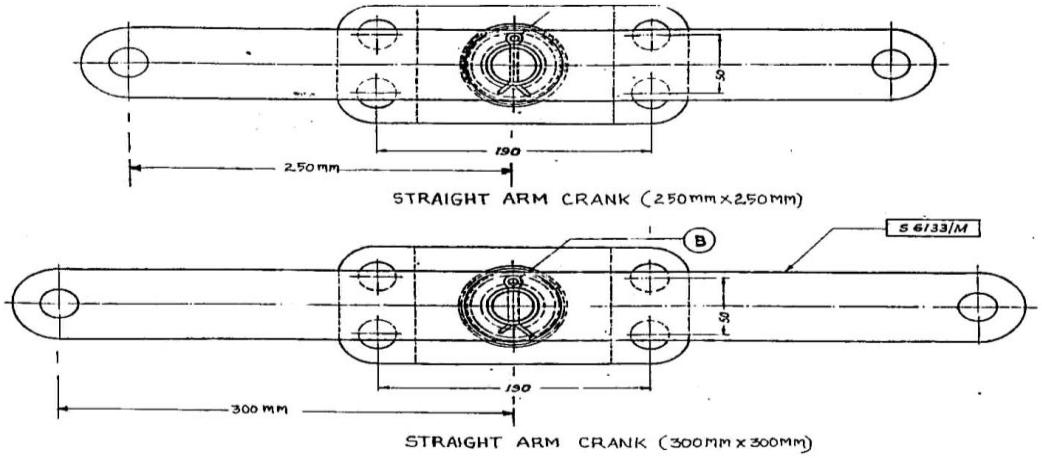


Fig. 2.2(d)

(e) **Horizontal Crank (SA 3414 and SA3415)**

This is a two arm crank with vertical axis; the arms of it are at right angles to one another and are available in size 300 X 300 mm is used for diversions in the main run of rodding and in the lock bar assembly 300 X 400 mm size of generally used in Lock Bar Assembly, See Fig2.2(e).

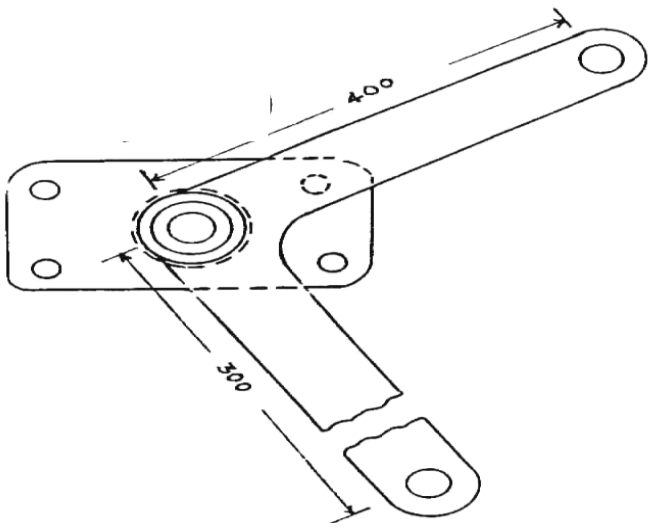


Fig. 2.2(e) HORIZONTAL CRANK (SA 3415)

(f) **Relief Crank (SA 6129, SA6130, SA6131)**

Arm crank arranged to transmit motion other than, in a straight line for small diversion usually when a diversion in a rodding run is required to be made to a maximum limit of 20 deg relief crank is used. This crank is available in three heights, high, medium and low. The length of the arm in each case 300 mm. The arrangement of placing the crank is illustrated in the sketch (See Fig2.2 (f)).

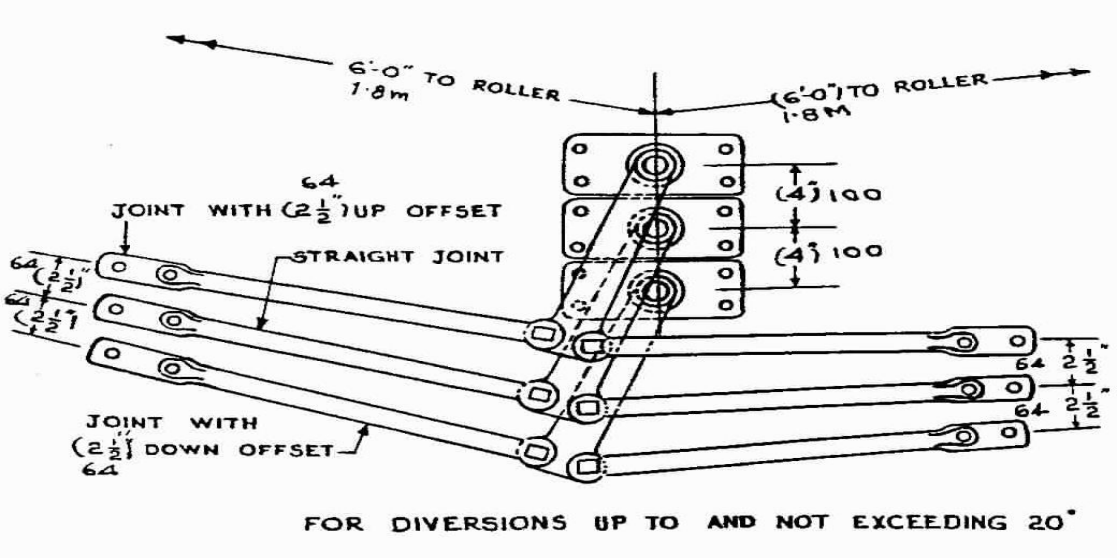


Fig. 2.2 (f) RELIEF CRANK (SA-6129, SA-6130, SA-6131)

(g) **Vertical Crank (SA 3412)**

It is a two armed crank with its axis horizontal, the arms being at right angles to each other .The standard crank is mounted on pedestal at a height of 438 mm, from the bottom of base. The crank arms are each of 300 mm. The vertical crank is used in the inside Lead Out for connecting one of its ends to the down rod from the lever tail, and the other to the accommodating crank, in the case of a crank type Lead Out (See Fig : 2.2 (g)).

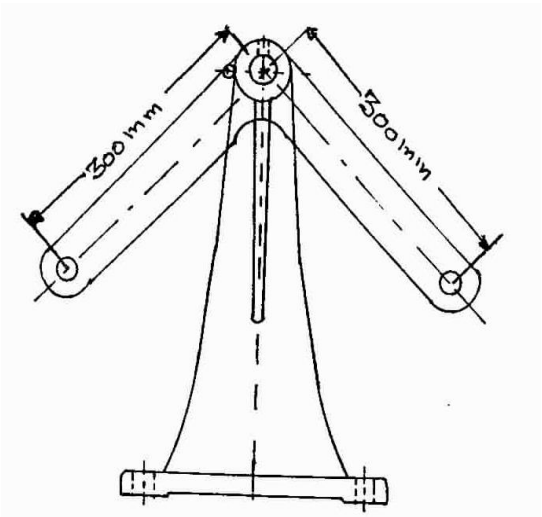


Fig. 2.2 (g) VERTICAL CRANK

(h) **Signal cranks (SA 2210)**

These are fixed at the base of signal and are available as 1-way and 3-way. The crank arm lengths are 225 X 300 mm. The 225 mm side is always connected to the signal C/W balance lever. The 300 mm arm has three holes to receive wire connection at distance of 225 mm, 262 mm and 300 mm from the crank fulcrum.

2.3 Points Adjusting Screws

(a) An adjusting screw consists of a left hand and right hand threaded ends fitted to the either end of an adjusting buckle. When the buckle is turned in one direction it draws the two threaded ends towards each other. Thus causing a shortening of length. When the buckle is turned, in the opposite direction, the threaded ends are drawn apart, thus causing a lengthening of rodding.

(b) **Uses:** Point adjusting screws (SA 3628, SA 3629) are used for shortening or lengthening the cross rod and thereby enabling the length of rod to be made exact as required. It is generally installed in the rodding run between the adjustable crank and the point or lock bar.

CHAPTER - 3: LEAD OUT

3.1 Lead Out

(a) The term "Lead Out" is applied to the mechanical connections of an interlocking installation, between the interlocking frame and outside run of rodding and wires [see Fig 3.2 (b)].

(b) There are two types of lead outs in use
(i) Crank type lead out; [see Fig 3.2(d)] and

(ii) Rocking shaft type lead out

But crank type lead out along shall be used unless otherwise stated a crank type lead out is divided into two parts: Inside Lead Out and Outside Lead Out.

(c) Inside Lead Out: The inside Lead Out usually comprise the following materials:

(i) **Down Rod:** It is a rod used for connecting an interlocking lever to a vertical crank It consists of two 33 mm solid joint at the two ends of a 33 mm solid rod. One of the joints is connected to the lever tail and the other joint is connected to a vertical crank placed vertically below the lever. The down rod is always made out of 33 mm solid rod. Sometimes it is made up of two 450 mm solid joint and a closure of a solid rod with coupling end. Down rods when more than 2.2 M in length must be furnished with a guide or guides in order to prevent buckling.

(ii) **Vertical Cranks:** Vertical cranks for receiving the Down Rods are bolted vertically below the lever either to mild steel lead out plates or to two parallel channel irons. The crank should be exactly at right angles to either the channel irons or to the longitudinal sides of Lead Out plates, and should be positioned in such a manner that the hole in the crank arms vertically below the concerned lever tail hole. This would enable a down rod being connected without an offset.

Vertical cranks should be neatly arranged on the inside Lead Out plate. The exact position of a vertical cranks is determined by dropping a plumb line from a hole (say giving 200 mm stroke) in the lever tail to which the connections are to be made with the lever normal, and the crank arm hole is directly below the plumb when it 330 mm above crank base bottom. The other end of the vertical crank, which works in between the two limbs of the crank stand, is connected to a standard Flush Joint (SA6053). The flush joint is connected to solid rod through the coupling ends, and is let out for connection to the outside Lead Out cranks.

(iii) **Lead Out Plates:** The vertical cranks are sometimes fixed to channel irons or sometimes to plates. When plates are used. It is usual to choose them of convenient sizes so that these could be easily handled by two persons. One Rly. uses Lead Out plates of size 2440 mm, 1000 X 600 mm the girders are spaced at intervals of 1000 mm. The two adjoining plates join each other on the girder along the web of the girders. The plates are riveted to the girder with 16 x 37 mm Cup head steel rivets, countersunk on top. The level at which Lead Out plates are fixed, always bear a definite relationship with the level of the adjacent track. It depends upon the level of the main rodding run. The Lead Out rod from the vertical crank is run straight to the medium accommodating crank. An offset of 60 mm up or down will be given these Lead Out rods which are to be connected to high and low accommodating cranks respectively. The Lead Out rods will be at the same level as the main run of rodding.

(iv) **Lead Out Channel Irons:** (Fig: 3.2(a))Channel irons are used by some to fix the vertical cranks, vertical wheels etc, the channel irons are placed parallel to the interlocking frame at ground level and is secured rigidly to the foundations embedded in the ground. The level of the channel irons is fixed in relation to the adjacent track rail level. The vertical cranks are directly mounted on the channel irons and are secured with 20 x 62 mm bolts and nuts. The vertical wheels are, however, fixed partly on the channel iron and partly on a separate foundation.

(v) **Wire Connections:** While making wire connections for signal transmission from the lever tail following materials are required See Fig 3.2(c).

Sl.no.	Description	Drg. No
1	Wire Shackle 20 mm Jaw	SA 3082
2	Split Link	SA 3085
3	7/17 strand or No10 SWG Solid wire with thimble joints	SA 3084
4	Wire adjusting screw	SA 3070
5	Wire rope slings	SA 3095
6	Vertical rope wheel	SA 3009

Wire rope shackle is fitted to the 16 mm pin hole of the lever tail and secured by 16 mm (5/8") pin. If the lever tail is at fairly good height a piece of either 7/17 strand wire or No.10 solid wire having thimble joints on either end is connected to the shackle through the split link. Then at a convenient height the wire adjusting screw is connected to this wire through split link. The adjusting screw in turn is connected to a wire rope sling again through a split link. The wire rope sling passes around a vertical wheel which is fixed either to the Lead Out plate or to the channel iron and placed directly below the signal lever. The wire rope sling is again similarly connected to a piece of either strand wire or solid wire and is let out to the outside Lead Out connections for catching the wire run of the signal transmission. The vertical wheel used in this connection is available only in one type, the base of which is 100 mm (4") broad. A guide should be fitted to each vertical rope wheel to prevent slipping off rope wire.

3.2 Outside Lead Out

(a) As already stated before, all crank type Lead Out will have an outside Lead Out. This is again of two types

(i) Plate type and

(ii) Girder or channel type

Plate type Lead Out

Plate type Lead Outs are usually fixed on the extended girders of the inside Lead Outs, thus maintaining the same level with the inside Lead Out plates. The size of the plate may be same as the size of inside plates. Accommodating cranks, high low and medium are arranged suitably to receive the rodding runs coming from the inside Lead Out and for transmitting them out in a right angle direction maintaining a spacing of 64 mm between the two adjacent rods.

When groups of accommodating cranks containing two low cranks are required to be fitted at 100 mm centre the pin of the curved arm of one will foul the fixing bolt of the base of the other. This bolt can be left out and only three bolts used instead of four bolts.

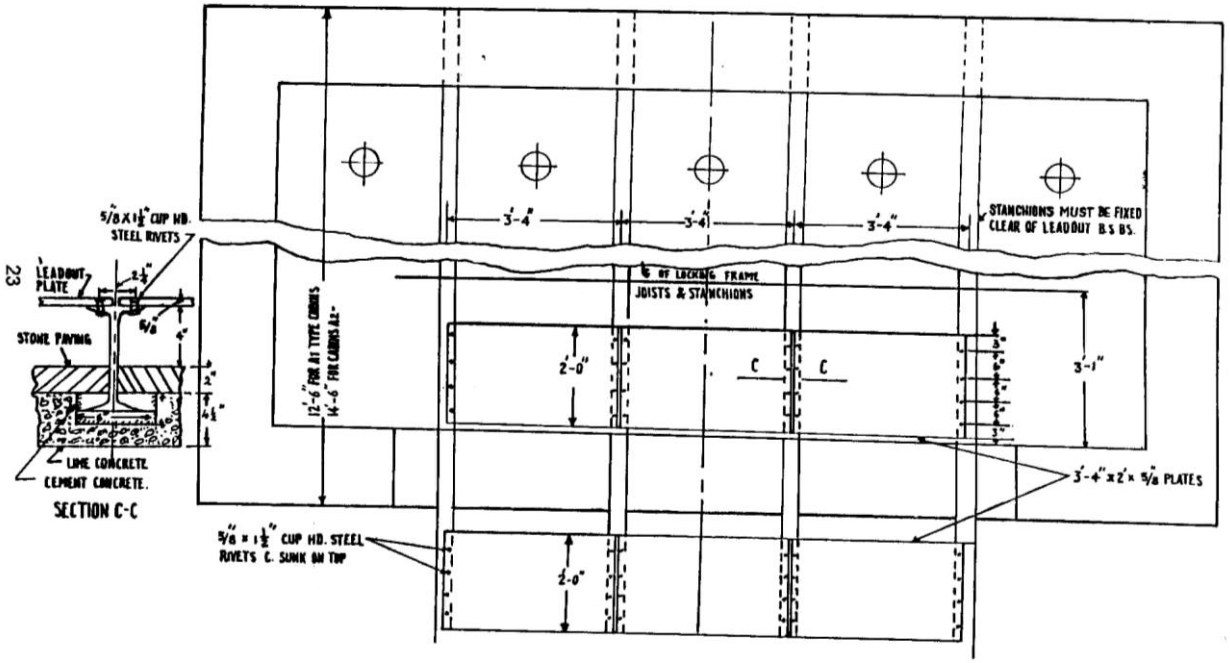


Fig. 3.2(a) TYPICAL LEAD OUT PLAN

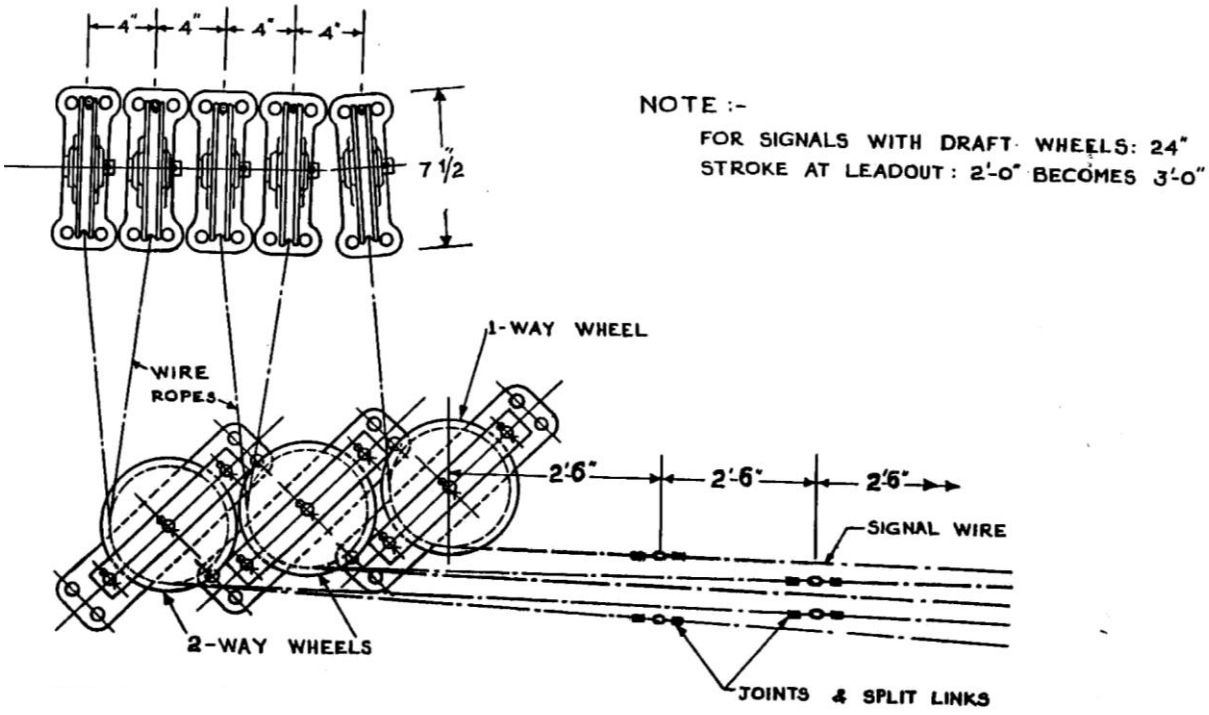


Fig. 3.2(b) WHEELS
(3-WAY WHEELS NOT TO BE USED ON LEAD OUTS)

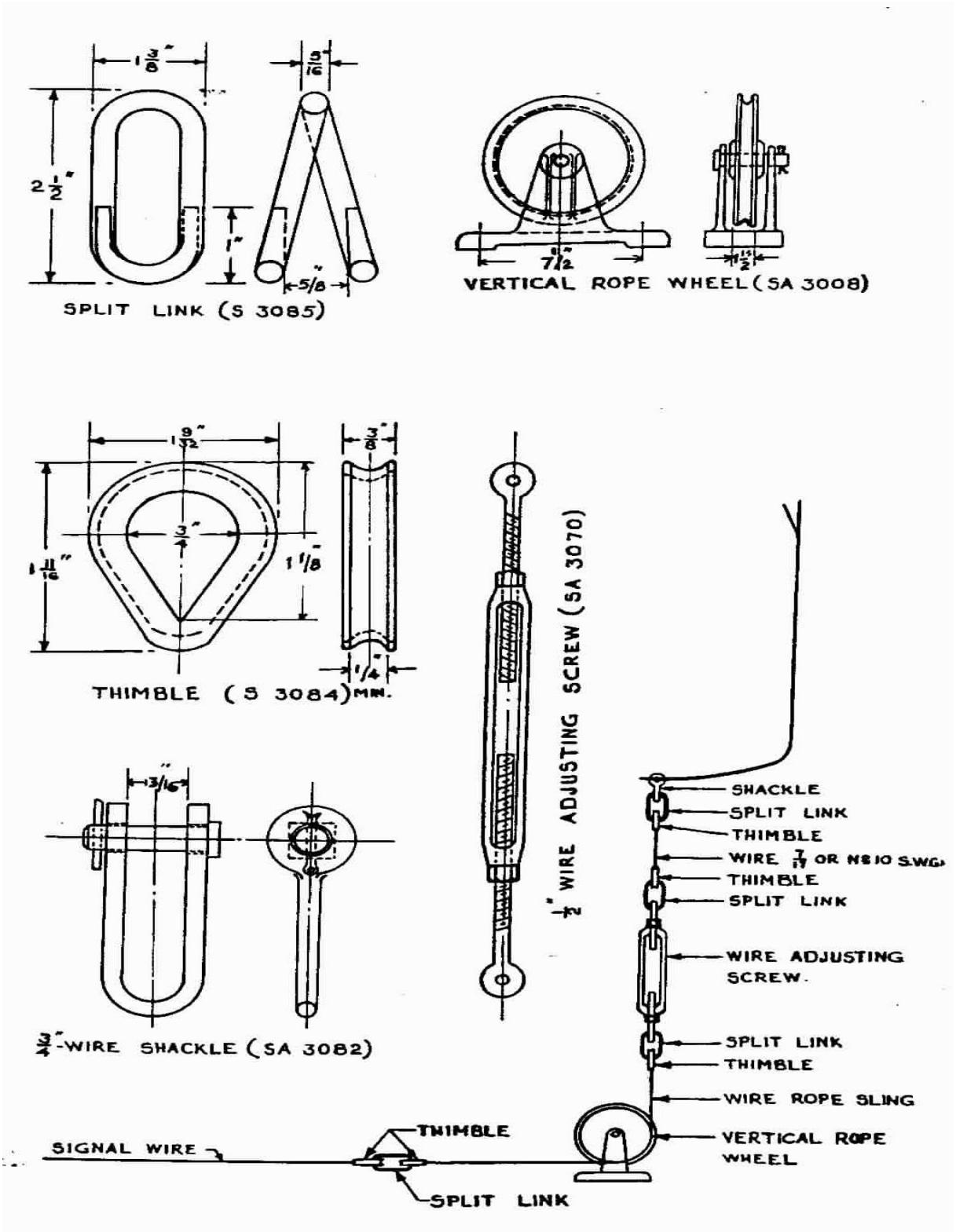


Fig.3.2 (c) WIRE CONNECTIONS FOR INSIDE LEAD OUTS

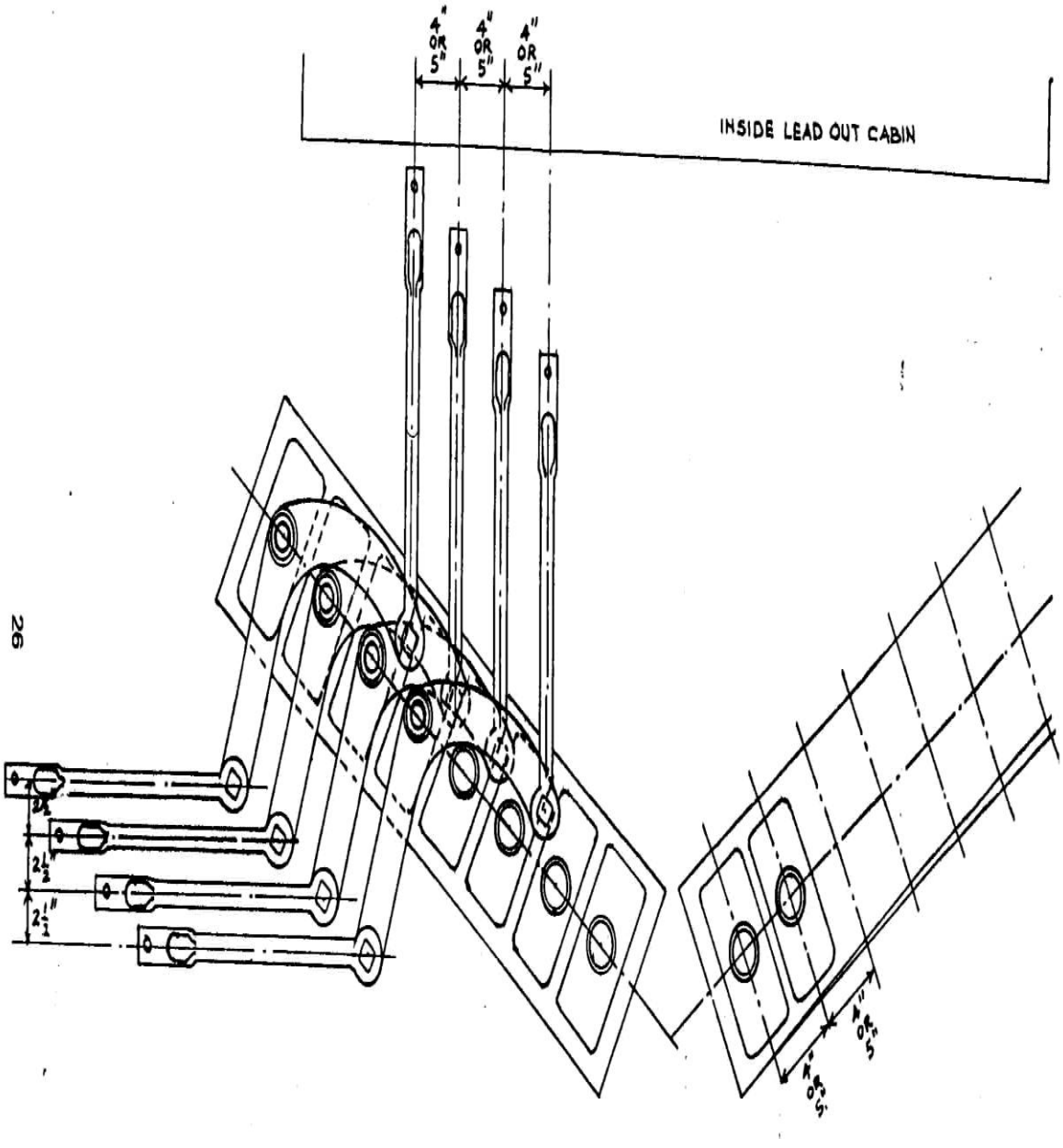


Fig.3.2(d). OUTSIDE LEADOUTS

CHAPTER- 4: RODDING, SUPPORTS, JOINTS & ALLIGNMENT

4.1 RODDING

The rods generally called "point Rods" are of various sections channel, T-section, round, tubular and solid. Most commonly used rodding on Indian Railways are the tubular and solid rodding. There are very few places in India where channel rodding and 'T' section rodding are used. The initial cost of channel-I iron is much more than that of a tubular rodding, but owing to its long life, greater rigidity and the saving of labor costs due to elimination of much of the Blacksmith's work and maintenance work it is sometimes considered more suitable for working points and lock bars than by tubular rodding. However, on Indian Railways, use of tubular and solid rods has only been recommended.

(a) **Solid Rodding (S 3635A)**

The solid rodding shall be in accordance with IRS Drawing specified by the purchaser and made from 33 mm dia. class I steel bar manufactured as per IRS specification NoM4 weighting not less than 4 lbs/ft. The coupling ends are either stamped from the full length of bar or are welded to 33 mm dia. solid bar steel grade std. 428 IS 226 IRS 65 and S10 by electric flash butt welding process.

(b) **Tubular Rodding (SA 3634 M)**

The tubular rodding with outside dia. 33.5 to 34.5 mm is supplied in accordance with IRS Drg. No.SA 3634 specified by the purchaser made from mild steel "C" class butting of 25 mm nominal bore (MS black tube 22 mm bore) (Heavy) in accordance with BS specification No.1337 of 1947. The standard coupling end shall be made from class I steel in accordance with IRS specification No.M4. They shall enter the tubes for a distance of not less than 90 mm and shall be securely welded in position.

Advantages & Disadvantages of Tubular Rod: Lighter in weight, less friction to be overcome and it is cheaper in initial cost, on the other hand, the use of tubular rodding requires extra maintenance to prevent corrosion and unless subject to careful inspection, such corrosion may eventually result in breakage with the possibility of serious failures. However, solid rodding alone must be used for down rods in the cabin between the vertical crank and the accommodation crank and where rodding crosses the track.

Solid and tubular rodding are supplied in lengths of 5500 mm with coupling ends on either ends. These are joined to one another by means of two 55 x 12 mm bolts fixed at the coupling ends. The coupling end (53633) has been designed in such a way that the entire force at the joint is taken up by the coupling arrangement and bolts are not subjected to shear stress. The function of the bolts is simply to hold the rods together.

4.2 Rod Supports

(a) For smooth movement of the rodding the rodding is supported on rollers which are called "bottom roller" spaced not more than 2.2 Mts. for solid rodding and 1.85 Mts. apart for tubular rodding. On curve the distance should be 1.85 mtrs. for both types. In addition, a small roller (top roller) is provided above the rods to prevent any undue distortion in vertical plane.

(b) **Trestles (S 3534/M or S 3535/M):** These are cast iron bases of height 380 mm to which roller stands are fixed. Trestles are supplied in two sizes, i.e., 2-way and 4-way. Trestles for multiple runs of rodding must be bolted together with 12 X 45 mm bolts. When an extra rod is to be laid in an old run, use may be made of trestles extension (S3542) pieces wherever possible. Trestles must be rigidly fixed in the

soil and the top surface of trestles must be level which should be tested by a spirit level If, however, local conditions of soil do not provide sufficient rigidity trestles must be supported with ballast well rammed or alternatively trestles may be fixed with cement concrete.

(c) **Guide Roller Assembly:** Materials required to guide and support a rodding is known as a "Guide roller Assembly". The detail of 1-way guide roller assembly (SA 3537/M) is given below See Fig 4.2.

Sl.No	Description	Numbers
1	Trestle	1 (S 3534/M)
2	Roller Stand	2 (S 3538/M)
3	Roller (Top)	1 (S 3540/M)
4	Roller Bottom	1 (S 3539/M)
5	Top Roller Pin	1
6	Split Pin 1/4"X3 (5X53 mm)	2
7	Bolts and nuts 1/2" X 1 1/2" (12 X 40 mm)	4 Nos.

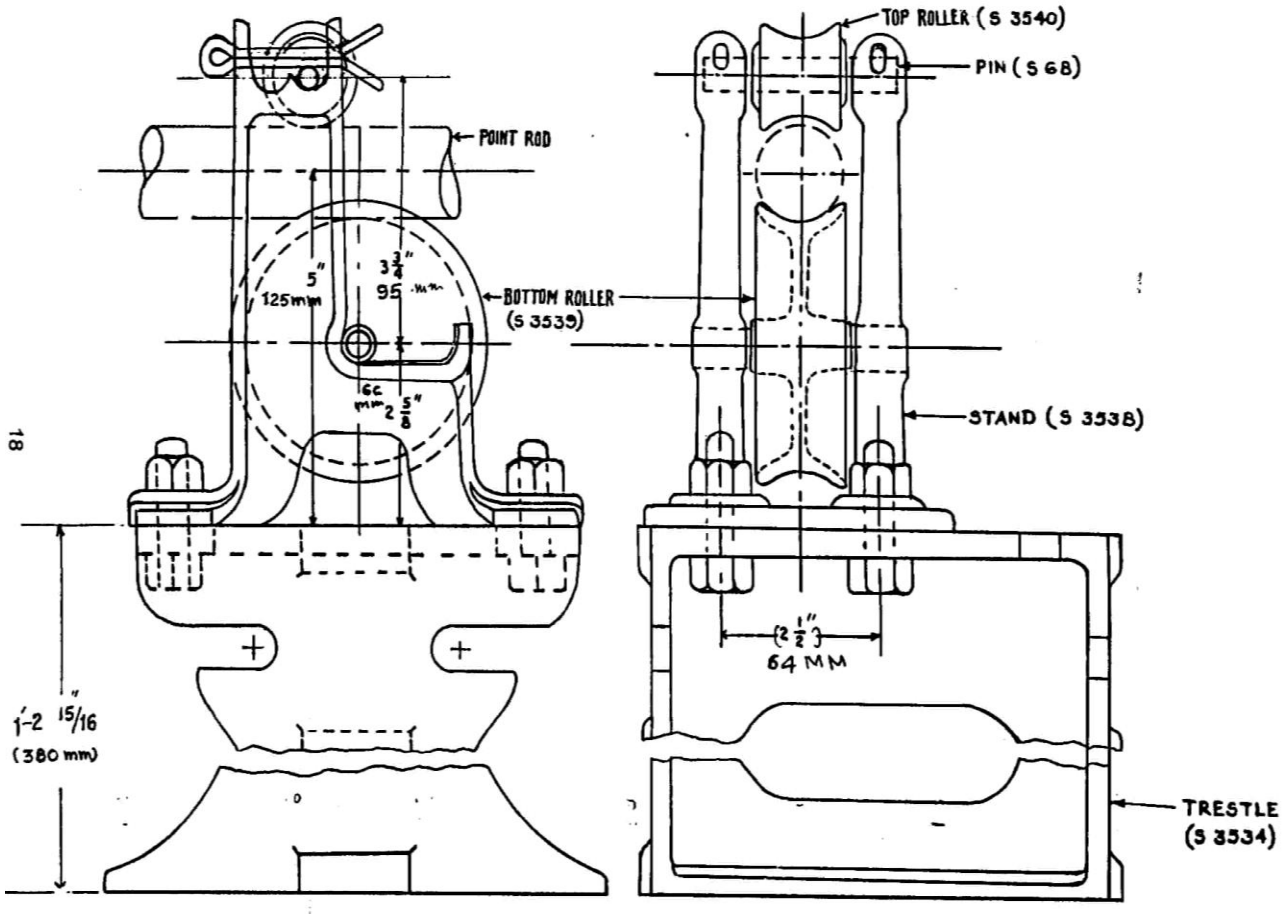


Fig. 4.2 GUIDE ROLLER ASSEMBLY-1 WAY (SA-3537)

4.3 Rod Joints

(a) Some Railways use standard types of joints with coupling ends for connection to all levers, cranks and compensators to enable joint renewals to be made afterwards without necessity for any smithy work in the field.

(Note: Please see Fig 4.3(a,b,c,d&e) for details. Annexure E in Page No : 156- has details of Type of joints & their drawing numbers.

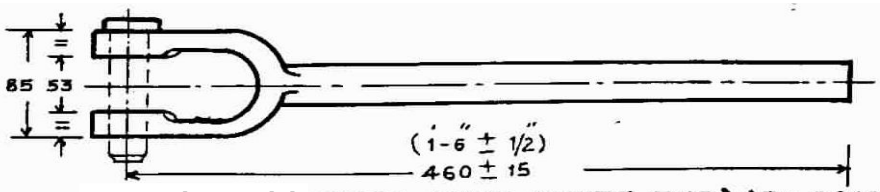


Fig. 4.3(a) WIDE JOINT (BUTT END) (SA 3619)

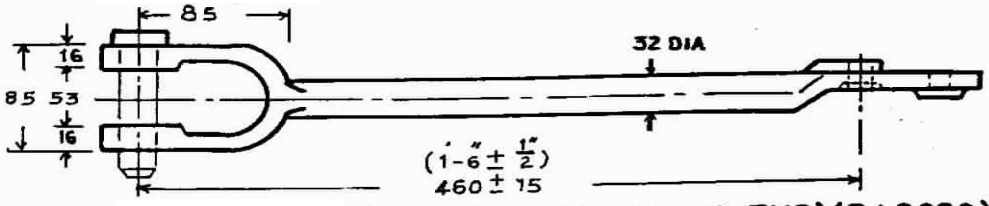


Fig. 4.3(b) WIDE JOINT (COUPLING END) (SA 3620)

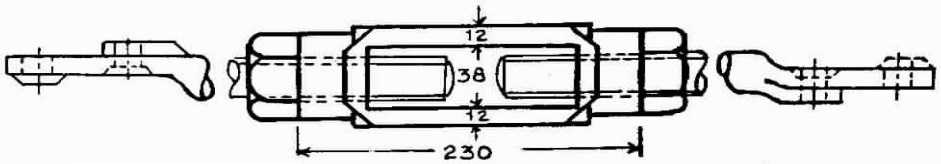


Fig. 4.3(c) POINT ADJUSTING SCREW (COUPLING EN (SA3628)

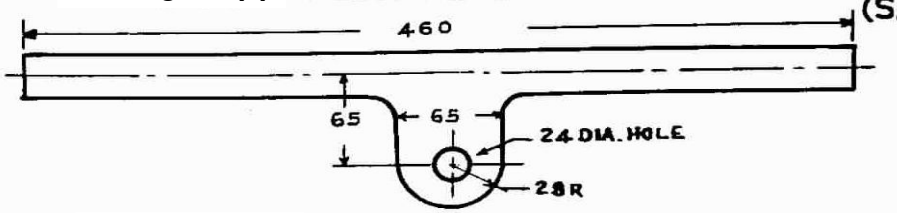


Fig. 4.3(d) LUG EYE (BUTT END) (SA 3631)

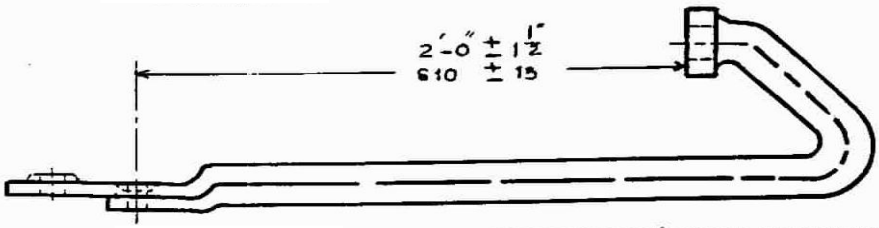


Fig. 4.3(e) SWAN NECK (COUPLING END) (SA 3608)

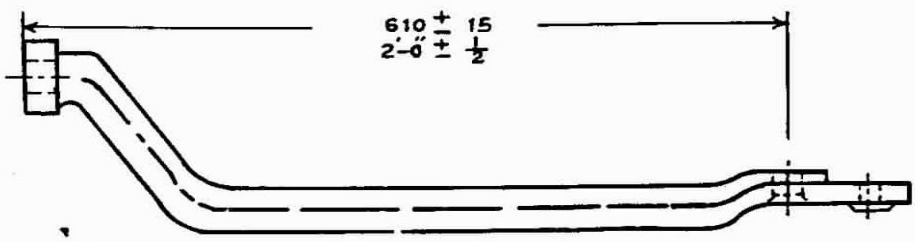


Fig. 4.3(f) GOOSE NECK (COUPLING END) (SA 3613)

4.4 Joints, Rods and Rod Supports

(a) It is considered desirable to use always standard joints with definite lengths and off sets. This will enable the renewals of the joints, at a later date by similar joints without involving Blacksmiths aid. If standard joints are not employed for each renewal Blacksmith's gang would be required at the site. Therefore, standard off set joints if used should not ordinarily be altered, but when a special offset is unavoidable, the straight 450 mm Joint should be used.

(b) Joints in the rod run should be laid flat some railways provide bolt heads of joints underneath for ease of inspection of nuts, but the drawback of this arrangement is that if the nuts are lost, then bolts fall down causing a disconnection, whereas some other railways provide bolt heads on top and claim that the rod does not get disconnected, but the inspection of nuts will be difficult Hence, it is preferable to provide one bolt with head on top and the other with head underneath. Bolts must be well tightened up, but not rivetted over.

(c) Standard coupling end 75 mm are used to enable intermediate closures to be made in rodding for making lengths fit the standard joints, this avoids necessity for extra cuts and waste of rodding Lengths of cut rodding saved should be utilised for other closures.

(d) When welding a coupling end into galv. tubular rodding, galvanizing at location of weld must first be burnt off in a slow fire; coupling end must enter tube a distance of at least 90 mm to make weld secure. Location weld and coupling end must afterwards be given two coats of aluminum paint.

(e) Welding of 35 mm joints into rodding should be avoided because this will alter the standards of joints, it will be difficult for the Blacksmith to work upon such a rod.

(f) When connecting up near end of coupled points or coupled locks one flush joint with coupling end and one of solid joint with coupling end may preferably be used for joining up lug eye to adjustable crank.

(g) When requiring a connection from a lug eye to a crank two of the solid joints joined together makes an alternative suitable connection provided one jaw is twisted through 90^{o}.

(h) Rods connecting the adjusting crank to the lug eye should be long enough to avoid extra frictional forces.

(i) Where standard driving and other rods are provided with screw joints the joint end must be connected to the unit to be adjusted.

4.5 ALIGNMENT OF POINT RODDING

The following rules shall be observed for running rodding runs

(a) Rods in main run should be arranged in a manner to permit leading off towards the track side in regular order.

(b) With the lever in the middle position joints and lug eyes must be located not less than 300 mm (12") from roller stand.

(c) Cranks and compensators should be so located in the main run that it leaves field side clear for additional rodding run and must not be fixed nearer a point rod roller than 900 mm (3 ft).

(d) Rodding must be run in straight alignment as far as possible to reduce frictional losses.

(e) Distance from the nearest rod to the Centre of the nearest track should not be less than 1905 mm on broad gauge lines and 1370 mm on MG and NG lines except when platform walls or other structures render this impossible.

(f) When practicable, rodding running under tracks must be arranged to permit the standard spacing and packing of the sleepers. The top of the rodding should not be less than 25 mm (one inch) below the bottom of the rails. Whenever possible, the running of rods under rail joints should be avoided. Where a series of crossings have to be made each group must not be less than two sleepers apart.

(g) Rodding under level crossing should preferably be run through standard reinforced concrete channels having mild steel cover plates at the road level.

(h) Where diversion in rodding run up to 20 deg is necessary relief cranks must be used in the manner shown in the drawing.

(i) Off-sets in the rodding should be limited wherever possible to 60 mm (2 1/2"). Off sets of 90 mm may, however, be made where solid rodding is used. Minimum lengths of the offset should not be less than twice the amount of the offset. Where more than one off set is necessary, a guide should be provided. When making off sets in joints, the pin should be kept in place to keep the pin holes true. No. off sets should be given in a tubular rod. The portion where offset is to be given has to be first replaced with solid rod.

4.6 Fixing of cranks and compensators

Cranks and compensators should be so fixed that the centre line of the rod connection passes through the centre of the joint pin when the crank or compensator is in its normal or reverse position. Care should be taken to see that the throw of a crank or compensator is the same on each side of the center.

4.7 Installation of a new run of Rodding

The procedure to be adopted for installing a new run is to lay the rodding out on the ground in its proposed position. Before this, it should be ensured that all rodding are straight and that there is no twist in the coupling ends of the rodding attached to either ends of each piece. The position of the trestles should then be marked care being taken that the joints of the rodding do not foul the rollers on the trestles and that the latter are not placed more than the maximum permissible distance apart. Great care has to be taken for ensuring the level of the run with respect of the track. The top of the top roller should be practically in level with the top of the rail or the top of the roller standards adjacent to track must not be fixed more than 64 mm above rail level. The height at which rodding alignment is taken is again a matter of compromise Lower the alignment, lesser will be the offset in the cross rod, but maintenance problems will increase because rodding run will be covered with dust and mud and also likely to be submerged in water if the adjacent ground is at a low level. As regards the rules to be observed, for running a rodding run, instructions given in Para 4.5 are to be followed.

4.8 Material required to run rod transmission for given point layout

(Total Rodding Length = 190 Mts.)

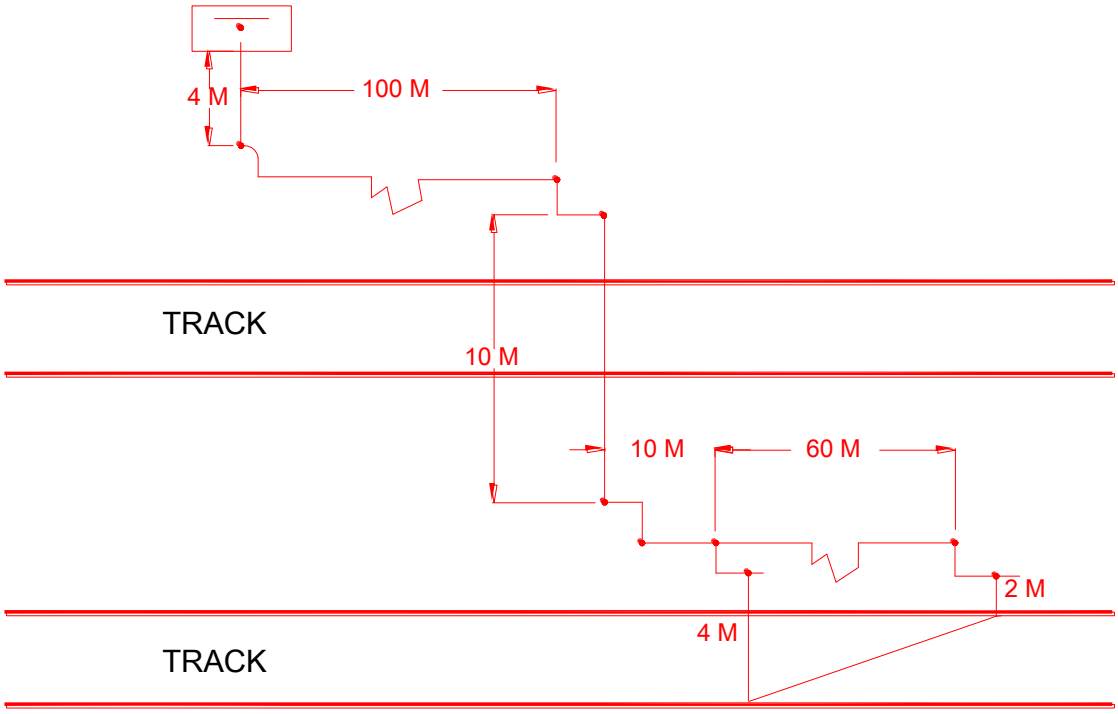


Fig: 4.8

Sl.No	DESCRIPTION	QUANTITY
1	Vertical Crank (300 x 300 mm)	1 Nos.
2	Point rod(5.5 Mts.x 33 mm)	37 Nos.
3	Accommodating crank (300 x 300 mm)	1 Nos.
4	Horizontal crank (300 x 300 mm)	2 Nos.
5	Adjustable crank (300 x 450 mm)	2 Nos.
6	Rod compensator	2 Nos.
7	Flush joint coupling end(33 mm dia. x 460 mm)	1 Nos.
8	Solid joint coupling end (33 mm dia.)	14 Nos.
9	Eye joint (33 mm dia. x 460 mm)	1 No
10	Compensator Rod (33 mm dia. x 1370 mm)	4 Nos.
11	Point adjusting screw but end dia.	2 Nos.
12	Foundation (C1)	6 Nos.
13	Trestle 2 way	100 Nos.
14	Roller Bottom	100 Nos.
15	Roller Stand	200 Nos.
16	Roller Top	100 Nos.
17	Top Roller Pin	100 Nos.
18	Split Pin (5 x 75 mm)	200 Nos.
19	Bolt MS HEX- with washers a) 12 x 37 mm b) 12 x 55 mm c) 12 x 65 mm	 a) 400 Nos. b) 200 Nos. c) 32 Nos.

CHAPTER - 5: ROD COMPENSATORS

5.1 Introduction

It is obvious that mechanical transmission, whether of rods or single wire or double wire, should be compensated for linear motion. This can be achieved automatically, in the case of rods and in double wire by an automatic compensator for single wire transmission there is no compensator. This chapter deals with the design and installation of compensators for rodding.

The transmission used in mechanical installations for the operation of points, locks and other similar functions, is tubular or solid mild steel rodding 33 mm outside diameter, which has a linear expansion rise in temperature Co-efficient 0.000012 mm per 1° C, Taking the case shown in the figure, if we assume the length of transmission to be 300 M and the temperature to vary from over a calendar day, the points will gap 68.4 mm, 300 mm - 37° to 18°C = 68.4 mm (0.000012 x 19°C x 300 m x 1000).

(a) The range of temperature variation at ground levels may be as much as (150°F) 83.3°C. over a whole year and (50°F)10°C over a calendar day and

(b) The length of transmission may be as much as 460 M and the importance of the need for compensation will be readily understood. Unless an automatic compensator is provided on rod transmission, the points or lock or any other similar function will require most frequent readjustment and if this was not done the function will operate in an irregular manner, or the rodding will buckle, and the installation will tend to work hard.

5.2 Types of Compensators

(a) Crank used as a compensator. A reverse crank and a crank which converts the pull motion of the rodding into push motion or Vice-versa and automatically compensate (see figure 5.3) equal lengths of rodding on each side of it moving in opposite directions.

(b) The standard IRS compensator (See Fig 5.1) which consists of one acute angle crank and one obtuse angle crank joined together by a link of suitable length.

5.3 Crank of different types

Cranks are used for changing the alignment and direction of motion, but sometimes advantages is taken of the position of a crank in the rodding transmission to serve the purpose of compensator as well. But crank used as a compensator has certain limitations. As the length of crank arm is only 300 mm. It can only take up the expansion and contraction of 60 M (200') of rodding connected to it. With a view to limit the deflection of rodding to 15 mm (06”) on either side of the mean position of the rodding runs. But as compensation depends upon the type of cranks used, so wherever they are used, the following rules in regard to their use should be borne in mind.

(a) The movement of the rodding leaving the vertical cranks in the cabin must ordinarily be a pull so as to correspond with the movement of the lever.

(b) All vertical and accommodating cranks must have equal arms.

(c) The last cranks in the alignment should be an adjustable crank.

Note: *When a crank does not convert a pull movement into push movements, it is normal and when it does, it is reverse crank.*

5.4 The standard compensator: See Fig: 5.1

The standard IRS compensator is a combination of two cranks, one obtuse (120 deg) and the other acute (60deg) and is designed to provide the range of compensation required under normal conditions. It works on the same principle as the other types; it simply reverses the direction of motion of the rod and, therefore, compensates equal lengths on either side of it.

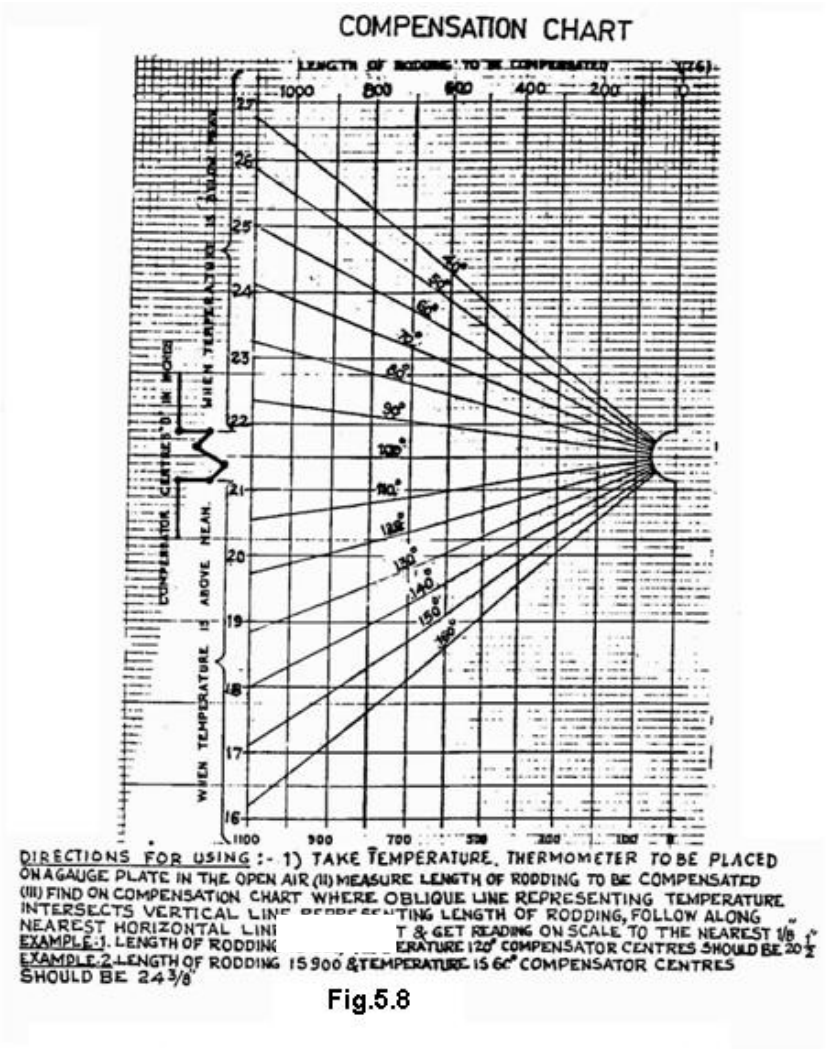


Fig.5.8

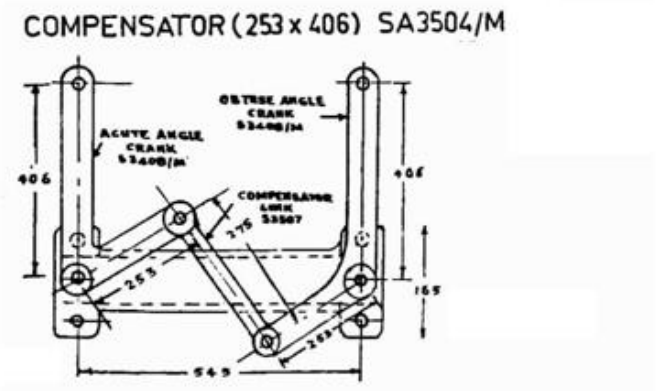


Fig. No. 5.1

5.5 Compensating range of standard compensator

The range of standard compensator with 253 mm x 406 mm cranks arms and $120^{0}/60^{0}$ crank arm angles.

The range of the standard compensator is up to 60^{0}, i.e., 30^{0} on either side of its mean position. Within this range the compensator will be able to convert the pull movement received at one crank arm as a push movement to the other crank arm without alteration of stroke. But if, however, the compensator arms are taken beyond this range, the stroke on either side of the compensators begins to change. For example when the 60^{0} crank angle arm of the compensator, is moved by 25 mm beyond its limiting stroke when the compensator is in open position the obtuse angle crank arm moves by about 37 mm. When the acute arm is moved by another 25 mm in the same direction, the obtuse arm end moves by 68 mm. This shows that whenever the compensators arms cross the limit of compensating range they start moving erratically and set up a dangerous condition, and if it be installed in a point transmission, the point may be left gaping with the corresponding lever in the cabin in the full normal or reverse position. It is, therefore, considered necessary to allow a safety margin on either side of the compensating range by confining the limit of the compensator to $22\ ½^{0}$ on either side of its mean position.

Another factor which is responsible for confining the compensating range of the standard compensator to 45^{0} is the necessity of restricting the displacement of rodding alignment within 15 mm (16") of its initial alignment. If the alignment of the rodding is allowed to be displaced by more than 15 mm (6") with the present spacing of roller standards, the working of rodding becomes extremely hard.

The standard compensator with its 253 mm x 406 mm (10" x 16") arms and $120^{0}/60^{0}$crank angles is, therefore, used for the ranges shown below.

Sl. No	Stroke at lever Tail of	Range of Temperature	Length of Transmission required	No. of compen sators	Remarks
1	6" (150 mm)	120°	390 Mts. (1300')	1	No Compensator need be used for transmission up to a length of 12 Mts. (40') for points and 18.5 Mts. (60') for lock bar operation
2	6" (150 mm)	150°	325 Mts. (1050')	1	
3	6" (150 mm)	120°	Beyond 390 Mts.	2	
4	6" (150 mm)	150°	Beyond 325 Mts.	2	
5	8" (200 mm)	120°	270 Mts. (80.0')	1	
6	8" (200 mm)	150°	210 Mts. (700')	1	
7	8" (200 mm)	120°	Beyond 270 Mts.	2	
8	8" (200 mm)	150°	Beyond 210 Mts.	2	

5.6 Principles of Compensation

The principles common to the various types of compensators enumerated above are as follows

(a) The compensator maintains the end point of the transmission in position during alteration to the length of the transmission caused by temperature changes. This is achieved by neutralizing the movement of the rod on one side of it by an equal and opposite movement on the other side of it the two movements are 'pull' and 'push' and it follows that the movement in 'pull' (Tension) should be equal to the movement in 'push' (Compression).

(b) The compensator should be so located that the movement caused by expansion/ contraction on one side of it must be equal to the movement caused by expansion or contraction on the other side.

(c) In the case of the standard IRS compensator the initial setting of the crank arms should correspond with prevailing temperature See Fig 5.1.

(d) The compensator should transmit working stroke unchanged although it must reverse the direction.

5.7 Installation and location of compensators

So from the above mentioned principles the ideal location of a compensator will be such that the lengths of the rodding in tension and compression shall be equal. The location of a compensator in a straight transmission is a straight forward problem and is easy to calculate the rodding to points and locks, however, in practice, is not run in a straight line but change direction at least once, and in many cases more than once. This makes the location of compensators slightly more difficult The best method of finding the position of a compensator in rodding which changes direction is the 'straight line' method, in which the whole of the rodding is registered as being run in one straight line and the middle point of the line found.

In example (Fig5.6) is shown a length of rodding which does not changes direction. The crank used to the correct position of the compensator is the middle pin of this line, which is 230 Mts. from each end. If we apply the rule given in Para 5.8 this position will be found to be correct Assuming that each 30 Mts. of rodding expand 25 mm then the movement due to expansion on each side of the compensator is 64 mm

5.8 Reversed Cranks

When the crank used to change the direction is a reversed crank, however, the length of the shorter rod must be subtracted from the length of the longer rod. The reason for this is that a reverse crank acts as a compensator because it reverses the motion of the rods, (Fig.5.7) the crank is reverse, and it can be seen that when one rod is pulled the other will be pushed supposing R1 expands 25 mm then R2 will be pulled 25 mm from B, but as R2 is the same as R1, that too would have expanded by 25 mm and the end of the rod at B will not move.

It follows, therefore, that in this instance, the reversed cranks has compensated the expansion of the whole of the rodding. If, however, R1 was long that R2, then the crank will not do all the compensating required. It will only compensate the cases rod and that portion of R1 equal to the length of R2. In such cases and when reversed cranks are used the length of the shorter rod must be subtracted from the longer rod, and the compensator will be fixed at the middle point of the remainder (See all example in Fig 5.7).

5.9 Cranks with unequal arms

So far, we have only considered cases where the arms of cranks are of equal lengths, when the end of one is moved certain distance, the end of the other arm will be moved the same distance, if, however, one arm is twice as long as the other arm the latter will be moved only half the distance. The ratio of the strokes (movements) of the arms of cranks equals the ratio of the lengths of the arms if the length of both arms is known and the stroke of one arm is also known, the stroke of the other arm can be calculated.

Example: the arms of a crank are 250 mm and 300 mm if the stroke on the 250 mm arm is 150 mm, the stroke on the other arm is

$$250: 300 :: 150 : X ; \qquad \frac{X}{150} = \frac{300}{250}$$

$$X = \frac{300 \times 150}{250} = 180 \text{ mm}$$

$$\frac{X}{16} = \frac{12}{10} \quad \text{Thus} \quad X = 72"$$

Again, if the strokes of both arms are known and the length of one arm is known, then the length of the other arm can also be calculated.

Example: An adjustable crank has to drop down 200 mm to 115 mm. The length of the fixed arm 300 mm (12") and the length of the other arm will, therefore, be calculated as follows

$$\frac{X}{300} = \frac{115}{200} = 1725 \text{ mm} \qquad \frac{X}{12} = \frac{4\frac{1}{2}"}{8} \quad \text{thus } X = 6\frac{3}{4}"$$

5.10 Effect of unequal armed cranks on compensations

If a reference is made again to example, it will be seen that if R1 expands 100 mm (4") R2 will be moved 100 mm (4"), and as R2 expands 25 mm (1") the total movement is 5". In this case, the total movement due to expansion is equal to the expansion of other side. If, however, the crank arms are unequal the total movement due to expansion of one side will not be equal to the expansion on the other side, it follows that unequal armed cranks will effect the position of the compensators.

In example Fig. 5.10 (i), the cranks arms are taken 300 mm (12") and 150 mm (6"). If R2 expands 12mm (1/2") R1 will be moved.

$$\frac{X}{12} = \frac{300}{150} = 25 \text{ mm} \qquad \frac{X}{1/2} = \frac{12}{6} \text{ or } 1"$$

The expansion of R2 has, therefore, in effect, been increased, or in other words, the movement due to expansion is equal to the expansion of 30 M (100') of rodding. In this case, in order to complete the straight line, 30 M must be added to R_1 not 15 M. The length of 30 M we will call the 'equivalent' length of R2.

It has just been shown that the equivalent length of a rod will depend on the ratio of the crank arms it follows therefore, that if the actual length known, and the lengths of the cranks, arms are also known, the equivalent length of a rod can be calculated. The formula used for this calculation is as follows

$$X = \frac{\text{Actual length of rod} \times oa}{aa}$$

Where X = the equivalent to be found
oa = the length of opposite crank arm
aa = the length of adjacent crank arm

Should, however, there be two or more unequal arm cranks in succession, the formula becomes

$$X = \frac{\text{Actual length of rod} \times oa \times oa \times oa}{aa \times aa \times aa}$$

This is explained more fully later. This formula must be memorised as it is impossible to find the correct position of a compensator without it.

Going back to example, 8, it was found that the equivalent length of R2 was 100' The total length of the straight line is 400' + 100' = 500' and therefore, the middle point will be 250' have been (400 + 50)/2 = 225' from A. The crank arm had been equal to the middle point would have been (400 + 50)/2 = 225' from A In Fig: 5.7 (iii), the equivalent length of R2 is : (50 x 12)/16 = 37 ½'.

As the crank is a normal crank, 37 ½' must be added to R, making a total of 400 +37½ Half of this is 218.75 which is the distance of the compensator from A.

The crank arms in example 10 are the same as these in example B, but the crank in this case is reversed The equivalent length of R2 must now be subtracted from R1, and therefore, the position of the compensator will be (400 - 100)/2 = 150' from A.

In Fig: 5.10(b), the 12" X 16" crank used in Fig: 5.7 (iii), has been turned round to act as a reversed crank the equivalent length of R2 17 ½", which must be subtracted from R1. The position of the compensator will be 400 - 37 ½ = 362 ½ 362 $^{5}/_{2}$ = 181:3" from A.

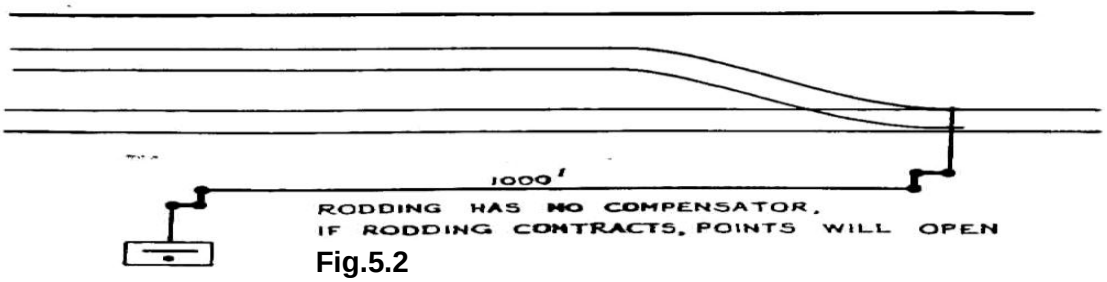


Fig.5.2

Fig.5.3

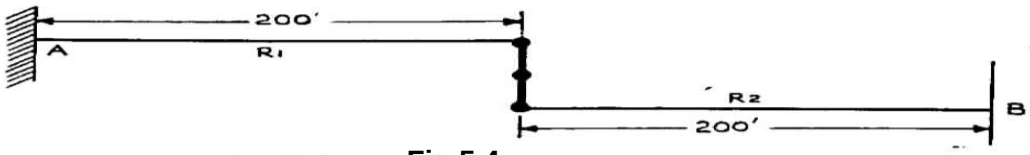


Fig.5.4

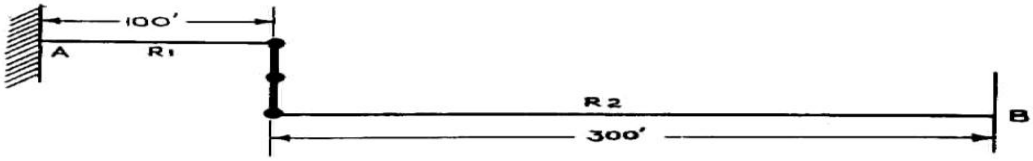


Fig.5.5

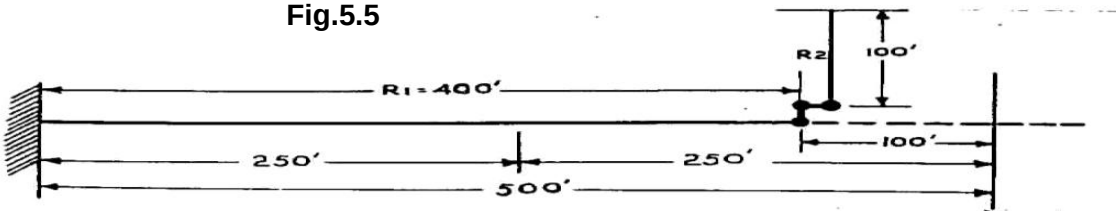


Fig. No. 5.6

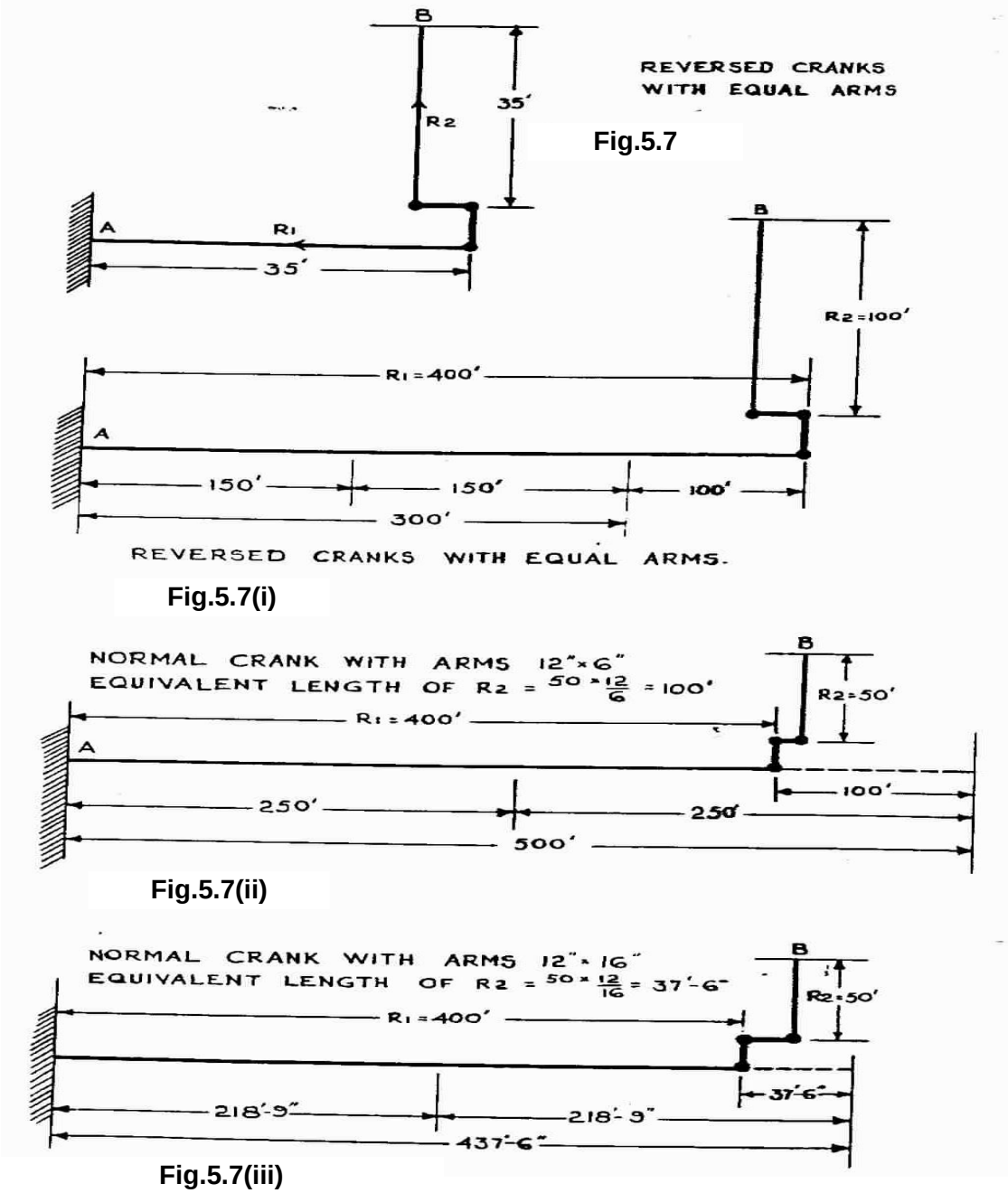


Fig.5.7

Fig.5.7(i)

Fig.5.7(ii)

Fig.5.7(iii)

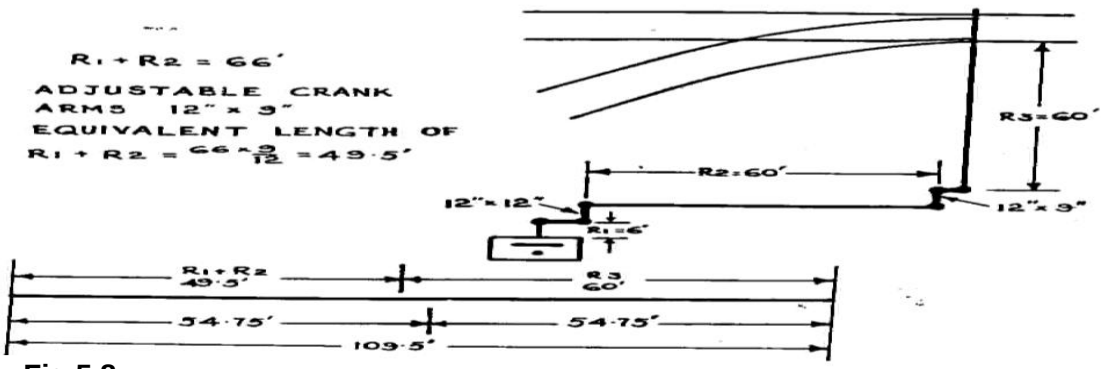


Fig.5.8

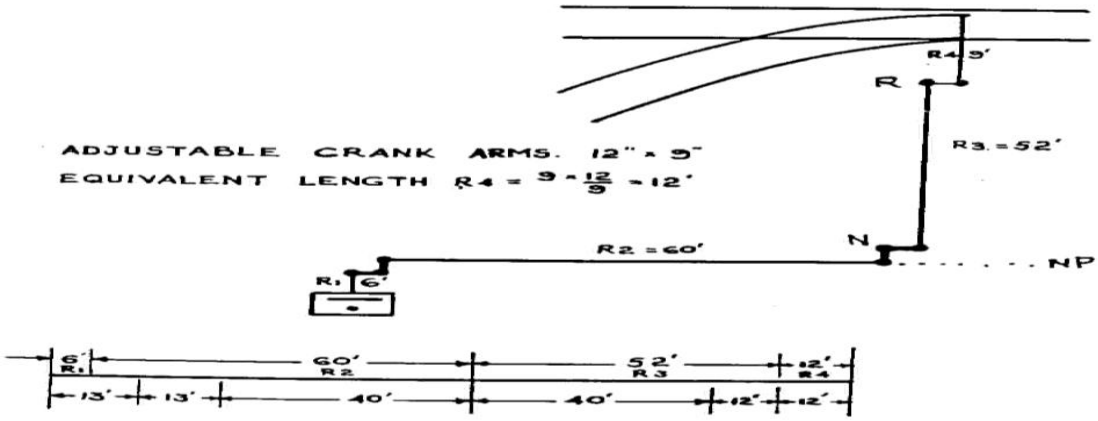


Fig.5.9

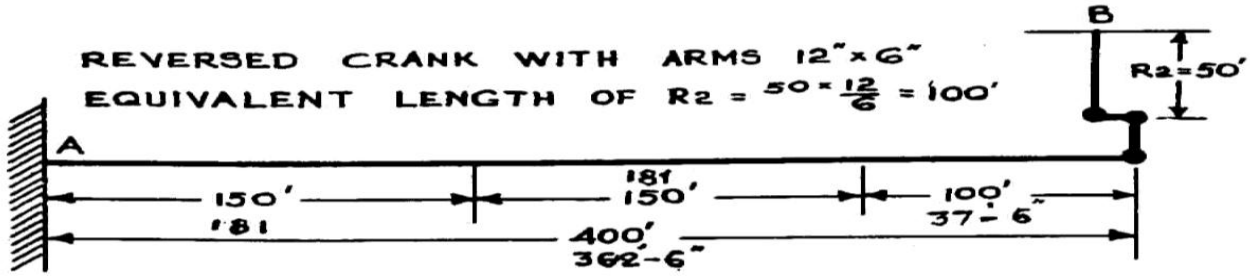


Fig.5.10(a)

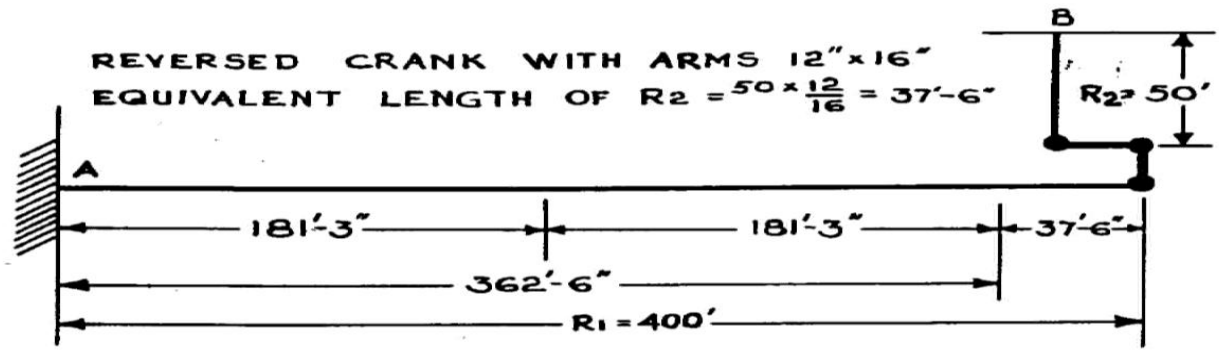


Fig.5.10(b)

5.11 Neutral Point

In Fig: 5.10 (a) & Fig: 5.10 (b), the limit of the length which has to be added or subtracted was marked, with a cross. The point so indicated is called the 'neutral point' and is the point in the rodding which will not move when the rodding expands or contracts. In example 5.6, the neutral point is an imaginary point representing the extreme end of the rodding where, of course, no movement due to expansion must be possible. But in example 5.7 and 5.8, the neutral point is in the longer rod. In order to prove that no movement takes place at the neutral point, we will consider example 5.7, and will assume that each 1500 mm (50') of rodding expands 13 mm (1/2"). The rod between A and the compensator, therefore, expands 64 mm (2 1/2") but the expansion of the first 4500 mm(150') will be taken up by the compensator and that of the remaining 3000 mm (100') will be taken up by the unequal armed reversed crank. It follows therefore, that at the neutral point will be no movement due to expansion.

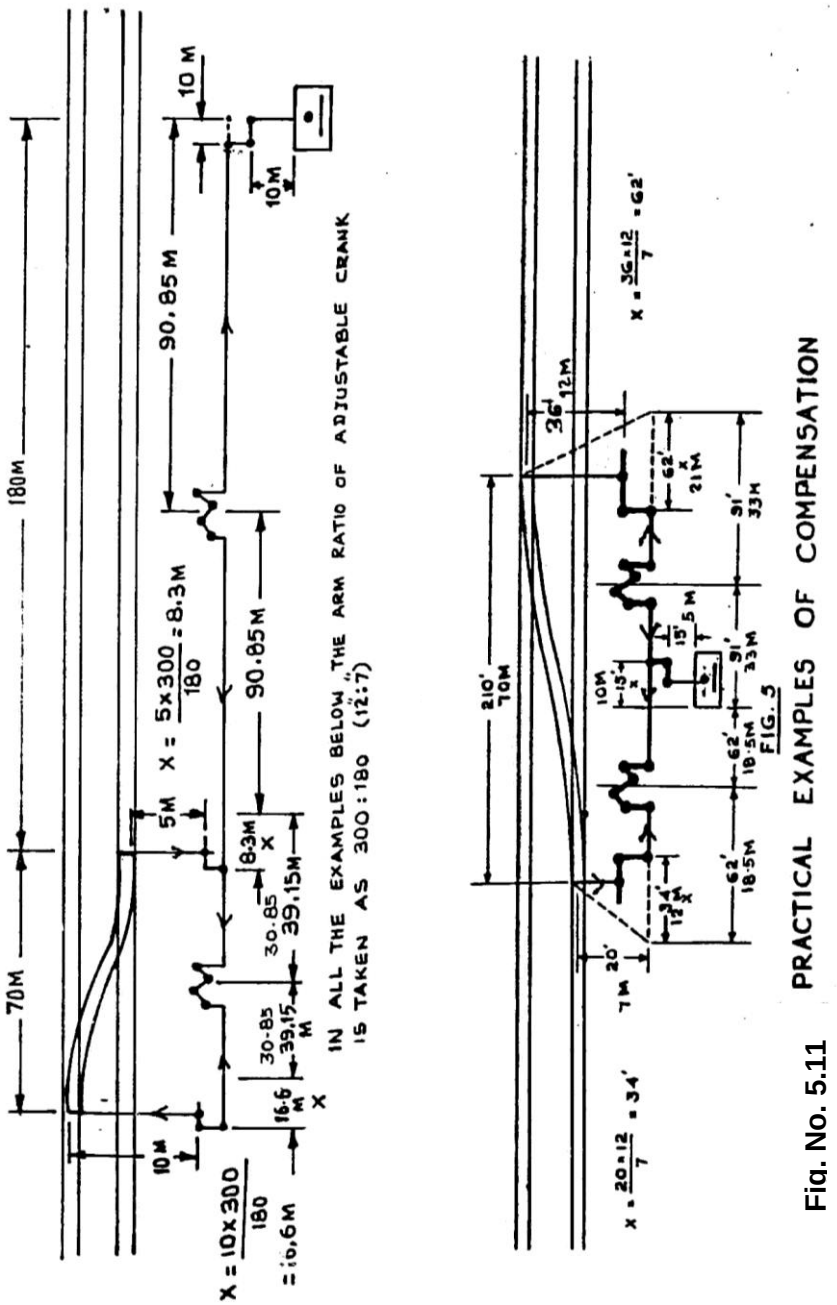


Fig. No. 5.11

5.12 Accuracy for location of compensators

Another point concerns the degree of accuracy required when finding the positions of compensators. If a compensator is placed a certain distance out of its correct position, it will mean that a length of rodding, equal to twice the distance remains uncompensated rodding even it does not cause a failure will be trouble because it necessitates more frequent adjustment of points and locks than would be required if the compensation was properly done.

In practice, due to various reasons it is not always possible to locate the compensators exactly in their correct positions. When rodding is first laid down, the lengths of the adjustable arms of the cranks will not be known until the points of locks are connected up and adjusted. It is, of course possible to do this before the compensators are installed, but that causes much extra work to obtain a high degree of accuracy that is not essential provided the length of rodding is accurately measured and the cross rod is not too long.

If the length of the cross rod is limited to about 10 Mts. (30'), a considerable error in the estimated length of the adjustable arms of cranks will have negligible effect on the location of the compensator. It is necessary to mention here that while calculating position of compensator, one must assume a certain loss of stroke, to develop in future and accordingly, the equivalent length should be calculated. An allowance of 25 mm extra loss of stroke to cater for future loss of stroke in cranks and compensators may be assumed while calculating the equivalent length of cross rod. It is anticipated the loss of stroke when the connections are now 38mm, an additional allowance of 25 mm may be added for calculating the equivalent length of cross rod. When this assumption is made, there will be hardly any effect in the position of compensator, even when the additional loss of stroke is 50 mm i.e., 25 mm more than the assumed loss.

Take the case of a pair of points having a cross rod 30' long and a main rod 100' long. This rodding has to be compensated, the actual length of the adjustable arm will, of course not known until the points are connected up and adjusted. If it is anticipated that there will be a loss of stroke of 1 1/2" the stroke at the crank may be taken as 6 1/2" and the length of the adjustable arm is 8". Using this figure to find the equivalent length of the cross rod, we find that X = (30 X 12)/9 1/4 or 44' (nearly). The position of the compensator will therefore, be (100 + 44)/2 = 72' from the cabin. The adjustable crank has been assumed to be a normal crank in this case.

It may be mentioned here, that the correct location of compensator plays a great part in the satisfactory operation of points and locks especially where the transmission is longer. When the length of transmission is great, loss of stroke is inevitable and to make up the loss of stroke it becomes necessary to move the sleeve of adjustable crank further out. This in turn, magnifies the expansion or contraction of uncompensated length of rodding in the transmission and causes trouble. Therefore, the compensators should be located as far as possible at their correct location. It is highly fallacious to presume that there can be uncompensated length of rodding up to 12 Mts. in the transmission because signal engineering manual states that compensator need not be provided when the length of rodding is less than 12 Mts. in the case of point transmission.

CHAPTER-6: FACING & TRAILING POINT LAYOUTS

6.1 Facing and Trailing Point

Points are said to be facing when a vehicle or a train moving over them can be diverted from one track to the other. When traversed in the opposite direction they are called trailing points. The sketch Fig.6.3 a&b illustrates a diagram of a typical facing or trailing point layout. The point will be facing or trailing depends on how it is traversed by the moving wheels of a vehicle. Thus it consists of a pair of stock rails between which moves a pair of switches. The switches are tied together by two or more stretcher bars which hold the switches together and make them to move as one unit. A lug connection is made to the front stretcher bar to which the throw rod is connected.

6.2 Points Assembly

(a) The points, tongues or switches are short pieces of a rail having one of its ends tapering. The tapering end is capable of being moved and set flush against the stock rail, and the other end is joined to 'Lead Rail' through a fish plate and a heel block in the case of a loose heel points assembly. The extreme point on the tapering end of the switch is called the toe of the points and the other end which is connected to the heel block is called the heel. The switch and stock rails are often fastened together at the heel with a stock wedged heel block between and this arrangement assists in checking any tendency of the switch rails to creep. The switches move over slide chairs mounted on sleepers. The slide chairs and the sleeper, over which the toes of the switches move are provided with a gauge, tie plate (on wooden sleeper layouts only and none on steel sleepers). The gauge tie plate has two butt plates riveted to it and placed against the two slide chairs to prevent the gauge from spreading. The slide chair is bolted to the underlying sleeper and a vertical projection from the chair bears against the web or the stock rail and is bolted to it. The switch, right from the toe to the heel is supported intermittently on slide chairs fixed to sleepers spaced at specified intervals according to the standard points and crossing layout drawing adopted by the Engineering Department.

(b) The stock rail or side rail is slightly longer than the switch rail and the toe of the switch is housed under the flange of it. The stock rail on the turnout side has to be kinked slightly at the toe of the switch to prevent tight gauge. This is done with a Jim Crow after laying the points, and the kink is made about 200 mm ahead of the toe. The switches held rigidly together by the stretcher bars and actuated by the lever and points rod, are moved to the right or left as the case may be the play being sufficient to leave between the open switch and the stock rail a clearance of either 115 mm or 100 mm (according to the gauge, so that there may be ample space for the wheel flange to pass through them without striking the toe of the switch.

(c) For some distance from the toe, the closed switch and its stock rail fit each other closely without any gap, but as they diverge the former requires lateral support of the upright web of the stock rail and is achieved through switch stop studs bolted to the web of the switch. Thus when the web of this switch is pressed against the stock rail the bending of the switch is prevented by the switch stops when the wheels pass over it.

6.3 LOOSE AND FIXED HEEL SWITCHES

(a) Switches and stock rails are usually made of ordinary steel rails selected, cut and Machined. There are two types of switches in use on the Indian Railways.

(i) Loose Heel Switch

(ii) Fixed Heel Switch

(b) Loose Heel Switch

A loose heel switch is a short switch joined to the dead rail behind it by means of a heel block and a fish plate. The front bolts of the fish plate are to be kept sufficiently loose to allow for the easy movement of the switch. To achieve this requisite set is given to the fish plate, the flexibility of the movement of the switch then becomes independent of the amount of the tightening of fish plate leading bolts. Some time the extra tightening of the fish plate leading bolts is to restrict by fitting split pins through them which in turn prevent further tightening of the nuts.

DEFINITIONS

Standing at the toe of the switch facing the crossing:

A left hand turnout diverts a train to the left of the straight main line or of the more important line in the case of a turnout from a curve. A right hand turnout diverts a train to the right of the straight main line or of the more important line in the case of a turnout from a curve. The left hand switch and stock rail are on observers left. The right hand switch and stock rail are on observers right In both RH&LH turn outs the crossing used is left handed i.e., has the splice rail on left.

The LH wing rail is on the left of the observer.
The RH wing rail is on the right of the observer.

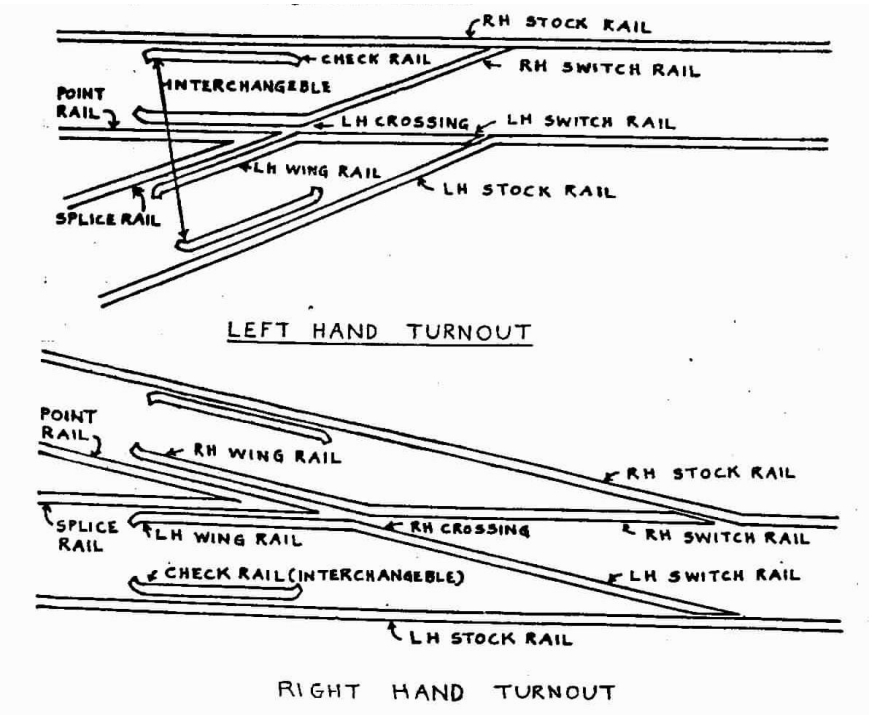


Fig: 6.3 a & b

(c) A Fixed Heel Switch

A fixed heel Switch is a comparatively longer switch which is not cut at the heel, but forms a part of continuous long rail. The movement of the toe of the switch is made possible through the flexibility of the tongue rail. The running over the fixed heel switch is quite smooth, and it is claimed that in contrast to the loose heel type switches the fixed heel type switches are easier to maintain and provide a much higher degree of travel comfort However, this design gives rise to a fairly general criticism, that the force required for the operation of point is increased. The uses of this type of switches are, however, confined to points and crossing with comparatively flatter curves.

6.4 NON - OVERRIDING AND OVERRIDING SWITCHES

There are two types of switches in use on Indian Railways

(a) Non-overriding switch or undercut switches

The earlier method of housing a tongue rail in a stock rail, was to plane down one flange each of the stock and the tongue rails and also the head of the tongue rails gradually towards the toe. The tongue rail thereby was brought as close to stock rail as required and the web of the tongue rail at the toe was housed under the head of the stock rail. This was known as the 'Undercut Switch' or 'Non-overriding switch'. The planed stock rails were, however, weak and the tongue rails wore down rapidly.

(b) Overriding Switch

The present standard switch in India has a tongue rail of section smaller than that of the stock rail. The tongue rail slides over the foot of the stock rail. The switch of this type is known as the 'Overriding Switch'. The section of the stock rail is not reduced and a further improvement is to hump the switch rail slightly over the head of the stud rail to prevent the sharp flange of worn out wheel from wedging between the stock and tongue rail.

Advantage of overriding switches

Overriding switches have the following advantages

(i) Stock rail being uncut, is stronger.

(ii) As all the work of manufacture is confined to the tongue rail the cost of work involved in tongue rail is much less than the cost of work involved in planning both the stock and tongue rails.

(iii) Since the tongue rail is supported by the stock rail, the arrangement is stronger than in the case when the switch alone is made to support the load.

Sl.no	LENGTH OF TONGUE RAIL (for 52 KG rail)	BG	MG/NG
1	1: 8 ½ turnout	4725 mm (Straight switch)	4116 mm (Straight switch)
2	1:12 turnout	6400 mm(Straight switch)	5428 mm (Straight switch)
3	1: 8 ½ turnout	6400 mm (Curved switch)	----------
4	1:12 turnout	7730 mm (Curved switch)	6700 mm (Curved switch)
5	1:16 turnout	9750 mm (Curved switch)	9750 mm (Curved switch)
6	1: 20 turnout	11150 mm (Curved switch)	

6.5 STANDARD POINTS AND CROSSING LAYOUTS

(a) IRS Track Manual gives the details of standard points and crossing layouts of BG, MG, tracks. Section of rails used in these drawings for BG tracks and 115R, 90R and 75R for MG and NG tracks are 75R, 60R, and 50R. The length of switches used in. Broad Gauge are 21'-0" over-riding with fixed heels and 156" overriding with loose heels with one in twelve crossings 21'-0" switches are used and with 1 in 8 ½ crossings 15'6" switches are used.

(b) The lengths of switches used for meter gauge are:

(i) 5.5 mtrs. (18'-0") overriding, fixed heel used in 1 in 12 turnouts.

(ii) 4.115 mtrs. (13'-6") overriding, loose heel, used in 1 in 8 ½" turnouts.

(c) The lengths of switches used for Narrow Gauge Tracks are 13'-0"(overriding), 10' (non-overriding).

6.6 STRETCHER BARS

To enable the corresponding points in the two switches to move in union, the switches are tied through stretcher bars. To allow a greater flexibility of the movement of the points a special type of stretcher bar, made out of steel having a high flexible property is used. In earlier days the switches used to be connected together by means of solid connecting rods. This arrangement caused considerable rigidity in the working of points, and occasionally, it resulted in bending of the connecting rod while the points were under operation, and thereby affecting the switch throw. Connecting rods were, therefore, replaced by William flexible stretchers. The force required to work point, besides other factors, depends upon the choice of stretcher bars have the dimensions mentioned below.

(a) Leading William flexible Stretcher

(i) Broad Gauge-6' X 3" X ½" and is fixed at a distance of 330 mm (13") from the toe of the switch.
(ii) Meter Gauge-4' X 3" X ½" and is fixed at a distance of 380 mm (15") from the toe of the switch.

(b) Following William flexible Stretcher

(i) Broad Gauge-4'8" X 3" X ½" and is fixed at a distance of 1397 mm (55") from the switch toe.
(ii) Meter Gauge - 2'9" X 2 ½" X 3/8" and is fixed at a distance of 1372 mm (54") from the switch toe.

If the switches are very long, a third flexible stretcher bar is also used. However, with 6.4 Mts. (21') over riding switches in BG and 5.5 Mts. (18') switches in MG only two flexible stretchers are used. The stretcher bars are fitted to the stretcher brackets which in turn are fitted to the web of the switch rails while fixing the brackets, one has to be careful to fit the right hand bracket to the right hand switch and left hand bracket to the left hand switch, or else, it would be difficult to work the points. The responsibility for the supply of flexible stretcher bar assembly and fixing the same generally rest with the permanent way Engineering Department. Care should also be taken while fixing the flexible stretchers to ensure that the leading flexible stretcher extends up to the bottom of two stock rails and at the same time clears them by not more than 3 mm (1/8").The arrangement prevents the lifting of the toe of the switch when a wheel passes over the heel of the points tongue rails having loose packing under the heels. The following flexible stretcher is, however, a short stretcher and does not extend up to the stock rails.

6.7 The Requirements of Facing Points

The movement over improperly set facing points may cause a derailment, but the movement over wrongly set trailing points causes only damage to the points and other concerned fittings, but seldom is any injury incurred by the train or vehicle moving over it. Therefore, it is absolutely essential in the interest of safety to fulfill the following conditions before a train is allowed to move over facing points.

(a) Closed switch must be housed against one stock rail without leaving more than permissible gap between the toe of the switch and the stock rail for a requisite distance,

(b) The toe of the open switch must clear the stock rail by a specified distance 115 mm(4 1/2") In BG and 100 mm (4") in MG and,

(c) Both the switches (the closed and the open) are held locked in their position.

6.8 Before points are taken over from the Engineering Department for being connected to an interlocked lever, the following checks are required to be made (as recommended in IRSE Manual) Para 12.40 Annexure - 5 part –II.

6.8.1 ESSENTIAL REQUIREMENTS BEFORE INTERLOCKING OF A POINT

Before the interlocking work at points is undertaken, it must be ensured that the JE/SSE(P-Way) has:

(a) Brought the track to correct level and alignment.

(b) Eased off rail joints on either side of points to be interlocked and closed the stock rail joints associated with lock bars.

(c) Fully ballasted and packed all points which are to be interlocked and taken adequate measures to prevent lateral and longitudinal movements of points.

(d) Provided creep and level pillars.

(e) Arranged the sleepers on adjacent tracks in alignment, where rods and wires have to cross.

(f) Seen that the gauge is correct.

(g) Provided and fixed special timbers as required.

(h) Provided means to prevent creep in the vicinity of points.

(i) Fitted gauge tie plates correctly.

(j) Made the stretchers of such a length so that the throw of switches is as per approved drawings.

(k) Adjusted loose heel switches so that:

(i) They can be thrown both ways with ease and can be housed against the stock rail by hand and remain there when the pressure is removed.

(ii) The planed surface of the switch rail fully houses against the stock rail as per approved drawings.

(l) adjusted fixed heel switches so that:

(i) They normally lie in the mid-position and flex equally in the normal and reverse positions.

(ii) The planed surface of the switch rails fully houses against the stock rails as per approved drawings.

(m) Fitted flexible stretchers so that they flex equally in the normal and reverse positions.

(n) Provided a stop for the open position of a single switch layout.

6.8.2 Maintenance of Switches (Para No 237 of page No 39 of IRPWM of 2004)

The condition of stock and Tongue rails should be carefully examined badly worn-out and damaged stock and Tongue rail should be replaced by serviceable ones. A Tongue rail may be classified as worn out/damaged when:

(a) It is chipped/ cracked over a small length aggregating to 200 mm with in the distance of 1000 mm from its toe.

(b) Chipped length will be portion when tongue rail has worn-out for a depth of more than 10 mm over a continuous length of 100 mm.

(c) It has developed knife edge tip (Thickness of Top edge being less than 2 mm) over a length of more than 100 mm any where up to a distance of 1000mm from its toe.

(d) It is badly twisted or bent and does not house properly against the stock rail causing a gap of 5 mm or more at the toe, the limit described in the IRPWM. The Tongue rail can however be reused after reconditioning of the broken/worn/damaged tip by welding.

(e) Tongue rail should be replaced/reconditioned when vertical/lateral wear exceeds the values laid down. The wear shall also be measured at a point with 13 mm head width and the point where Tongue & Stock rail are the same level.

VERTICAL WEAR	LATERAL WEAR
8 mm for 60 Kg	8 mm for 60 Kg
5 mm for 52 kg & 90 R	6 mm for 52 Kg & 90 R
3 mm for 75 R & 60 R	5 mm for 75R & 60 R

6.9(a) The arrangement in the various layouts are similar and equipments used are mostly common.

The lock bar is driven from the end away from the points with help of a horizontal crank bar driving rod and a driving attachment riveted to the lock bar. The lock bar itself is supported and worked by 12 lock bar clips (clamp type) fixed to the rail with an inter clip distance of about 1220 mm. Three stops are provided on the lock bar rail to limit the position of the lock bar. Another driving attachment is fixed on the second or third section of the lock bar and is connected to the radial guide extensions bracket which is connected to the lock bar by means of a flange connecting rod. The stroke is transmitted from radial guide to the facing point lock plunger which locks the points by engaging in the notches of the split stretcher bars in either normal or reverse positions the detection of points is achieved attaching switch extension pieces Fig: 6.9(a) to the end of the switch rails and to connect these to the point slides through the rods. The lock detection is done by transmitting the plunger movement directly to the lock detection slide with the help of the cross slides and the cam provided on the lock plunger.

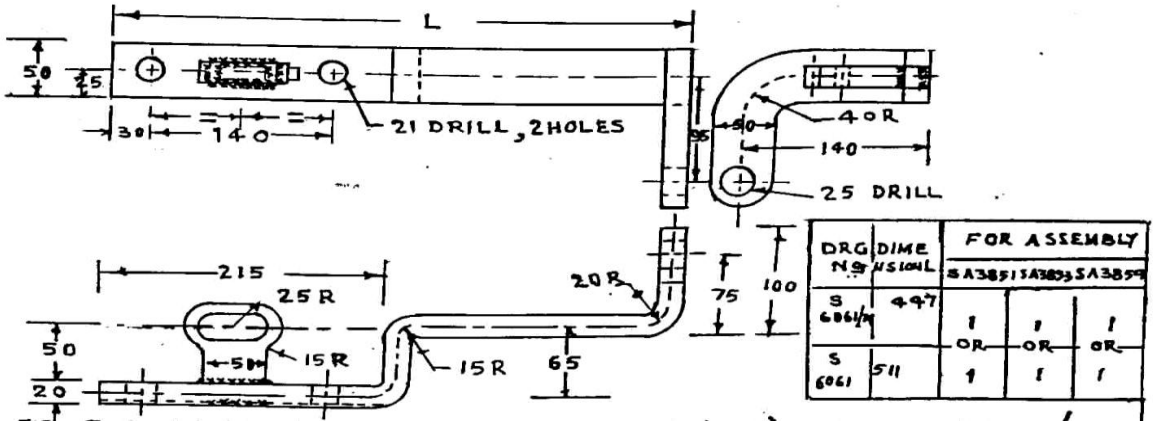


Fig. 6.9 (a) SWITCH EXTENSION PIECE (L.H) FOR BG S 6061 & 63/M- S 6061A

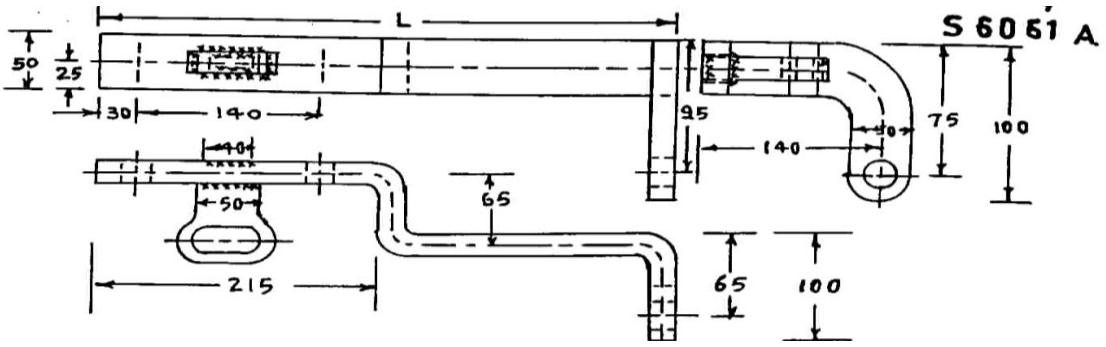


Fig. 6.9 (b) SWITCH EXTENSION PIECE R.H FOR MG (S 6060/M- S 6060A)

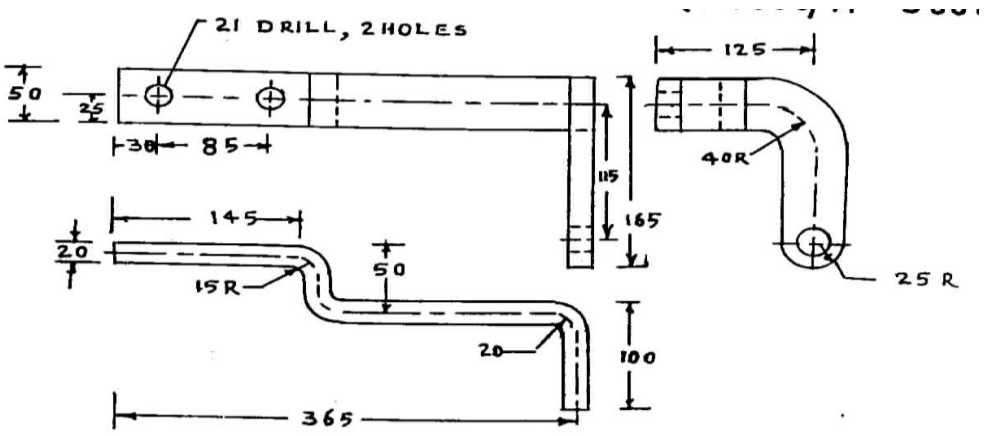


Fig. 6.9 (c) SWITCH EXTENSION PIECE FOR BG S 6062 & 63/M

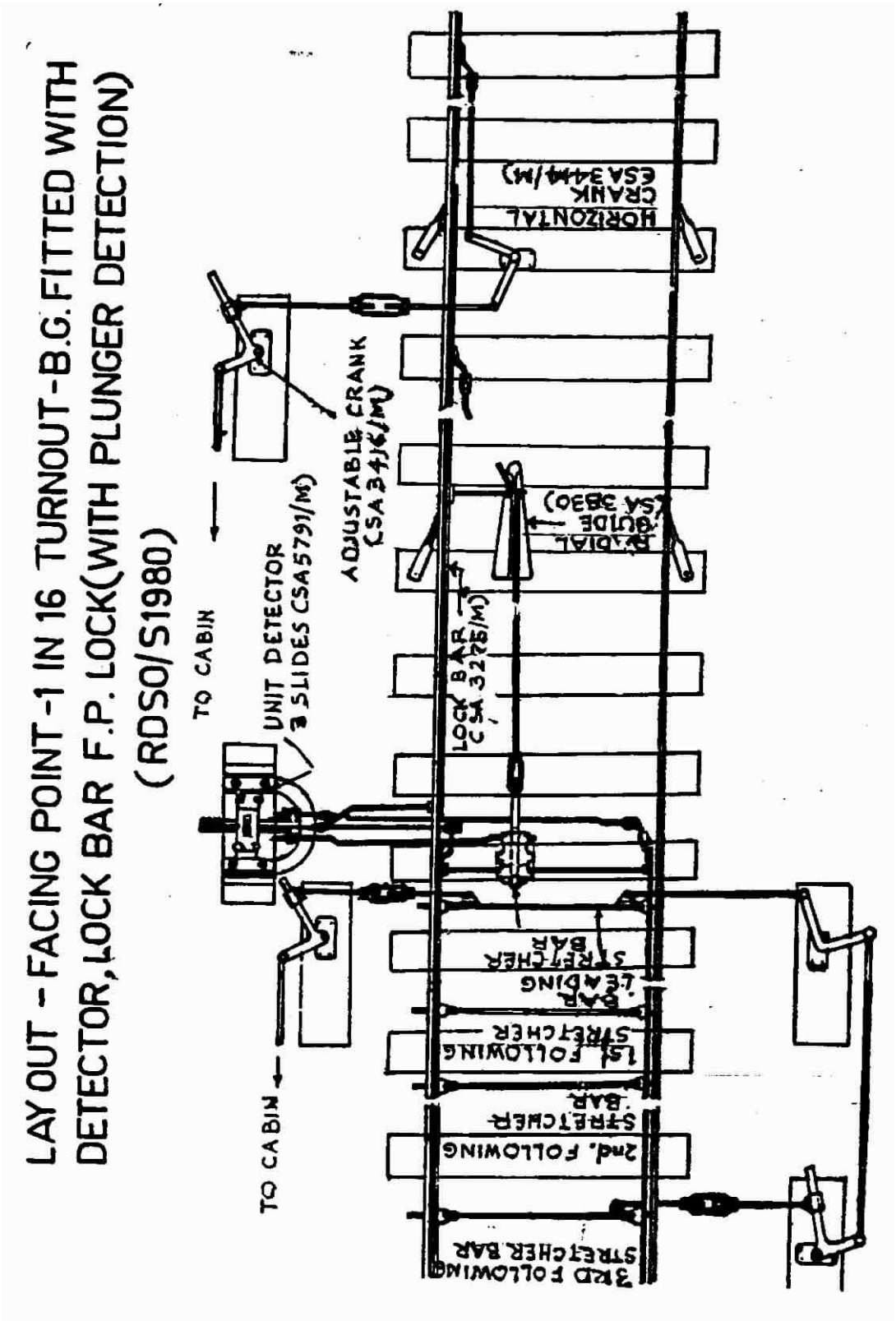

LAY OUT - FACING POINT -1 IN 16 TURNOUT-B.G.FITTED WITH DETECTOR, LOCK BAR F.P. LOCK(WITH PLUNGER DETECTION)
(RDSO/S1980)
TO CABIN
UNIT DETECTOR 3 SLIDES CSA5791/M)
ADJUSTABLE CRANK (CSA 3416/M)
LOCK BAR CSA 3275/M)
HORIZONTAL CRANK ESA 3444/M)
TO CABIN
1st. FOLLOWING STRETCHER BAR
2nd. FOLLOWING STRETCHER BAR
3RD FOLLOWING STRETCHER BAR

Fig. 6.9(d)

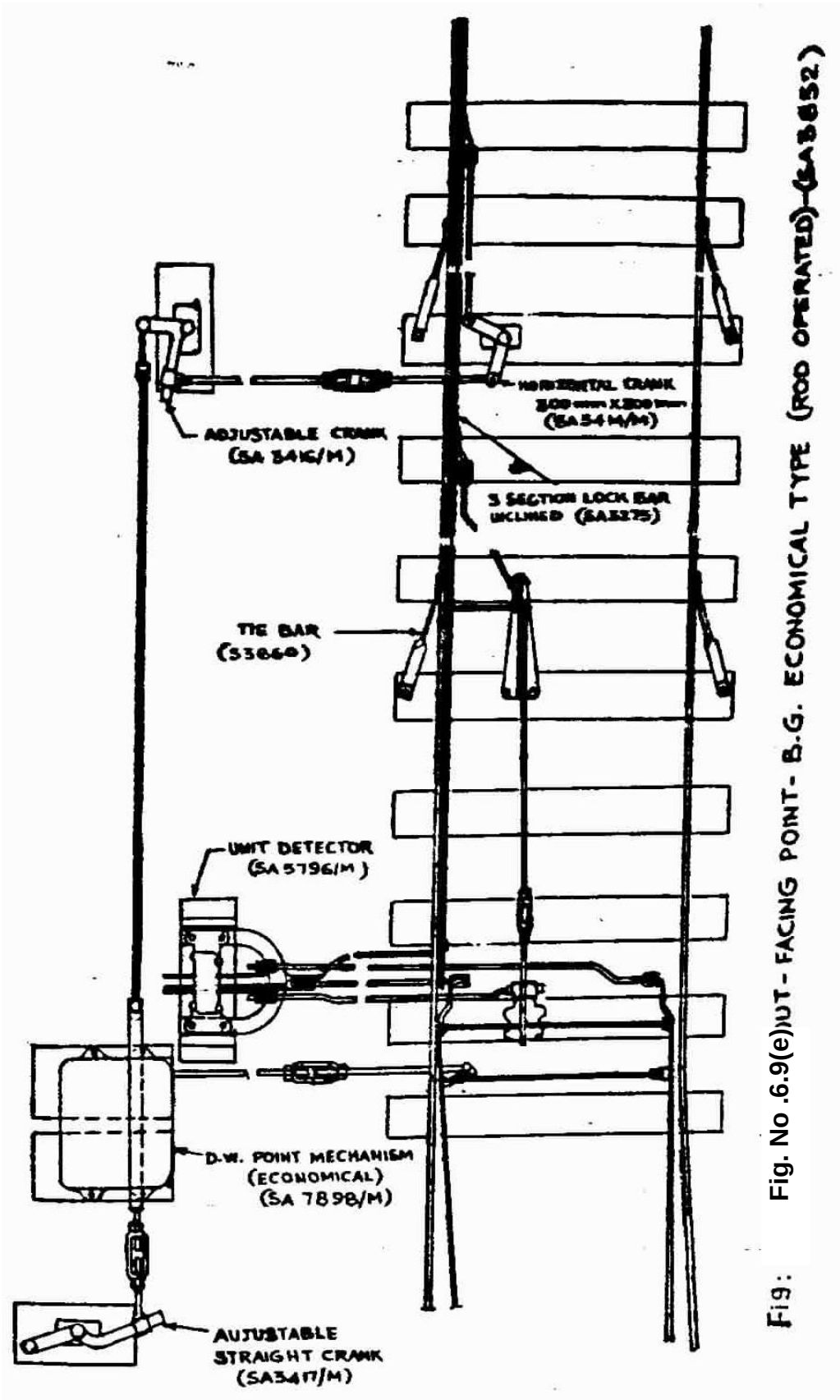


Fig: Fig. No .6.9(e)UT - FACING POINT - B.G. ECONOMICAL TYPE (ROD OPERATED) (SA3852)

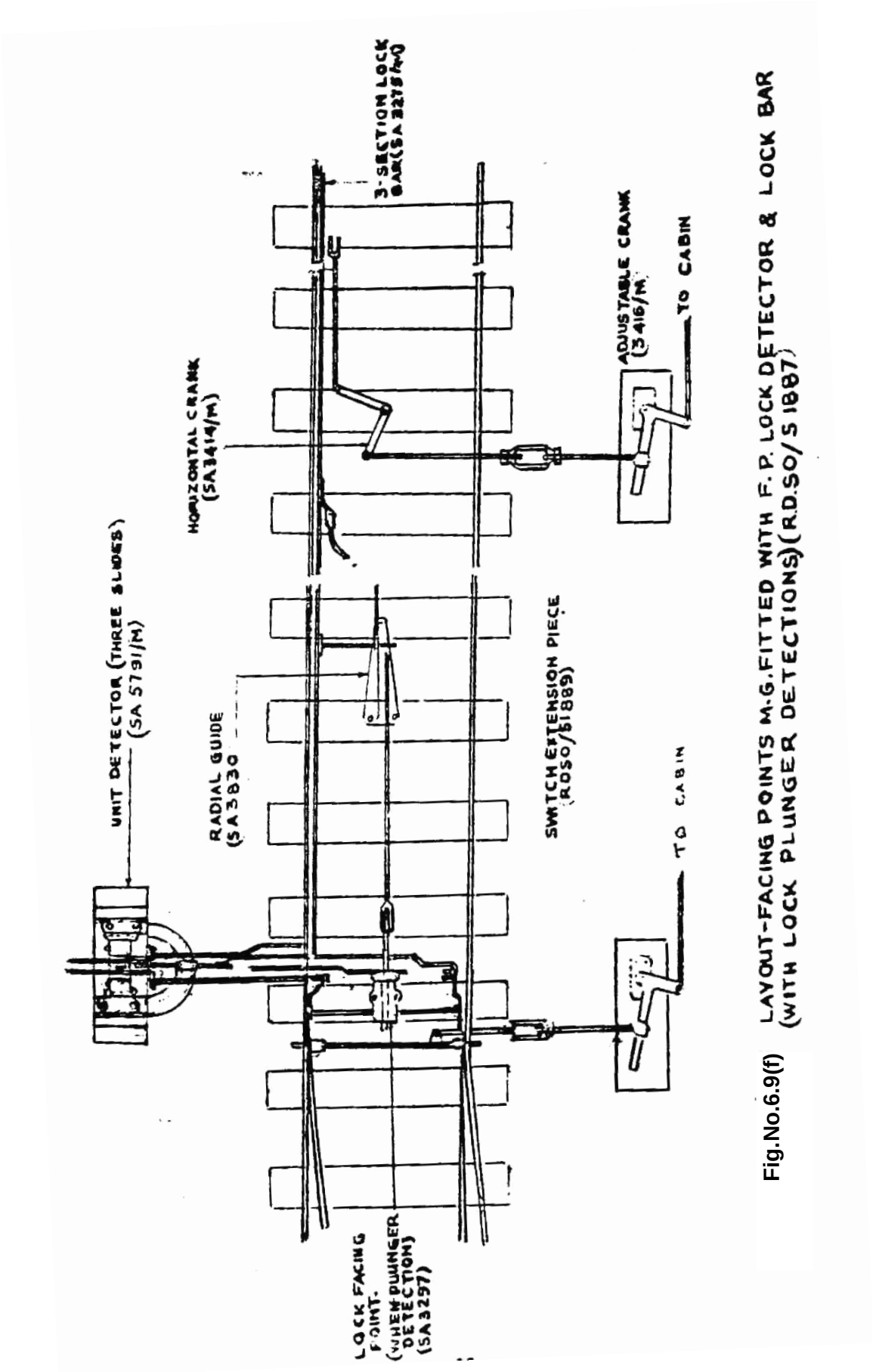


Fig.No.6.9(f) LAYOUT-FACING POINTS M.G.FITTED WITH F.P. LOCK DETECTOR & LOCK BAR (WITH LOCK PLUNGER DETECTIONS)(R.D.SO/S 1887)

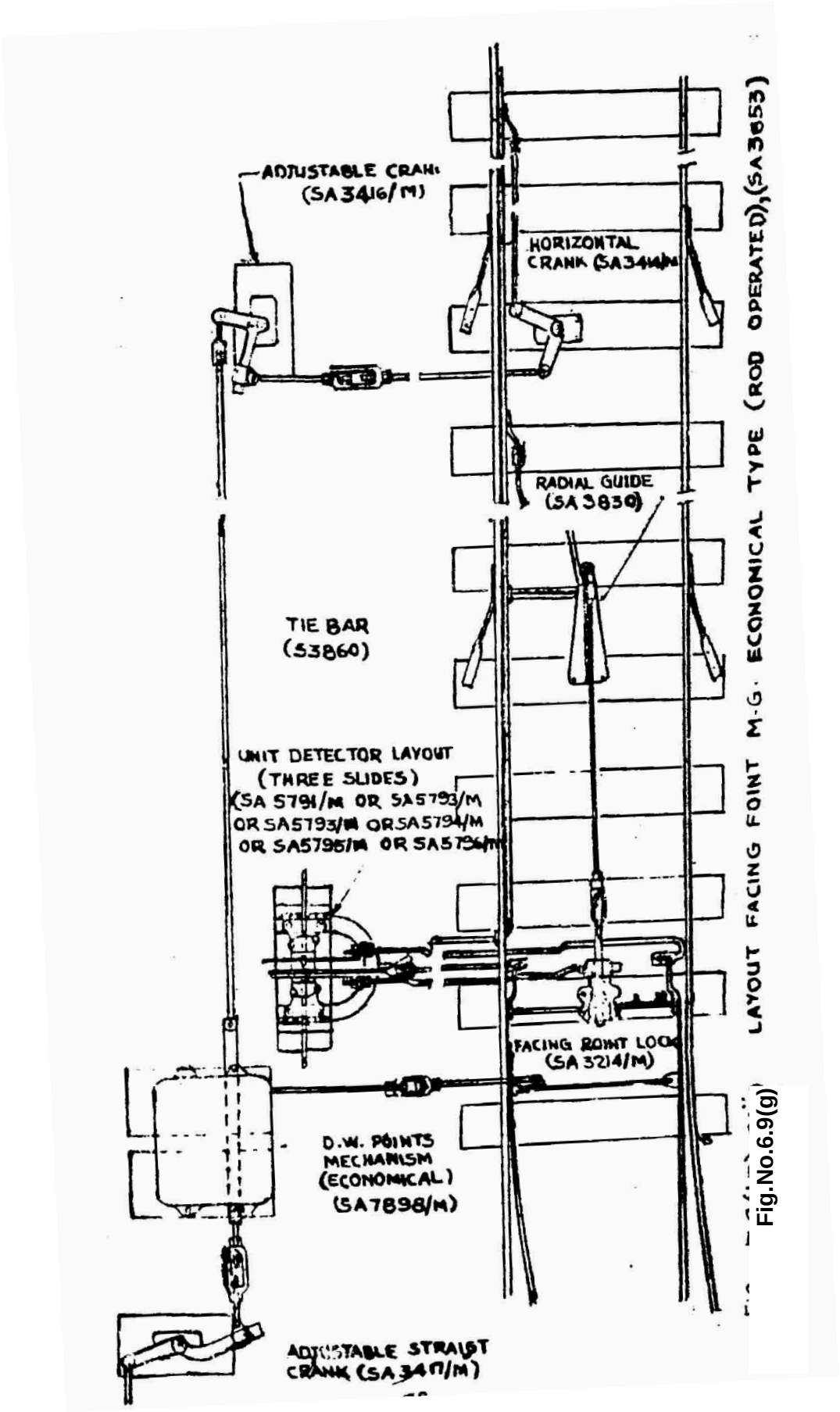

ADJUSTABLE CRANK (SA 3416/M)
HORIZONTAL CRANK (SA 3414/M)
RADIAL GUIDE (SA 3830)
TIE BAR (53860)
UNIT DETECTOR LAYOUT (THREE SLIDES) (SA 5791/M OR SA 5793/M OR SA 5793/M OR SA 5794/M OR SA 5795/M OR SA 5796/M
FACING POINT LOCK (SA 3214/M)
D.W. POINTS MECHANISM (ECONOMICAL) (SA 7898/M)
ADJUSTABLE STRAIGHT CRANK (SA 3417/M)
LAYOUT FACING POINT M-G. ECONOMICAL TYPE (ROD OPERATED),(SA 3853)

Fig.No.6.9(g)

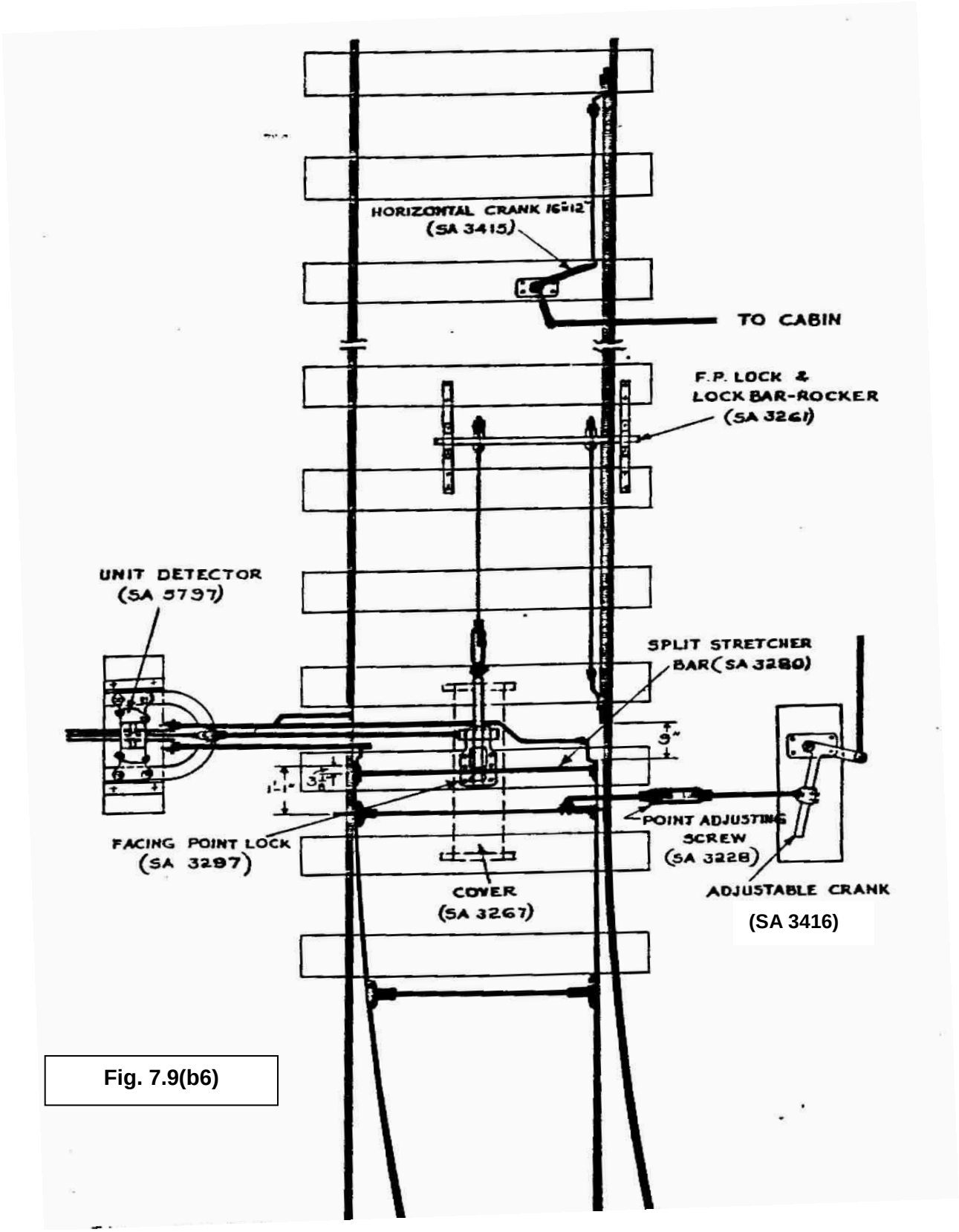


Fig. 7.9(b6)

Fig. 6.9(h)

FACING POINT, F.P.LOCK, DETECTOR & LOCK BAR (WITH LOCK PLUNGER DETECTION) SA-3213

6.10 FACING POINT LAYOUT (NON ECONOMICAL)

Where two levers are there, one for the points operation and another for lock both operations are used then that point is known as non - economical point.

Drawing No SA 3213 is a standard layout for a Facing point on broad gauge it meets all the requirement of locking a facing point to allow a train to pass over it at speeds over 50 KMPH and is, therefore, provided with the following equipments.

A plunger type facing point's lock which provides a means for locking each switch independently through two split stretcher bars fitted to the two switches. A suitable device has been provided to detect the two switches independently and in addition provision has been made for the lock detection as well to prevent the point from being unlocked during the passage of a train, a lock bar of length more than the maximum distance between the adjacent wheel bases of a bogie has been provided.

WORKING

The lock bar is driven from the end away from the points with the help of a horizontal crank, bar driving rod and a driving attachment (SA 3243A) rivetted to the lock bar. The lock bar is itself supported and worked by 12 lock bar clips fixed to the rail and interclip distance does not exceed 1200 mm. The bar stops are fitted on to the lock bar rail to limit the position of the bar when the connecting lever is either in the normal or in reverse positions. Another driving attachment is fixed towards the points end of the lock bar, and is connected to a bar driving rod to drive the "Rocker Shaft" (S3262) through its "Rocker Arm" (S3264). The rocker shaft carries another Rocker arm to drive the lock plunger through a lock driving rod. Thus a 200 mm stroke imparted to the lock bar at its far end is finally transmitted to the lock plunger which in turn engages the lock stretcher notches and thereby locks points either in normal or in reverse positions.

In this metric drawing of SA 3213/M, Radial Guide has been used in place of Rocker Shaft. Details of the parts used in the assembly of drawing No.SA 3830 are shown in fig. no. 6.18.

6.11 FACING POINT LOCK

Following 3 types have been standardized for use in Indian Railways

(a) **FACING POINT LOCK: (SA 3291)**

The facing point lock essentially consists of a casting through which the lock bolt or plunger works the lock casting is provided with a suitable cover which can be bolted to the main casting after the split stretcher bars have been placed in position.

(b) **FACING POINT LOCK: (SA 3297)**

The lock plunger consists of a 498 mm wide steel bar fitted with another steel bar of same width and thickness on top at a distance of 120 mm from its end as shown in Fig.6.11(b). The locking of split stretcher bars which are placed on top of the plunger is achieved by cutting notches on them. The size of the notch will be 20 mm X 53 mm. The notches will be on the bottom side. The 120 mm projection of the plunger is provided to support the split stretcher bars.

PLUNGER DETECTION

The purpose of plunger or lock detection is to ensure that the points are effectively locked before the signal can be cleared. For this purpose a cam is fitted on the underside of the plunger, two roller followers fitted on a cross slide are normally flanking the cam on either side. The cam is designed to give the stroke to the cross slide as follows

Movement of plunger	Corresponding movement of cross slide
87 mm	idle
57 mm	32 mm
56 mm	Idle
Total : 200 mm	**32 mm**

It may be seen that the cross slide remains idle and then gets a stroke and again it remains idle, so that as soon as the points cease to remain effectively locked, the lock slide obstructs the detector. The notch in lock detector slide is cut 22 mm so as to have a clearance of 6 mm on either side of a signal slide (width 10 mm). This clearance is provided to allow a signal to clear if there is a loss of stroke on the plunger.

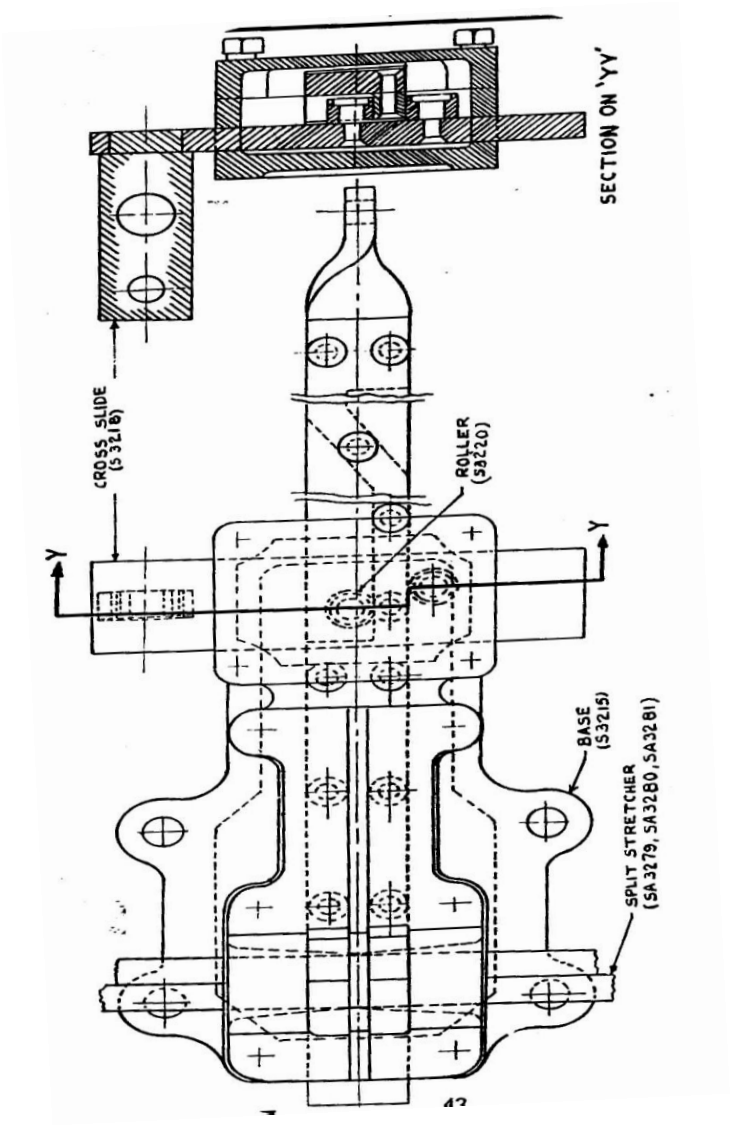


Fig. 6.11(b) FACING POINT LOCK (SA 3297)

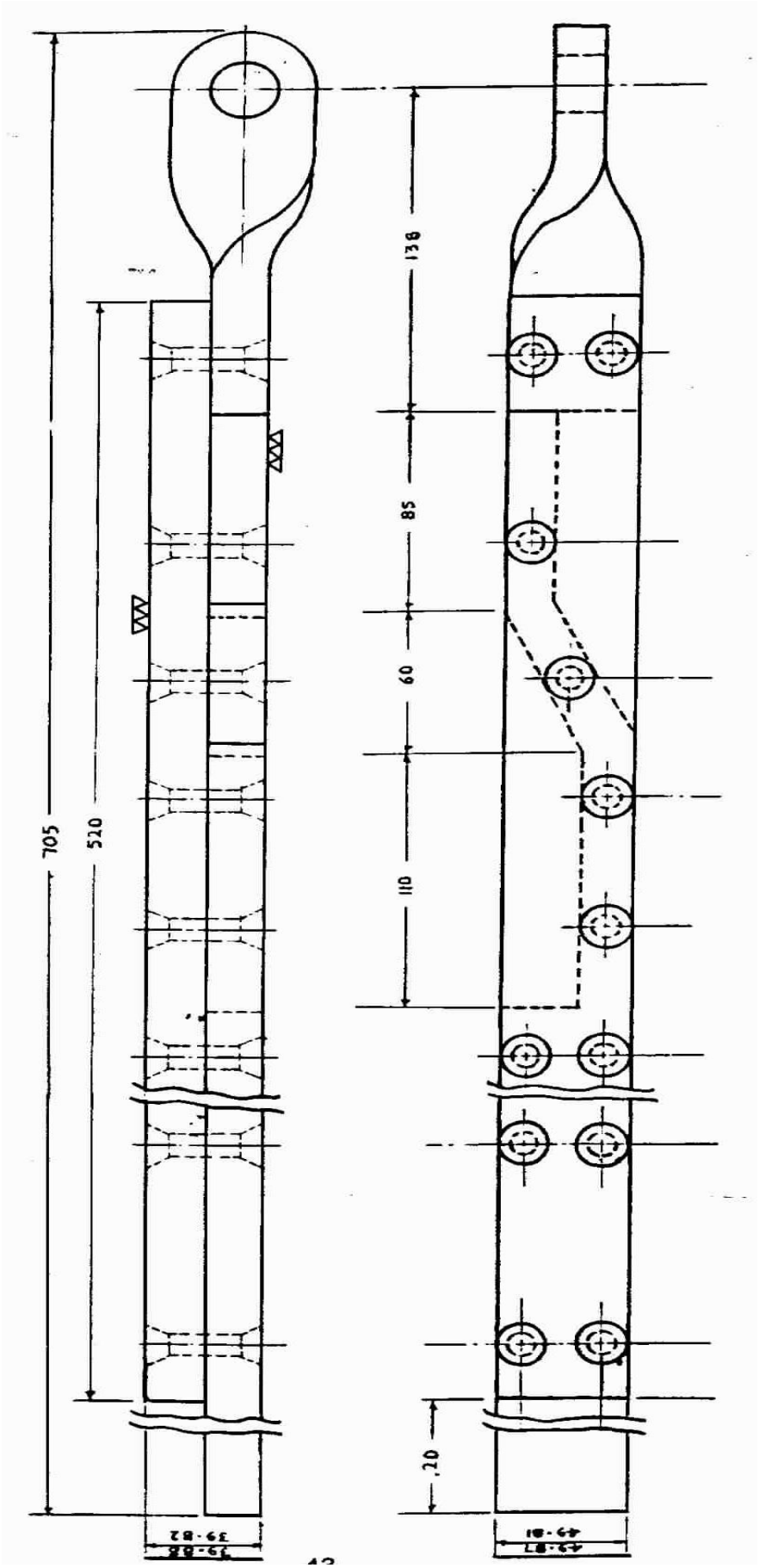
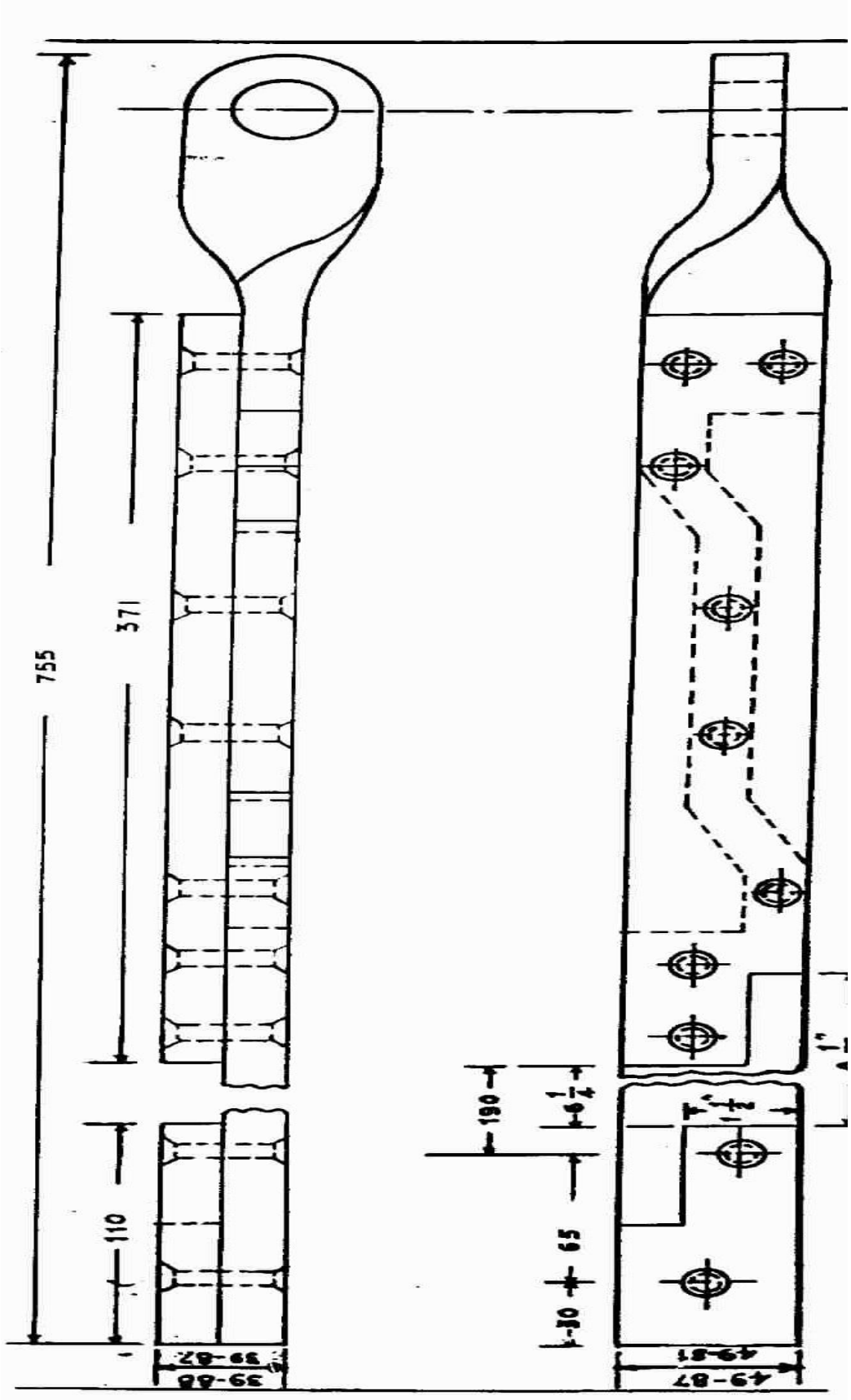


Fig. No. 6.11(b1) PLUNGER (NO: S 3298) FOR FACING POINT LOCK SA-3297
(All Dimensions are in mm)

a) **ECONOMICAL FACING POINTS LOCK (Drg No.SA 3214)** See Fig. 6.11 (c)
(All Dimensions are in mm)



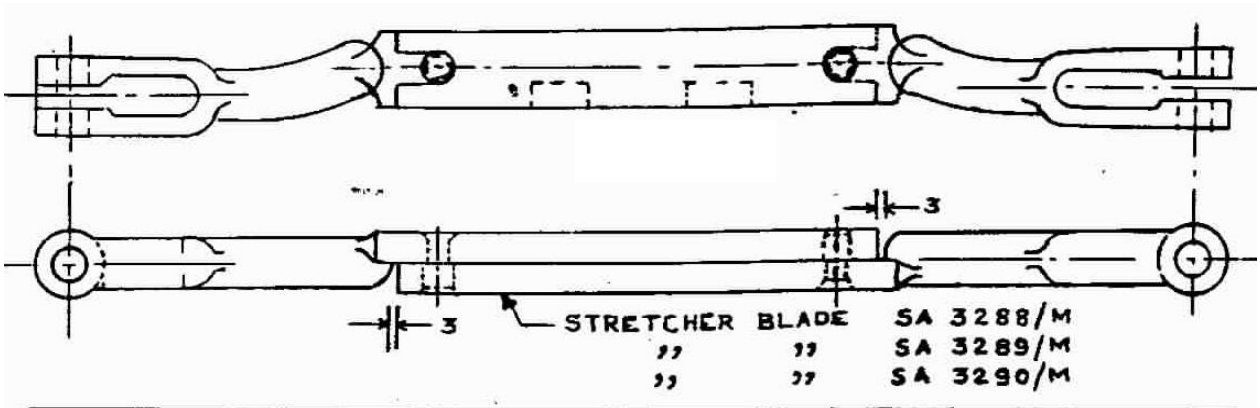
Please refer notes on Double Wire Signalling.

6.12 SPLIT STRETCHER FOR FPL (See Fig: 6.12.1 to 6.12.4)

Two stretcher bars are bolted to the webs of the two switches close to their toes and their free ends terminate in blades with notches and are made to work in the stretcher way provided in the facing point lock two sets of notches are cut in the split stretcher bar provided in the facing point lock.

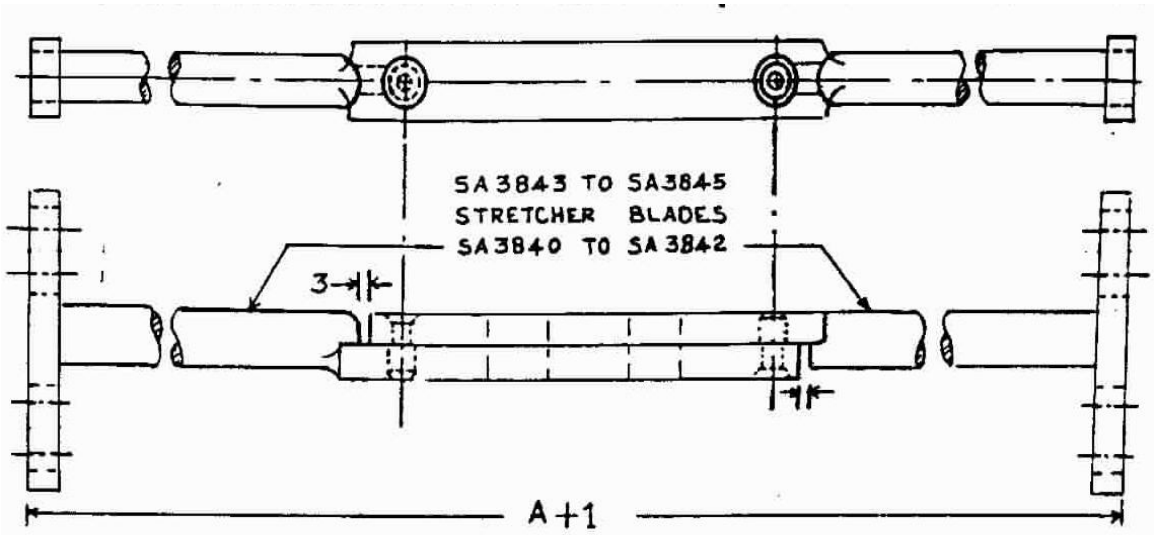
(Note: An improvement has been made in the split stretcher bar by providing slotted holes on the flange of the split stretcher bar to obviate the effect of creep on switches (Drg. No. SA 3837-39) For MG layouts the split stretcher bars with a pin connection in the lug of the switch extension piece has been used. For the different split stretcher bars please refer proforma 2).

Two sets of notches are cut, so that the plunger of the facing point lock is driven when the lock bar is operated to lock the points either in normal or in reverse position. The notches in the stretcher bar blades are so cut that if the closed switch is slightly gaping 450 mm (18"), or if the open switch is not opening properly, it should not be possible to plug the plunger in and consequently the lock plunger lever cannot be pulled over.



FOR USE WITH SWITCH EXTENSION PIECE			
DESCRIPTION	RAIL SECTION	DRG. No	'A'
SPLIT STRETCHER BAR FOR LOCK F.P. (D.W)	31.13KG. (75R)	SA3285/M	747
ECONOMICAL TYPE M.G. - DO-	29.76KG (60R)	SA3286/M	749
- DO-	24.80KG (50R)	SA3287/M	750

Fig.6.12.1
SPILT STRETCHER BAR LOCK F.P (D.W. ECONOMICAL TYPE)



FOR USE WITH SWITCH EXTENSION PIECE			
DESCRIPTION	RAIL SECTION	DRG. No	'A'
LOCK F.P. SPLIT STRECHER BAR (WITH SLOTTED HOLE)	52 KG	SA3837	1505
" -DO- "	44.61KG (90R)	SA3838	1507
" -DO- "	37.13KG (75R)	SA3839	1508

LOCK F.P. SPLIT STRETCHER BAR (WITH SLOTTED HOLE)B.G.
(SA3837-39)

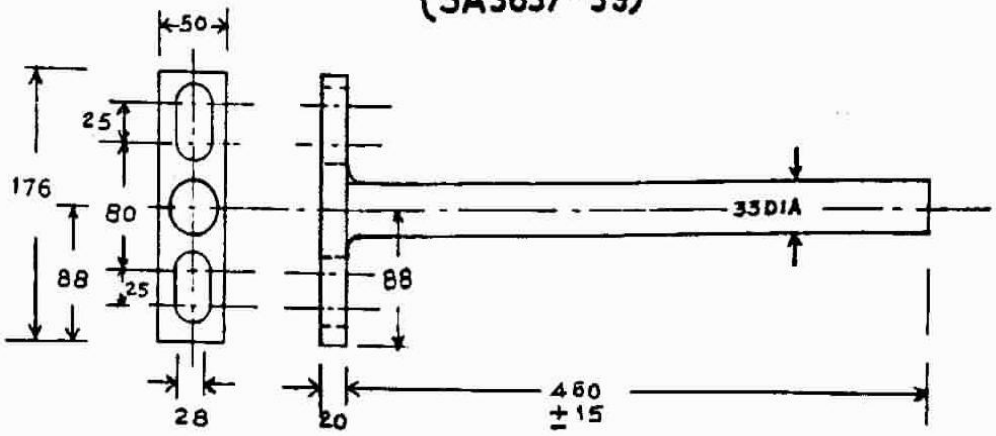


Fig.6.12.2
STRETCHER BAR – FLANGE CONNECTING ROD (S-3846)

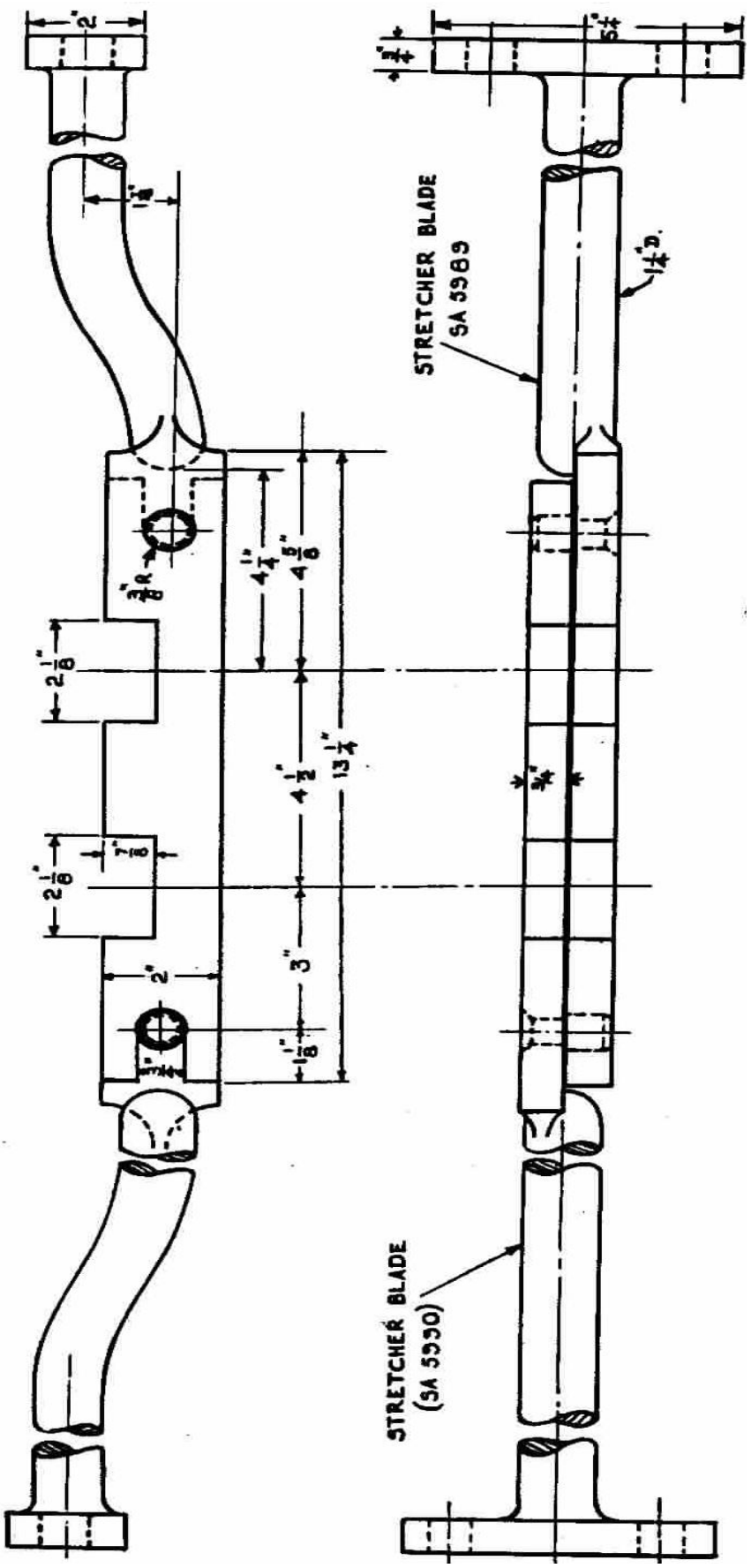


Fig.6.12.(3)
SPILT STRETCHER BAR FOR F.P.L B.G. (SA-5988)

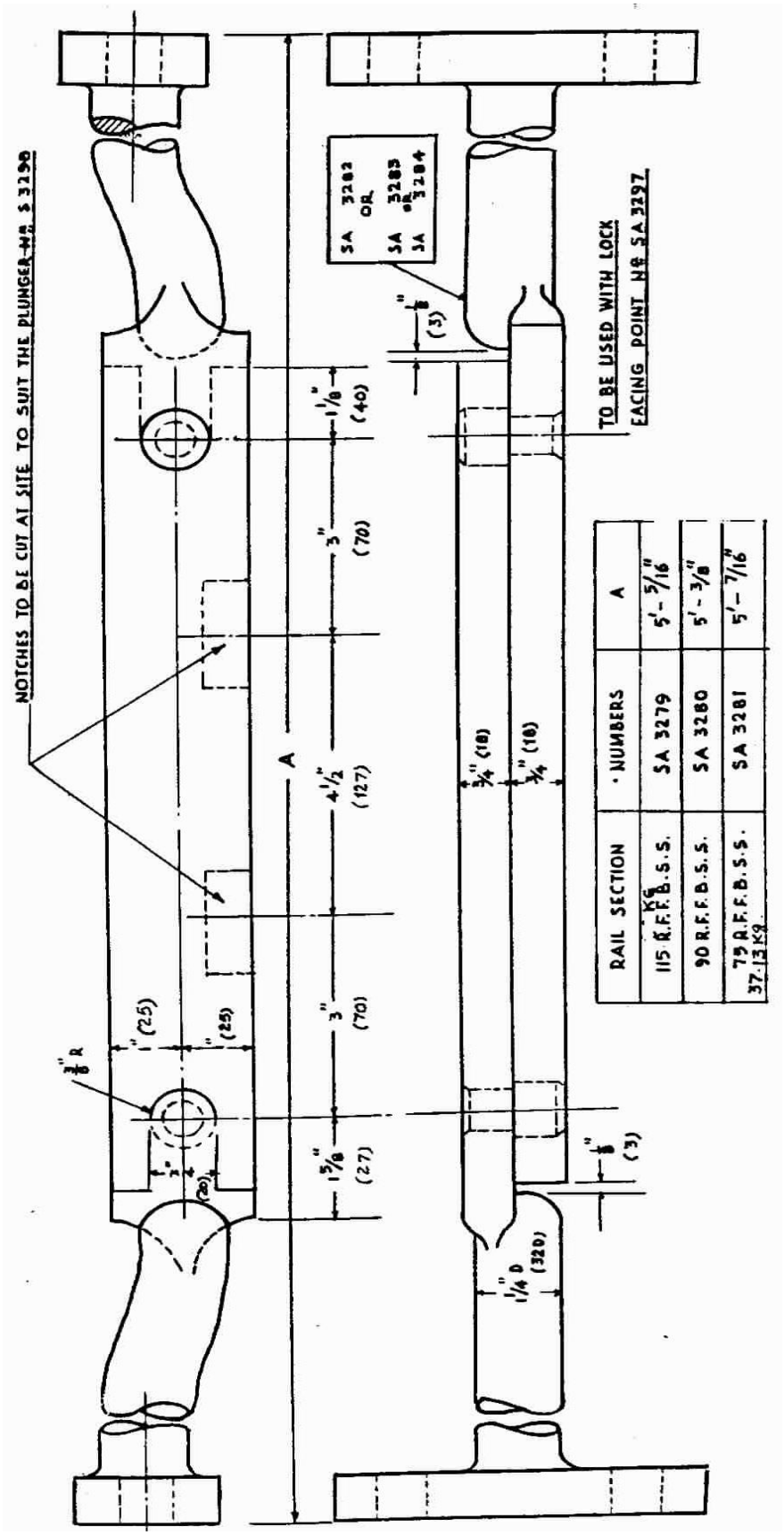


Fig.6.12.(4)
SPILT STRETCHER BAR FOR F.P.L B.G. (SA 3279-81ADV.)

6.13 LOCK BAR (Drg.No.SA 3275)

In order to prevent the unlocking of points while the train is moving over it in the facing direction lock bars are provided to work the lock plunger in conjunction with it. The length of the lock bar has, therefore, to be more than the maximum distance between the adjacent wheel bases of any vehicle. The length of lock bar in the case of BG is 12810 mm and is made out of an angle iron of section 50 X 37 X 6 mm. Normally the bar is lying down clear of the flanges of the wheel, but when it is moved, it raises to the flange, so that should any wheels be over the bar it is impossible for the bar to be moved up. The depth of the wheel flange is 28.5 mm when new and 35 mm when worn out and allowing for the wearing of 3.25 mm of the rail head, it is usual to arrange for the normal position of the bar for being about 38 mm below the top of the rail when the rail is new. To facilitate easy transport of lock bar, a 12810 mm lock bar is made out of 3 pieces normally of 4270 mm each. At the time of installation the 3 pieces are joined together at the site by means of mild steel plate, and rivets. The mild steel plates, splice plates are usually kept rivetted to the two end pieces of the lock bar, a portion of this plate extends beyond the lock bar for being riveted to the lock bar center piece 50 x 50 x 6 mm size has been adopted for lock bar in metric dimensions.

Lock bar to Drg.No.SA 3324 is available for use in case of installation of the lock bar between the check rail and the running rail.

Lock bar clips to Drg.No.SA 3569 will be used with lock bars. It is used for single slip and double slip layouts.

6. 14 LOCK BAR DRIVING ATTACHMENT (SA 3243A): See Fig: 6.15.2(a)

These are used with each lock bar assembly and are rivetted to the lock bar near its ends to provide means or connecting the lock bar to other gears. The driving attachment at the far end of the lock bar is connected to the horizontal crank through a bar driving rod, and the other driving attachment is connected to either the rocker arm or radial guide.

6.15 FPL ROCKER SHAFT SA 3262: Fig 6.15.1 and 6.15.2

In order to transmit 200 mm (8") stroke of lock bar to the lock plunger a 'Rocker shaft assembly' is used. It consists of a 1363 mm (4'-6 1/2" long mild steel shaft having a circular cross section of 38 mm (1$\frac{1}{2}$") dia. for a distance of 3" from its two ends, the rest of the 1213 mm length, i.e. 4$\frac{1}{2}$" is of a square cross section 1$\frac{1}{2}$" side. The shaft is borne at its ends on two bearings which are bolted to the sleepers. Two 'Rocker Arms' (S3264) are fitted to the shaft and held rigidly in position by means of studs. One rocker arm is connected to the lock bar by means of bar driving rod and a driving attachment rivetted to the lock bar. Through the rocker arms works the lock plunger through a lock driving rod. Both the bar driving rod and the lock driving rod are provided with screw joints for making necessary adjustments.

Fig. No. 6.15.1
F.P.L. ROCKER SHAFT S-3262(ADV)

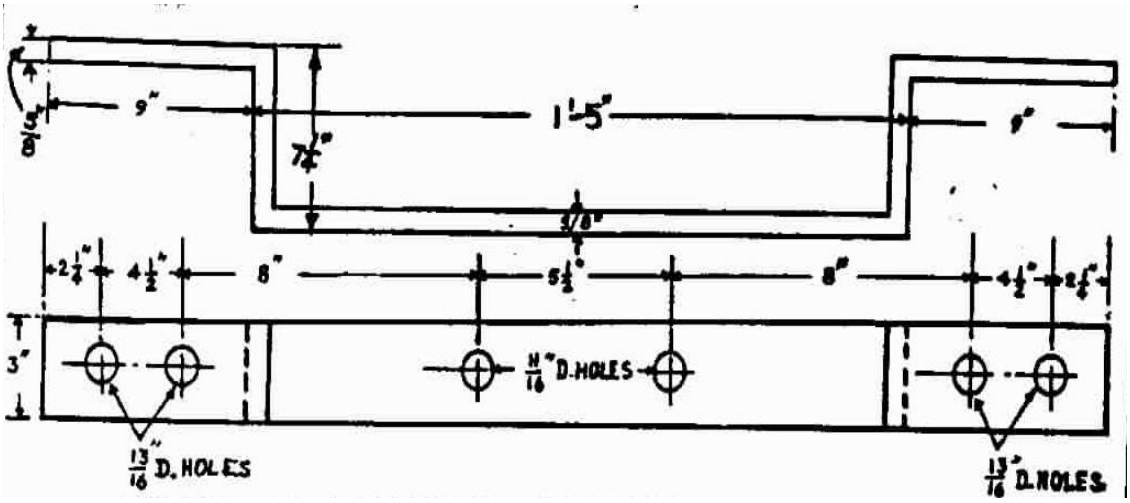


Fig. No. 6.15.2
F.P.L. ROCKER BRACKET S-3263(ADV)

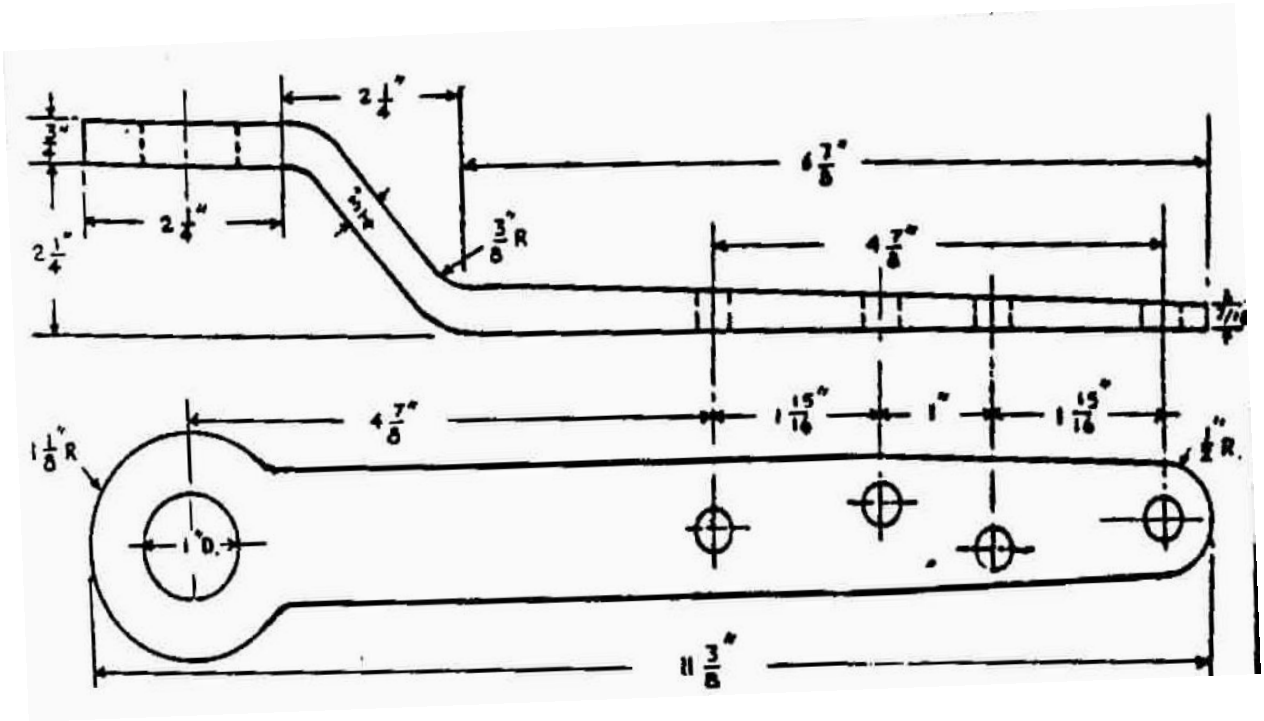


Fig. No. 6.15.2(a)
LOCK BAR DRIVING ATTACHMENT (S 3243 & 3243A)

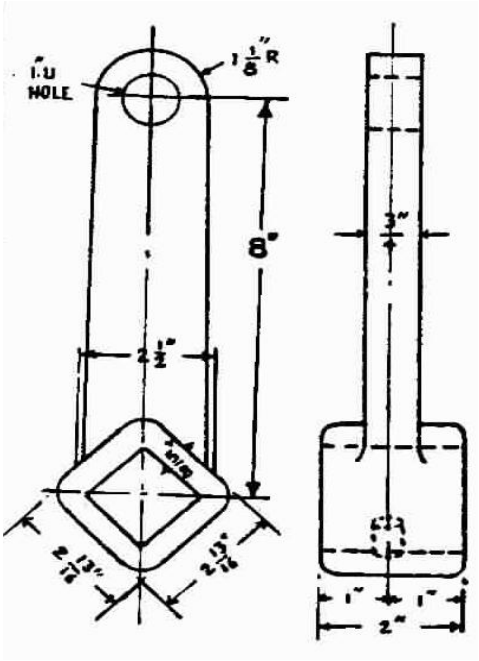


Fig. No. 6.15.3
F.P.L ROCKER ARM S-3264

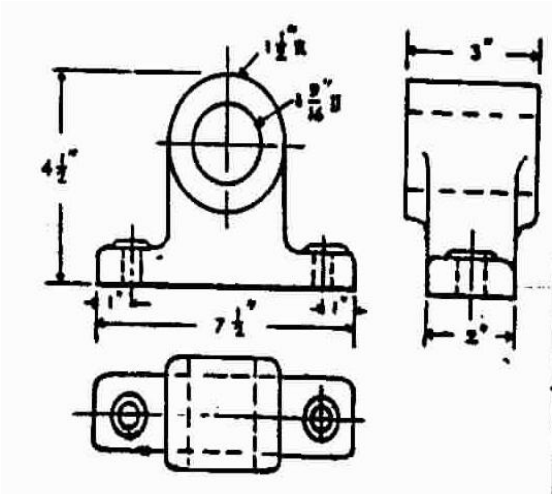


Fig. No. 6.15.4
F.P.L ROCKER BEARING S-3265

6.16 Lock Bar Clips: (See Figure 6.16.1 & 6.16.2)

A lock bar is usually supported by 12 clips fixed at a distance of about 1220 mm (4ft) from one another. The lock bar clip mainly consists of a bracket and a link or a rocker arm lock bar clips are of two types. One is a clamp type SA 3181 for 90R rail section and the other is of the fixed type SA 3247 for 90R rail section. The bracket of the fixed type clip is bolted to the web of the lock bar rail and the link is connected to the lock bar through a stud passing through a hole made in the 50 mm only 325 mm (1/8") under similar conditions. The total lift of the lock bar should be 44 mm for inside bars, and 285 mm for outside bars. The length of the links of the fixed type clips is 137 mm inside bars and 162 mm for outside bars and are meant for rail section 115, 90R, 75R, 60R, and 50R, lock bar bracket for these rail sections are, however, of different sizes (See proforma attached).

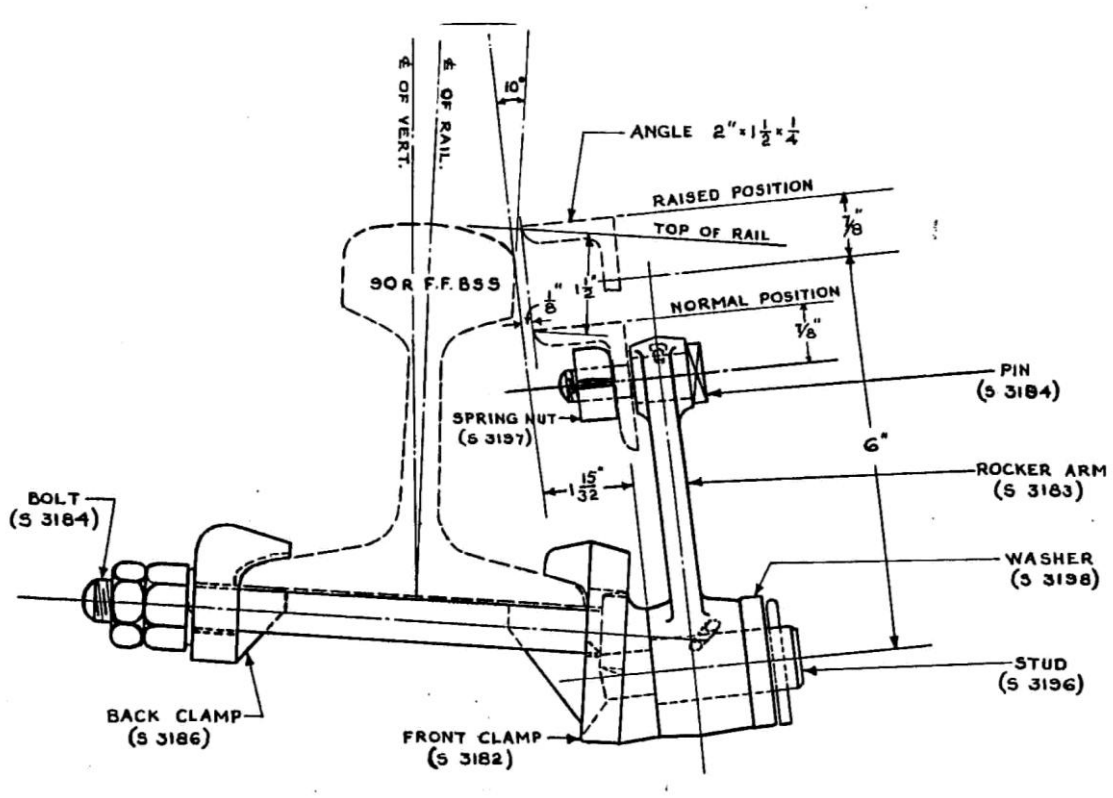


Fig. No. 6.16.1
CLIP – LOCK BAR (INSIDE) 90R F.F. B.S.S (SA 3181)

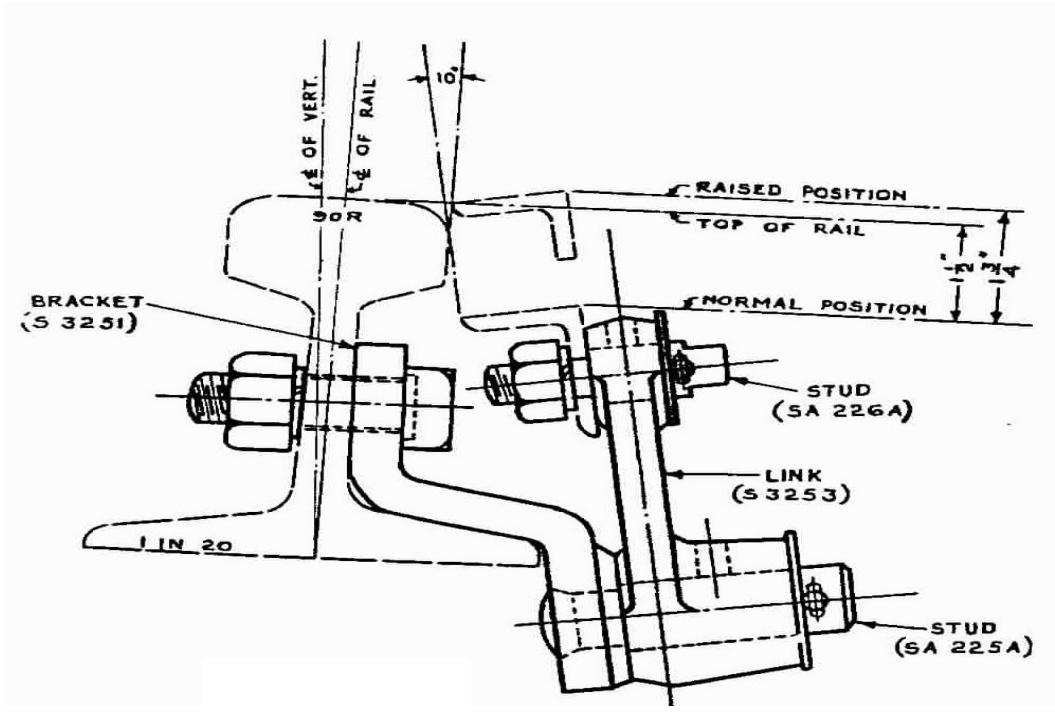


Fig.No.6.16.2
CLIP – LOCK BAR INSIDE (SA 3247)

6.17 LOCK BAR STOPS (See Figure 6.17)

To ensure a fixed clearance between the top of the rail and the top of the bar, 3 bar stops are provided in a facing point lock assembly. These bar stops are of clamp type and are clamped to lock bar rail at approximately equal intervals and stops the bar from dropping any further. This design of bar stops, however, fails to prevent guiding the bars in case lock bar develops a tendency to lean away from the rails. It should be noted that it may be dangerous to allow the lock bars to lean away from the rails. If the gap between the lock bar and the rail increases, there is a possibility of the wheel flange to escape through that gap when an attempt is made to work the lock bar under the train, and thus unlocking of points will be possible. This equally holds good in case of outside lock bars as well In that case if the bar leans away from the wheel type, the lock bar is likely to be rendered ineffective. Hence, it becomes absolutely necessary to maintain the lock bar clips properly so that there is no possibility of lock bar moving away from the rails. A possible solution to avoid this difficulty may be the use of bar stop and guide of a suitable type. The guide should be so designed that it should not allow the lock bar to lean away even if the bottom clip studs become shaky or other connections become worn out.

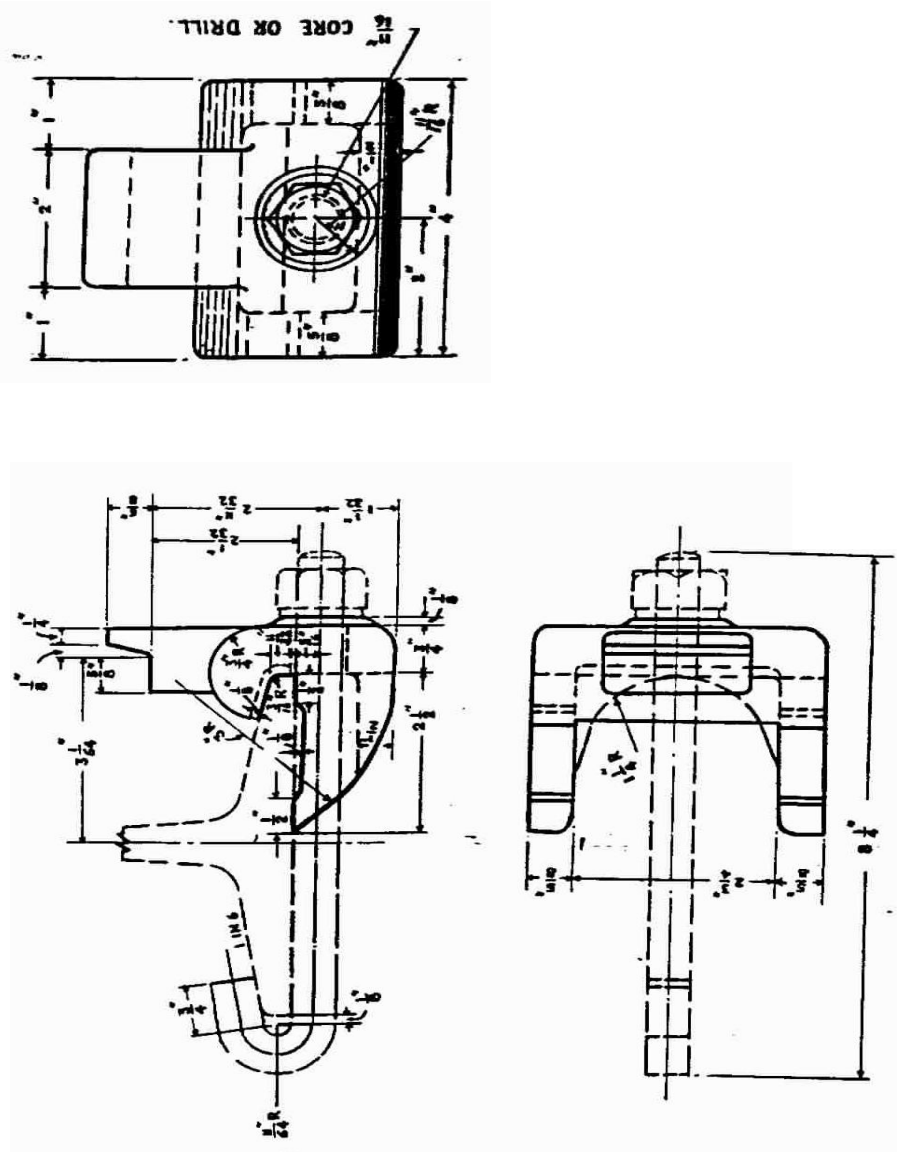


Fig.No.6.17
LOCK-BAR STOP (CLAMP TYPE)

6.18 RADIAL GUIDE NO SA 3030 (Fig. 6.18)

It consisting of a casting with a triangular base having a slot in the central vertical ridge of the casting. This casting is fixed to the sleepers. A rod with a flange, fitted to the lock bar in the manner shown in the diagram (extension bracket) has its free and supported and guided by the radial slot is connected to the lock bar through a bent rod having an eye joint at the radial guide and solid joint at the other end for being connected to the lock bar driving attachment fitted to the lock bar. The drive for the lock plunger is taken from a point on the rod (extension bracket) which works in the radial guide in the manner as shown in the diagram. It is claimed that the provision of the path roller assembly makes working of the lock bar easier.

Fig. No. 6.18

Fig. No. 6.17

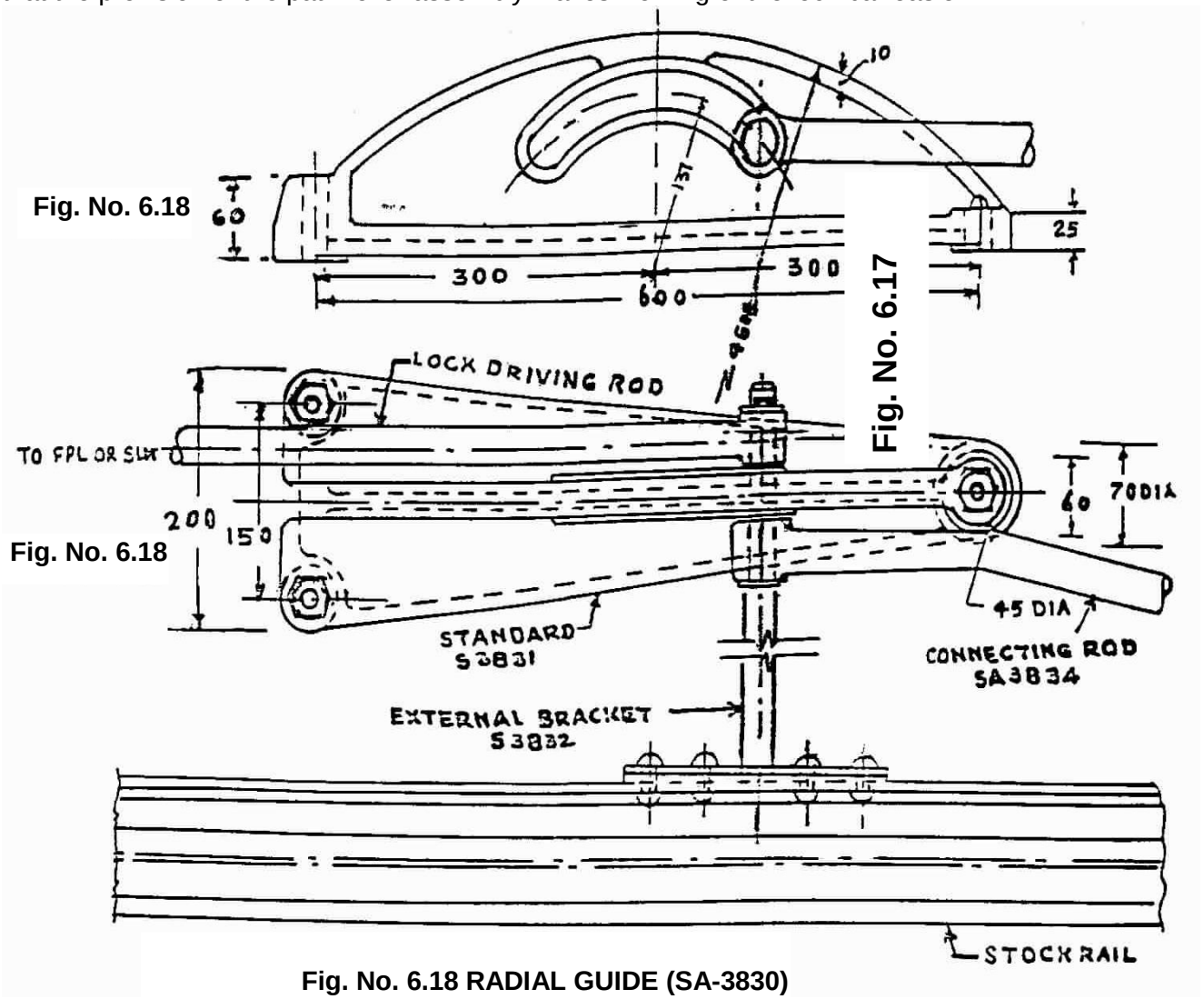


Fig. No. 6.18

Fig. No. 6.18 RADIAL GUIDE (SA-3830)

6.19 Installation of Lock Facing Point

(a) Before fixing split lock stretchers, it must be ensured that the switches are correctly set against the stock rail extending at least up to the tapering porting of the switches. The flexible stretcher is then fitted to give about 3 mm (1/8") extra throw then actually required e.g., for a BG track, switch throw may be initially adjusted to 118 mm (4-5/8") instead of 115 mm (4 1/2").

(b) The holes for split stretcher bars are then drilled in the switches after taking the following precautions.

(i) The stretcher bars should just clear FPL casting bottom and the alignment should be such that while the switches are moved from normal to reverse, there is no binding on the sides of the casting.

(ii) The two stretcher blades must lie against one another in the same alignment without any gap between them. The stretcher ends must butt against studs provided in the opposite stretcher and they should spring connection to the extent of 3 mm (1/8"). This arrangement brings the opening of switch from 4-5/8" to 4 1/2"(118 to 115 mm). In case of BG layouts and claims an advantage of automatically throwing the points detection out in the event of breakage of any one of the stretcher bars.

(c) The lock casting is fitted on the First sleeper on which the first slide chairs are bolted. The FPL casting should be at right angles to the stretchers and shall be placed in such a way that there is no binding between the stretcher bars and casting while the points are being moved. When the casting is thus placed, a marking for the casting holes are made on top of the gauge plate of sleeper itself in case of steel layout 18 mm (3/4") holes are next made out at the markings, and the casting is then securely bolted to the sleeper through these holes. The lock plunger is then driven into butt against the stretcher. The marking for the plunger in the stretcher are taken after holding the points, in the correct normal and reverse positions. The notches are then cut and care should be taken that it does not exceed the scheduled dimensions and the clearance between the plunger and the stretcher notch is 16 mm (1/16"), otherwise it may not withstand gauge test.

(d) The FP lock is fitted at 500 mm (20") from the gauge face of the rails on BG and in the centre on MG layouts.

6.20 Installation of Lock Bars

Following points may be borne in mind before installing a lock bar

(a) Lock bar driving attachment should be rivetted towards the ends of the lock bars, preferably adjacent to the two extreme lock bar clips in the case of layouts provided with Rocker Shaft. However, for layouts with Radial Guide the lock bar driving attachment on points side has to be fitted as indicated in the drawing (Fig. 6.9.(f)).

(b) First mark off the positions of bar stops, on that side of the points where the stock rail does not have a kink, distributing them at uniform spacing.

(c) Fix the bar stops after drilling the necessary holes at the marking on the web of rail (not necessary where clamp type bar stops are used). Place the lock bar on the bar stops and ensure against that the level of the top of the lock bar is correct with respect to the rail level.

(d) Place each clip in its correct positions taking care that clip bracket is firmly secured to the foot of the rail and against its web mark off and drill the holes in the rail in the case of clips of type SA 3247). Then fix clips, taking care that the end clips are fixed at a distance not greater than 225 mm (9") from the ends of the lock bar remaining clips 10 may be fixed at almost uniform intervals. The distance between the adjacent clips should not exceed 1220 mm. Care should be taken to see that the position of the lock bar clip does not infringe with the sleepers or joints on rails or lock bars. Afterwards mark off for holes for top studs on bar. This can be done by placing the lock bar on the bar stops either in the normal or reverse position and then marking off lines on its vertical face above the centre of bottom studs of all clips. Then mark off another set of lines on the vertical face lock bar at 100 mm (4") distance from each of the lines drawn earlier. Mark off on these lines centre points for drilling lock bar stop stud holes. Check up the correctness of these markings by swinging round the clip rocker arm, to the centre mark for top studs and examines whether the mark correctly corresponds to the top stud holes of the clip. Now drill holes at the centre points. These holes in lock bars must be drilled with proper ground twist drill and not a flat drill. The clip, close to the switch should preferably be provided with a special top stud and the hole in the lock bar must be slotted so as to prevent lock bar buckling when the rail expands or contract. This need not be done in cases where care has been taken to close the stock rail joint associated with lock bar rail before the markings for lock bar clips are taken. Where clamp type clips (SA 3188) are used, the clip should be fixed in position and no drilling of holes on the web of rail is involved. However, the holes for top studs in lock bar have to be drilled in the manner explained already.

6.21 Installation of inside lock bars between bar and check rails

Where ever there is a check rail adjacent to a lock bar rail, installation of inside lock bar becomes difficult as the movement of the lock bar is prevented by the check rail, 'block' which are placed between the lock bar rail and the check rail. Because of this difficulty, it was necessary to introduces the use of outside lock bars though, on many occasions, it has been seen that an outside lock bar is ineffective as the bar can be operated under the wheels of a passing train and creating a dangerous condition with the introduction and standardization of special check rail clamp, it has now been possible to use an inside lock bar between the check and lock bar rails With this arrangement, check rail. The lock bar in turn is suitably fitted with rollers to enable it to work along the surface of the path rollers721. Just as the lock bar clips, the path rollers also support and guide a lock bar during its 200 mm (8") travel Lock bar vertical to Drg.No.SA 3324 should be used in this case (see fig. 6.21).

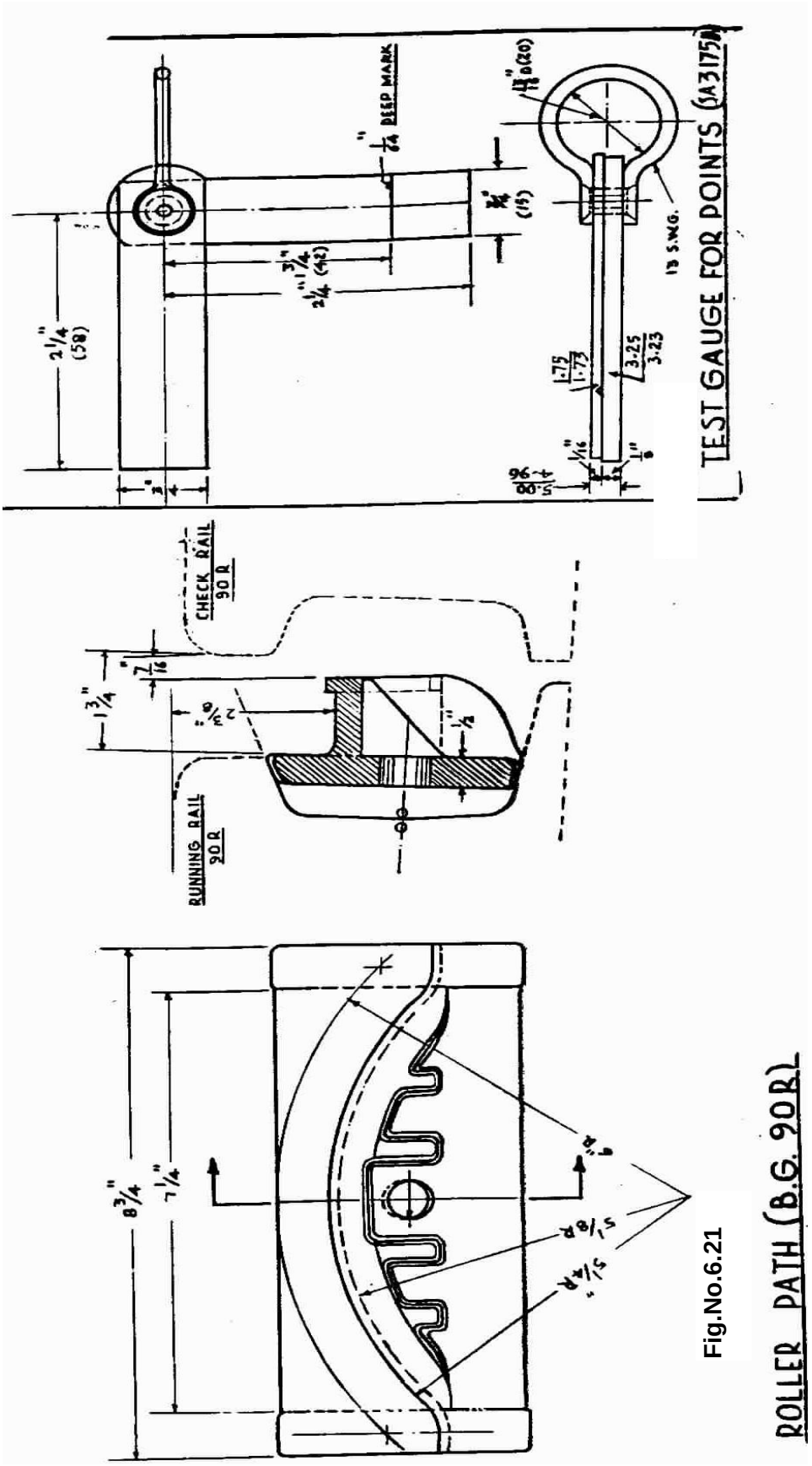

TEST GAUGE FOR POINTS (SA31750)
DEEP MARK
15 S.W.G.
CHECK RAIL
90 R
RUNNING RAIL
90 R
ROLLER PATH (B.G. 90R)

Fig.No.6.21

6.22 Use of vertical clip (SA 3514)

As the space between the check rail and the lock bar rail is limited and is just sufficient for the free movement of a lock bar it is desirable that the lock bar movement is restricted strictly to a vertical plane. If the lock bar is allowed to move at an angle of 10° to the CL of rail section the space required for its free movement would be much more than what is normally available between a lock bar and check rails. A vertical clip ‘clamp type' is, therefore, recommended for use wherever a lock bar is installed to work between a check rail and a lock bar rail When such clips are used, they are meant to be used to support and work only the portion of the lock bar which is outside the check rail, the position of the lock bar which is inside the check rail being guide and supported by the path rollers.

6.23 Two locks worked by one lock bar

Sometimes when the distance between the opposite facing points is less, say 13.1 M (43ft) locking of these two points is done through one lock bar only. The interlocking assembly in this assembly in this connection employs a rocker shaft. The arrangement is such that either both the points are locked or unlocked simultaneously. However, if it is requested to lock one point while the other is being unlocked it will be necessary to replace the rocker shaft with a straight arm crank.

6.24 Adjustment of FPLS

Following is the method of connecting up and adjusting FPL

(a) Adjust travel of the lock bar correctly 200 mm (8") from adjustable crank in which case the lock bars must rest on its stops when the lock bar lever is normal for reverse. The end of lock bar must be 25 mm (1") clear from the toe of the closed switch or any attachment there from, when lock bar is operated towards the toe of switch rail.

(b) With the lock bar and horizontal crank central, connect bar driving rods.

(c) With the lock bar resting on the stops in the normal position, and the FPL plunger 12 mm (1/2") clear split stretcher bar, connect lock driving rod to the radial guide and to the lock plunger.

(d) The clearance between the sides of stretcher notches and the lock plunger not be more than 15 mm (1/14") to that the points cannot be locked with an obstruction piece of 3.25 mm or 5 mm (1/8") or 3/16") placed between closed tongue rail and stock rail approximately 150 mm(6") from the toe of the switch. The JE/SSEs and Signal Technician test in this case should, however, be with 3.25 mm (1/8") test piece only.

6.25 Adjustment of single ended and double ended points

After ensuring that points have been correctly handed over by the Engg. Department, the transmission of the rodding is also required to be checked to ensure that there is no undue strain felt in working the rodding without the points being connected. If it is found that the rodding are working very heavy, the causes there of should be investigated and rectified.

The following are the common defects which may occur in a rodding transmission

(a) Joints and coupling ends twisted.

(b) Extra frictions due to trestles and guide roller assembly not being fixed in proper Alignment.

(c) Extra friction due to bend in rodding.

(d) Cranks and compensators being out of square and out of alignment.

(e) Compensators being fixed at wrong places.

(f) Off sets in rod joints not being adequate.

(g) Due to incorrect fixing of cranks and compensators with respect to rod alignments.

(h) Incorrect setting of cranks and compensators with respect to temperature.

(i) Lack of lubrication.

(j) Cross rod rubbing underneath the rail or side of sleepers.

After ensuring that there is no defect in the point or in the rod transmission, the connection to single ended points should be made as follows

(a) Measure the stroke available at the 300 mm (12") arm of the adjustable crank Say 200 mm (8").

(b) Calculate the length of the adjustable arm for giving a stroke equivalent to opening of switches and 3 mm (1/8") spring.

$$\frac{118}{200} \times 300 = 177 \text{ mm} \quad (4\ 5/8" \times 12 \text{ for BG}) = 6\ 15/16" = 7"$$

(c) Fix the sleeve at the calculated distance.

(d) Keep the points in the mid position by means of a crow bar and the lever in the mid position. Connect the correct length of the throw rod to the adjustable crank sleeve on one side and the lug of the leading flexible stretcher bar of the points.

(e) Operate the lever to see if the points set properly in either position.

(f) Balance the available stroke equally on both sides through the point adjusting screw of the throw rod, if required.

(g) Increase or decrease the stroke as per requirement at the adjustable crank.

(h) Test the spring on the points by using a Tommy bar and inserting it between the switch and the web of the stock rail and levering out the switch to cause the opening in the points, then gradually releasing it. The switch should go back to its original position and set against the stock rail without leaving any gap. Forces required to lever out both the switches should be the same i.e., at ‘N’ & ’R’ positions.

(i) Spring test on the lever.

Press the catch handle of the lever in normal and reverse positions the lever should spring forward over the quadrant by 12 mm (1/2").

Adjustment of double ended points

Connecting points: When connecting up a double ended pair of points to the cabin, the points nearest to the cabin should be coupled and adjusted first. This facilitates in having a second check at the near end points when walking back to the cabin.

While testing point layouts following test are required to be carried out:

Obstruction Test: Insert a test piece of 5 mm thickness between the switch and stock rail at a distance of about 150 mm, from the nose of the switch, and then pull over the lever in the cabin and ensure that:

(a) In the case of facing point bolt lock, it is not possible to latch the lever working the facing point bolt.

(b) In the case of facing point bolt lock it is not possible to latch the lever working the facing point bolt.

(c) In the case of facing point lock key type, it is not possible to extract the key.

In addition to the above mentioned requirements, the obstruction test should also prove that the corresponding signal slide is obstructed by the point slide when 3.25 mm or 5 mm obstruction test is carried out by inserting the test piece between the switch and stock rail at a distance of 150 mm from the nose of the switch and pulling over the point lover. This test is usually carried out by simply pulling the relevant signal wire in the direction of the pull along the signal slide and ensuring that the same is obstructed. For this purpose, the wire should be pulled from point beyond the first pulley stake from the detector. This would ensure that the direction of the pull is the same as when the wire is operated by the concerned lever in the cabin.

CHAPTER- 7: POINT & LOCK DETECTOR

7.1 PRINCIPLES

Before pulling off a signal for the movement of trains over facing points it is necessary to ensure that the concerned points have been set to their correct position. The facing point lock, however, ensures the correct setting of switches with respect to the stock rails, but it does not ensure that the points have been set in their Normal or Reverse position. Moreover, due to a failure of FPL to lock the points on account of a break in the transmission there is a chance of point being left undetected. Therefore, it has been found necessary to provide an apparatus called 'Detector', to detect the position of points and locks, in addition to the interlocking between points and signal levers in the interlocking frame itself. The function of the detector is often not only to prove the correct Normal or Reverse setting and the detection of the switches, but also to ensure that the lock plunger, where provided, has been properly operated before the corresponding signal can be pulled off. To sum up, the functions, of a detector, therefore, are to check the following points, before a train is signalled to pass over a facing point.

(a) That the closed switch has been set against the stock rail and the gap between the switch and the stock rail is less than the permissible limit.

(b) That the open switch has been thrown properly and the gap between the open switch and stock rail is within the permissible limits.

(c) That the route has been correctly set.

(d) That the points are kept held in the last operated position as long as the concerned signal is in the off position, or as long as the detector lever is kept in the reverse position, where the detectors are being operated by separate levers.

(e) That the lock plunger has locked the points properly.

7.2 Arrangements

(a) The usual method employed is to pass a point slide through a slot cut in a cast iron casting placed a little distance away from the points at right angles to the points slide. The point slide is attached to the point and registers the correct throw of the point by means of a narrow notch cut in the point slide a signal slide is made to pass at right angles to it. The signal slide is made to slide through the narrow slots provided at the two ends of the detector casting where it can move in a direction parallel to the length of the detector casting. When the signal lever is pulled, the signal slide, being in the signal wire transmission, is also pulled, and moves through the narrow notch cut in the points slide, provided that the points are correctly set. To allow a free movement of the points slide when the signal slide is in the normal position, a notch is cut in the signal slide. The arrangement is such that if the points slide not normal or "half reverse" the signal slide is locked and conversely if the signal slide is 'not normal' the points slide is locked in whatever position 'N' or 'R' it happens to be.

(b) The figure (below) shows the relative positions of a points slide with respect to a signal slide. The lower slide is a signal slide and has a notch 27 mm wide and 12 mm deep. The points slide works at right angles to the signal slide through the 27 mm notch of the signal slide. The points slide itself has a notch of 13 mm width and 12 mm depth. Thus the clearance between the signal slide and the points slide notch is 15 mm on either side of signal slide, the thickness of signal slide being 10 mm. Thus if the point slide notch is displaced slightly due to points gaping, the signal slide gets obstructed and the signal cannot be taken to OFF aspect.

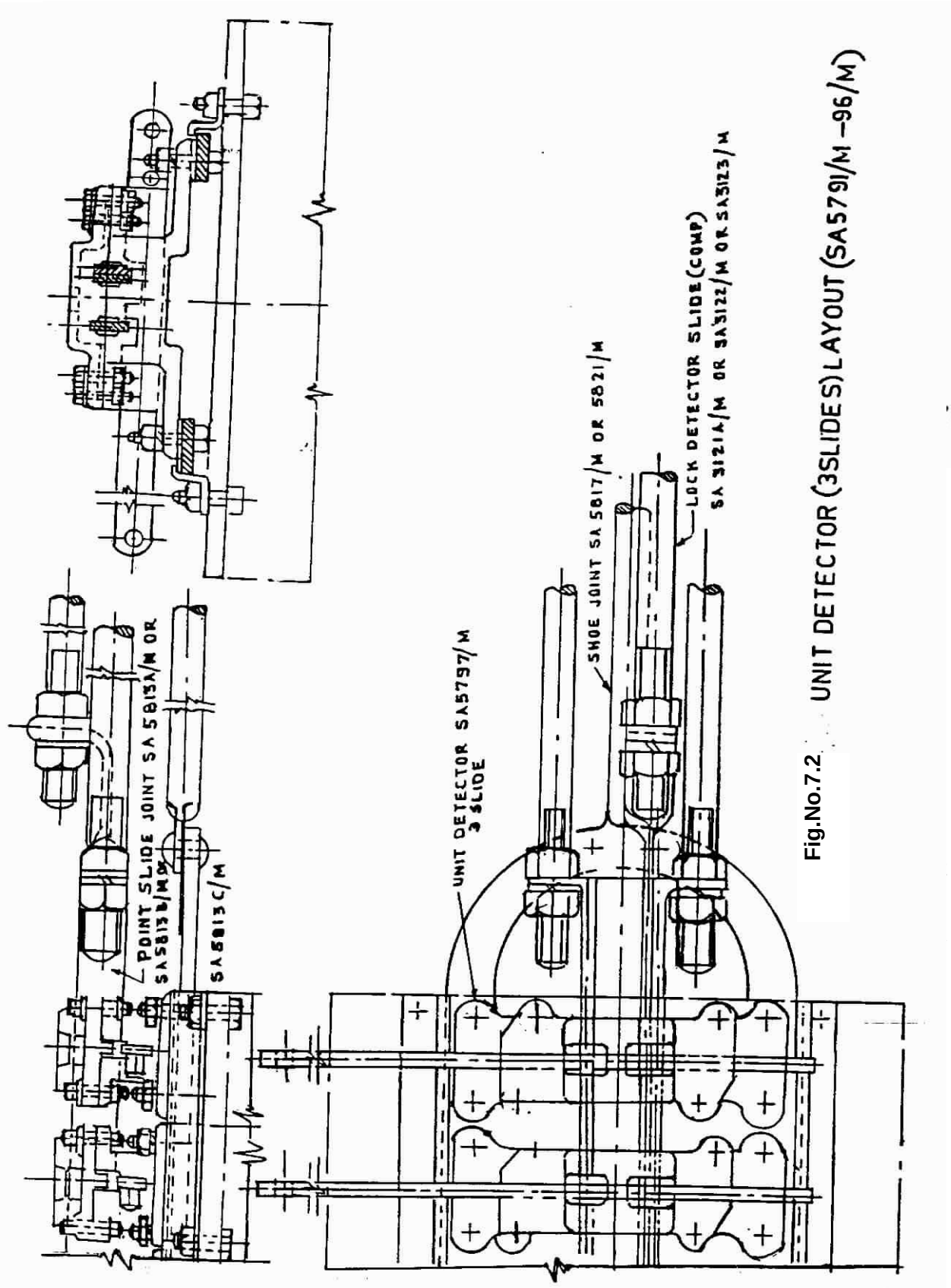
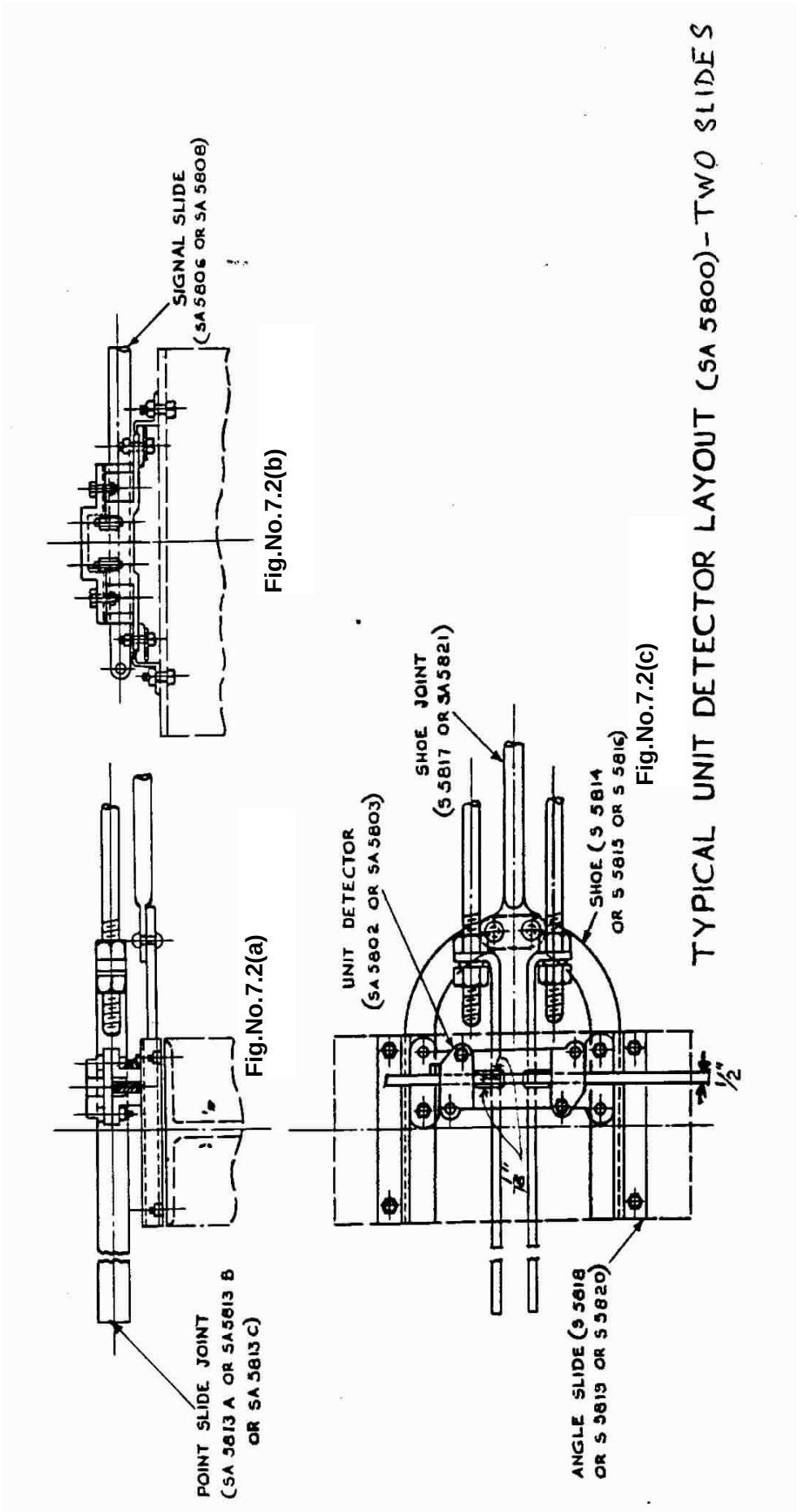

UNIT DETECTOR (3SLIDES) LAYOUT (SA5791/M -96/M)
POINT SLIDE JOINT SA 5813A/M OR SA5813B/M
SA5813C/M
UNIT DETECTOR SA5797/M 3 SLIDE
SHOE JOINT SA 5817/M OR 5821/M
LOCK DETECTOR SLIDE(COMP) SA 31214/M OR SA3122/M OR SA3123/M

Fig.No.7.2


TYPICAL UNIT DETECTOR LAYOUT (SA 5800) - TWO SLIDES
SIGNAL SLIDE (SA 5806 OR SA 5808)
Fig.No.7.2(b)
POINT SLIDE JOINT (SA 5813 A OR SA 5813 B OR SA 5813 C)
Fig.No.7.2(a)
UNIT DETECTOR (SA 5802 OR SA 5803)
SHOE JOINT (S 5817 OR SA 5821)
SHOE (S 5814 OR S 5815 OR S 5816)
Fig.No.7.2(c)
ANGLE SLIDE (S 5818 OR S 5819 OR S 5820)
1/2"
1"
1/2"

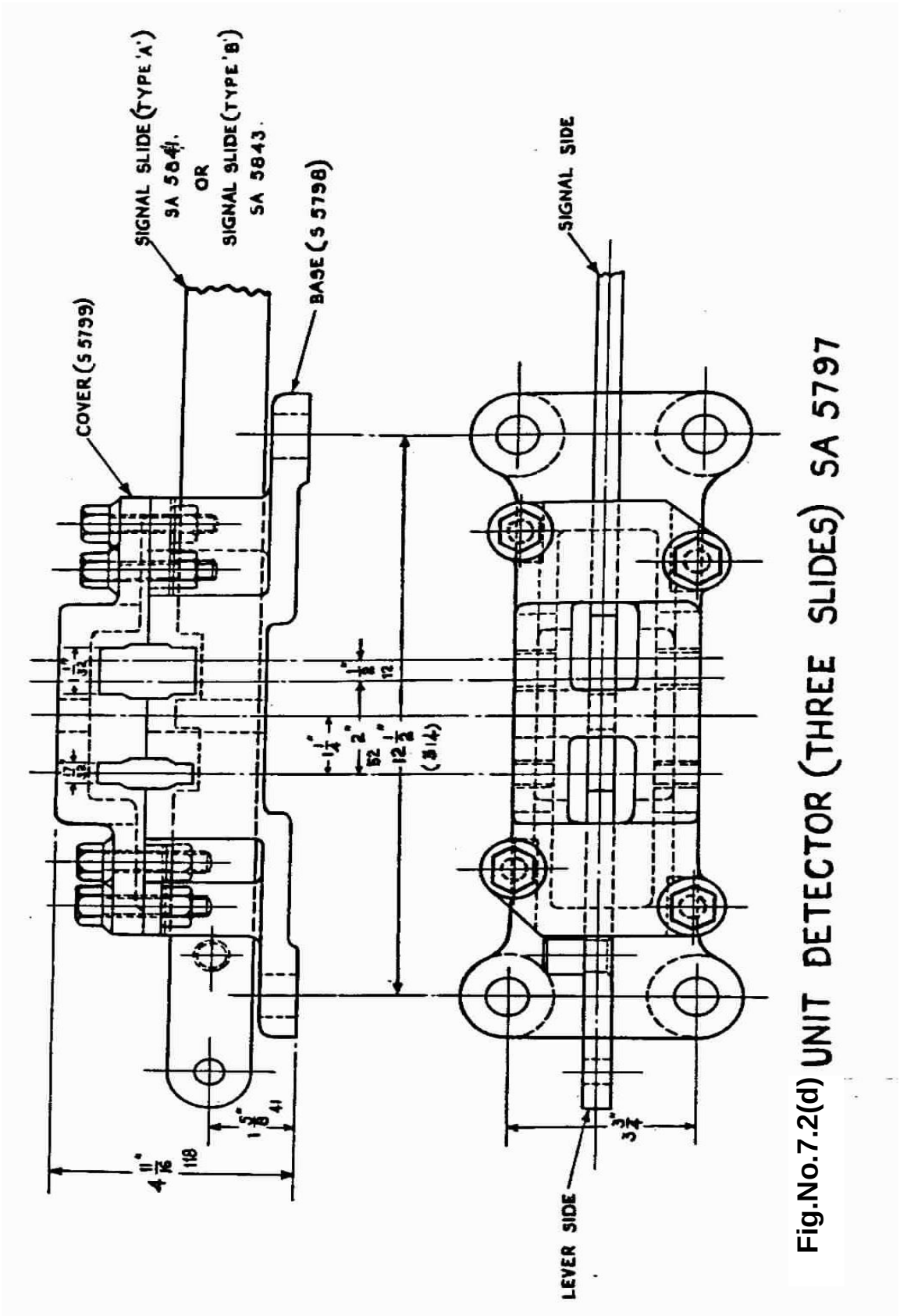


Fig.No.7.2(d) UNIT DETECTOR (THREE SLIDES) SA 5797

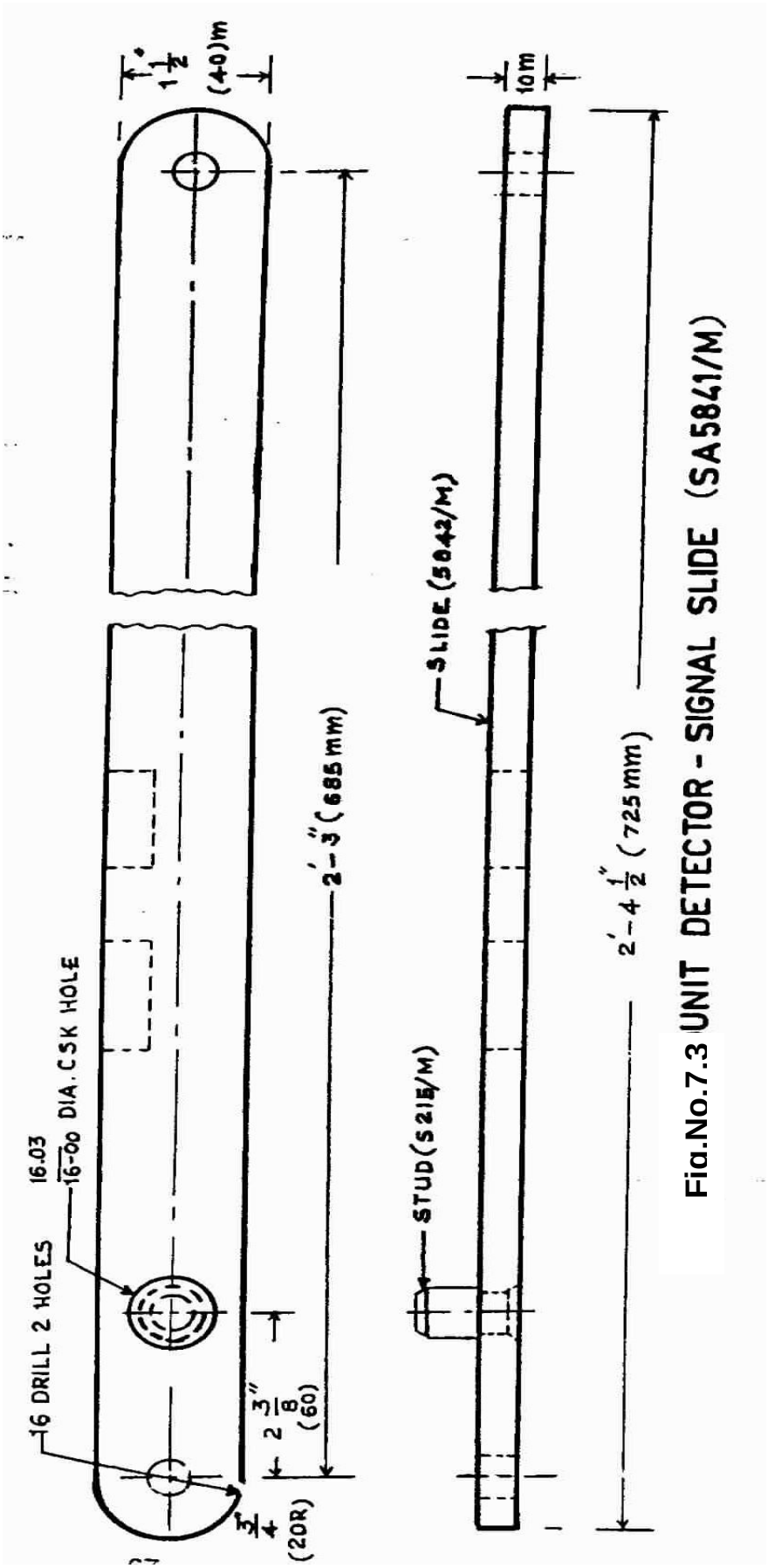


Fig.No.7.3 UNIT DETECTOR - SIGNAL SLIDE (SA5841/M)

7.3 Materials for a 2-way detector assembly

Following are the details of materials used in 1-2 way assembly

Sl.No	Description	Drg. No.	Qty.
i)	Angle slide 1 or 2 way -	S 5818	2 Nos.
ii)	Point slide joint 1 or 2 way	SA 5813A	2 Nos.
iii)	Shoe Joint (coupling) + shoe (S5814)	SA 5822A	1 No
iv)	CI Base		1 No
v)	Hex. Head Bolts and nuts 20 mm X 55 mm		4 Nos.
vi)	Hex. Head Bolts and nuts 20 mm X 45 mm		4 Nos.
vii)	Unit detector	SA 5812	2 Nos.

(a) Angle Slide: (S6080)

Angle slide are available as 1-2 way, 3-4 way and 5-6 ways as per Drg.No.S5818, S5020 respectively. Two of these are fixed parallel to one another on a CI base to form guides for the detector shoe. The CI base is placed parallel to the track along the wire transmission in which the detector is to be installed. Each angle slide is fixed to the CI base in a direction at right angles to the length of the CI base. The distances, between each of the angle slides and the CI base slides parallel to the slide, should be equal so that the detector shoe may assume a central position with respect to the CI base. The number of CI bases for a 3-4 way angle slide and 5-6 way angle slide is two and three respectively. The bolts used to hold the angles slides against CI base are of Hex Head and of size 20 mm X 45 mm and two of these are required for each two way angle slide.

(b) Point slide joint 1 or 2 way - SA 5813A

It consists of a mild steel blade of 12 mm thickness and 50 mm width. The length of the blade depends upon whether it is for two or four or six way assembly. One end of the blade is bent at right angles for a hole being provided in the short bent end. Through this hole passes a threaded rod with provision of nuts on either side of the bent portion of the slide. Any adjustment required in the position of the points slide may be done through the help of the threaded rod and the adjusting nuts. With the typical unit detector assembly (SA 5000), we use two slide one for the points and the other for the lock slide. There is no difference between these two slides except for the size of the notches cut in them and the direction of the bend at the ends of the two slides being opposite to each other. Since the lock slide notch is 25 mm broad, it is necessary to place the lock slide in the particular detector slot which has got 32 mm projection in the casting to avoid points hold up due to lock slide notch 25 mm engaging with the detector casting during the course of its movement. The usual thickness of the detector is about 20 mm and the points slide notch in cut 13 mm wide, and therefore, there is no fear of entanglement of points slide with the casting, during operation of points.

(c) Shoe and shoe joint coupling end (SA 5821)

The unit detector is not directly fixed to the CI base but is fixed to the detector shoe which in turn is made to rest upon the CI base. The shoe is not bolted to the CI base and the arrangement is floating, or in other words, the shoe is free to slide over the CI base in direction at right angles to the length of the CI base, in case there be a slight movement, either due to temperature variations of the rod connecting the shoe to the stock rail or due to a slight lateral displacement of the track. Therefore, the purpose of having a floating arrangement of detectors is to avoid failure caused through the relative movement between the point slide notch and the signal slide.

Such a relative movement may arise either

(i) due to variation in the length of rodding attached to points slide due to temperature variation or

(ii) due to a lateral displacement of points slide notch owing to lateral displacement of the track. To prevent this relative movement, the detector is fitted to the detector shoe which in turn is made to rest on a CI base and it's connected to the stock rail by means of rodding. As the lengths of the rod connecting the shoe to the stock rail and the rod connecting the detector stretcher to the points slide are practically the same, there is hardly any chance of a relative movement between points slide notch and signal slide. Thus failures are avoided. The detector shoes are available in 3 sizes such as,1-2 way, 3-4way and 5-6 way as per standard Drg.Nos.SA 5821A, SA 5821B and SA 5821C.

(d) Unit detector (SA 5802)

It consists of a cast iron base (S 5804) and a cover (S 5805). It has two slots one at each of its two ends, through which a signal slide of 40 mm width and 10 mm thickness placed in a vertical plane, is just able to slide, the tolerance between the slot and the slide being very little. On the two sides of the casting two pairs of slots are provided for the points slide and lock slide. It may be seen that these slots have been provided in such a manner that the points and lock slides move at right angles to the signal slide. The point and lock slides are also placed at a higher plane than the signal slide so that a mutual obstruction of about 10mm is obtained between the bottom of points and lock slides and the top of signal slide. However, this interference is over come in the normal position of the slides by cutting suitable notches in points, lock and signal slides. The clearance between the slides and the casting slots is kept extremely low to prevent wobbling of the slides. Signal slides used with unit wires detectors of drawing No SA 5802 are of type A (SA 5811). The dimensions of signal slide (A) are given in the diagram See Fig: 7.3. The length of the signal slide should be sufficient to permit the full travel of signal wire. The shackle at the signal end of the signal slide acts as a limiting stop and is obstructed by the detector casting if the slide were to be pulled further than what it has been designed for. The detector has a cast iron cover (S 5805) fitted to its lower counterpart with the help of four bolts to prevent the signal slide from being lifted up the unit detectors when fitted side by side on a detector shoe almost touch each other and maintains a pitch of 145 mm between the adjacent signal slides, thus eliminate a possibility of a conflicting notch arising in points slides which have a maximum throw of 115 mm only.

7.4 Method of installation of two way unit wire detector assembly

A two way unit wire detector assembly is first fitted to a cast iron base in the manner already explained before. The two angle slides should accommodate the detector shoe loosely and the shoe should assume a position central and at right angles to the CI base. The unit wire detectors together with the signal slides shall then be mounted on the detector shoe. A pit has to be dug under the signal wire transmission and opposite the point which is required to be accommodate the CI base. The CI base with the detector assembly fitted, on it, shall be placed in the pit and should be kept parallel to the track, the signal slides being placed parallel to, and under the wire transmission. The level and the position of the CI base should be adjusted with respect to the rodding leading from detector stretcher or being connected to points slide. The rod connecting the detector stretcher to the points slide shall be supported on roller guides assembly in the usual manner, and the position and the level of the CI base adjusted accordingly.

The detector shoe is connected to the stock rail by means of flange connecting rod. This rodding also will be carried to the CI base over guide roller assembly. The position of the CI base, shall then be finally realigned, re-leveled and then consolidated. The CI base will then be secured in position firmly and the excavated earth will be put back in the pit and well rammed in layers of 150 mm deep. Care should be taken to see that the level of the CI base and its alignment does not get disturbed.

Precautions

Following precautions are to be observed while installing detector layouts

(a) The signal slide is directly in line with the direction of the signal wire transmission.

(b) The points slides and lock slides do not have any binding with the detector casting either laterally or vertically.

(c) The notches in the points slides are cut at site and the clearance of the notches on the lock slides is correct.

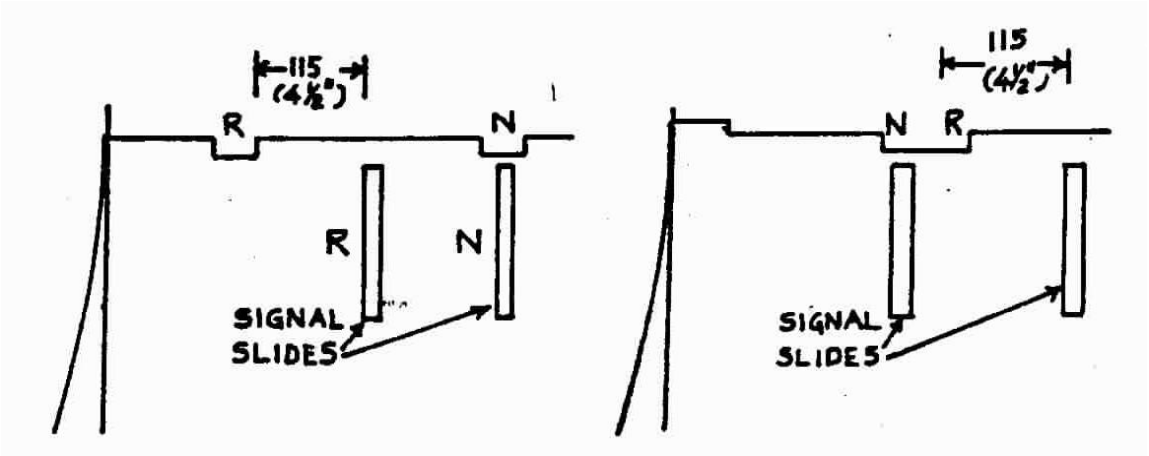
(d) The cabin end portion of the signal slide notches clears the point slide by 3 mm (1/8") when the signal slide stops bears against the detector casting.

(e) The signal slide notch is cut in such a manner that it detects the closed switch first. This can be done by cutting the signal slide notch pertaining to open switch slightly longer than that of the closed switch. This facilitates testing Refer sketch A&B Drg. No. SA-5802 and Drg. No. SA-5797.

(f) There should not be any undue play between the signal slide and casting.

(g) Points slide and lock slide shall be placed in the prescribed slots made in detector casting for this purpose, otherwise, the lock a slide might get caught in detector casting during movement.

(h) Care should be taken to arrange the signal slide in such a way that the normal and reverse notches in the points slide are sufficiently apart.



CORRECT METHOD WRONG METHOD

Fig: 7.4

Drg. No	No of Units
SA 5791/M	1 way
SA 5792/M	2 way
SA 5793	3 way
SA 5794	4 way
SA 5795	5 way
SA 5796	6 way

7.5 Details of Unit Detector 3 slides layout SA 5791/M to 5796/M may be seen in Annexure

Assembly with two points slide and one lock slide (SA 5797)

Here in this type of assembly each of the switching has its own individual points slide and a switch extension piece (S 6062-63) attached to the switch toes. These extension pieces are attached to the switches with two bolts. At a point near the switch toe it is bent at right angles and moves away from the stock rails for a few inches and takes another right angle turn and extends forward for a few inches parallel to the switch. It is then set downwards to a depth below the base of the rail and then again it bends at right angles away from the stock rail to receive the rod from the point's slide of the detector. The unit detector used in this case is of a different type (SA 5797) so far the arrangements of slots in the detector casting from the point and lock slides are concerned. One slot is 13 mm wide i.e., exactly of the same size as that of the type discussed already the other slot is of width 25 mm to accommodate one point slide and a lock slide each of which is 12 mm wide.

In this type of detectors the notches in signal slide are cut in such a manner that the closed switch is always detected first by the signal slide. This is easily achieved by cutting the two notches in the signal slide, one slightly longer than the other the smaller notch striking against the points slide pertaining to the closed switch in case it is gaping. When the point is reversed, suitable notches should be cut in another signal slide in such a manner that the closed switch is detected first. The notch corresponding to the open switch must again be cut slightly larger than the notch in this case. The front notch in the signal slides in this will be longer because it has to cater for two points slides placed in one slot Side by side Refer Fig.no.7.2(d).

7.6 Lock Detections

It is often necessary to ensure that the point has been locked properly before the concerned signal is taken off. There are generally two methods employed for this purpose one is the crank method (the crank method is obsolete) and the other is the cam method. The facing point lock with plunger detection Drg. No. SA 3297/M has been standardized In this type of lock 200mm plunger stroke is converted to 32mm of on the cross slide by means of the cam. The lock detection slide is connected to the cross light by means of a rod (see fig: 7.6).

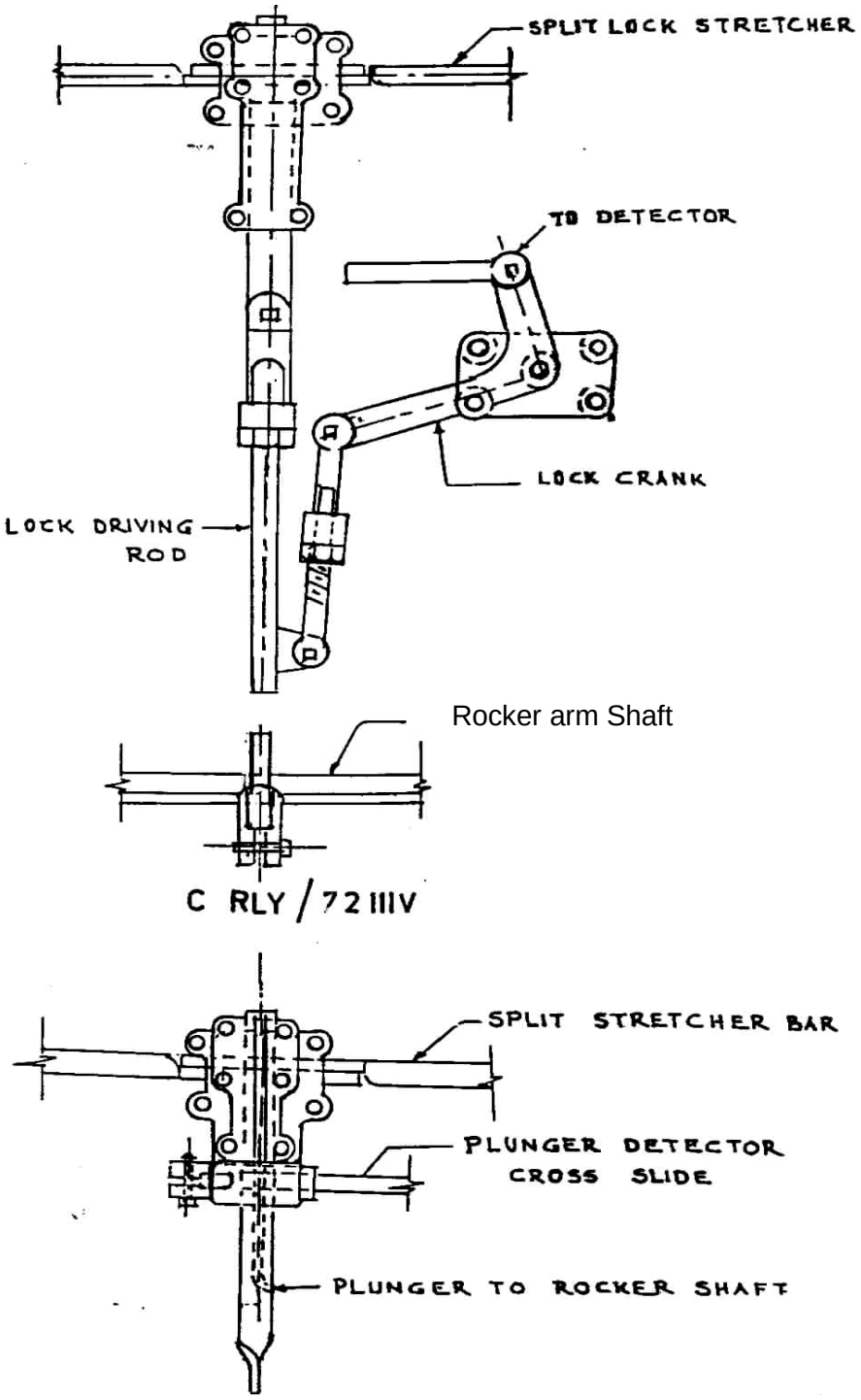


Fig. 7.6. F.P.L. WITH PLUNGER DETECTION SA- 3297/M

7.7 SIGNAL WIRE TRANSMISSION HAVING DETECTORS IN THE WIRE RUN PARA 12.66.1- IRSE MANUAL II

Where there is more than one detector in a wire run, the wire must be run from the cabin first to the detector farthest from the signal to operate them through the other detectors concerned and back to the signal.

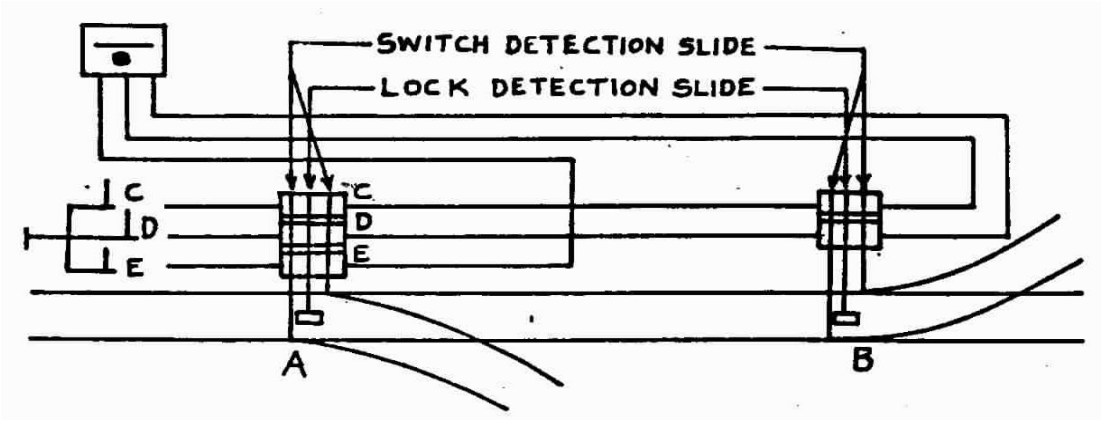


Figure above illustrates the wire transmission having detectors in the run

Fig. 7.7

At the point 'B' a two way detector assembly will have to be installed to detect the point position in the normal and in the reverse for the Signal D and C respectively. For signal No. D the wire run from the cabin will first be taken to the farthest detector at point 'B' then to the signal through the nearer detector 'A' similarly, for signal C, the wire is first taken to point B and connected to Signal Slide 'C' from 'C' the wire goes to the slide C of point A and finally to Signal 'C' The wire run for signal E need not be taken to point B, since the signal is concerned with point 'A' only.

7.8 The reason why a detector wire is taken first to the farthest detector from and signal can be followed with the following illustration. Let us first analyses what may happen if we take the wire first to the detector closer to the signal and then to the further detector and lastly to the signal.

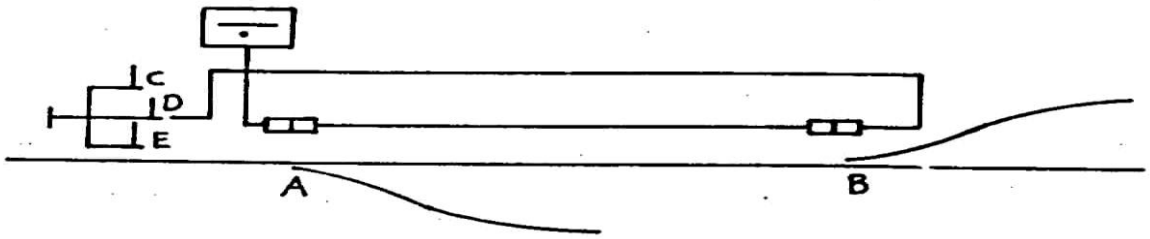


Fig. 7.8

The counter weight lever on the signal is responsible for fully drawing back the signal slides at 'A' and 'B' to their stops to avoid a point held up due to signal slides fouling when the signal lever is returned to its normal position. In this particular case, the counter weight balance lever has to ensure proper return of signal slide at 'A' which is situated, in terms of wire length, more than double the distance AB from the signal. The counter weight balance lever bracket is provided with a limiting stop and will not be able to absorb the slack in the wire which may develop due to rise in temperature. The proportionate slack at 'A' will be much more than at 'B' and therefore, the chances of signal slide going out of adjustment at A as much more than at B Hence, to avoid this the wire is first taken to detector B from the cabin and from there to the C/W balance lever through detector A. With this arrangement, the maximum distance in terms of wire length, of the farthest detector is reduced to half, and consequently, the chance of a possible point held up on account of detector due to temperature raise is reduced.

7.9 NOTCHES ON POINTS, LOCK & SIGNAL SLIDES:

Notches on signal should be cut at site as shown in Fig. No. 7.9.1 & 7.9.2.

(a) Notches on point slides should be cut 13 mm wide 12 mm deep Pitch of normal adjacent notches must be equal to 145 mm notches must have square edges. The point slide notches should be adjusted to give 15 mm clearance on both sides of signal slides. For lock slides cut notches 12 mm deep and give 6m clearance on either side of signal slides, so that the total length of notches are 6+10+6 = 22 mm each.

(b) In the case of rod operated points with economical point mechanism (SA 3850 and SA 3851) and economical facing point lock (SA 3214/M), the size of the notch on the lock detector slide has 18 mm to be as the movement of the lock detection slide 12 mm for 200 mm travel of the Facing Point Lock plunger.

(c) As already explained before, when point slides and lock slides are used in a detector the notches in signal slides should be cut in such a way that the signal slide first enters the point slide and then the lock slide. This is usually done by cutting of signal slide notch for lock slide 8mm longer than the notch in signal slide meant for point slide detection. This is necessary when testing the detection to see whether the signal slide is held up by the point slide or lock slide.

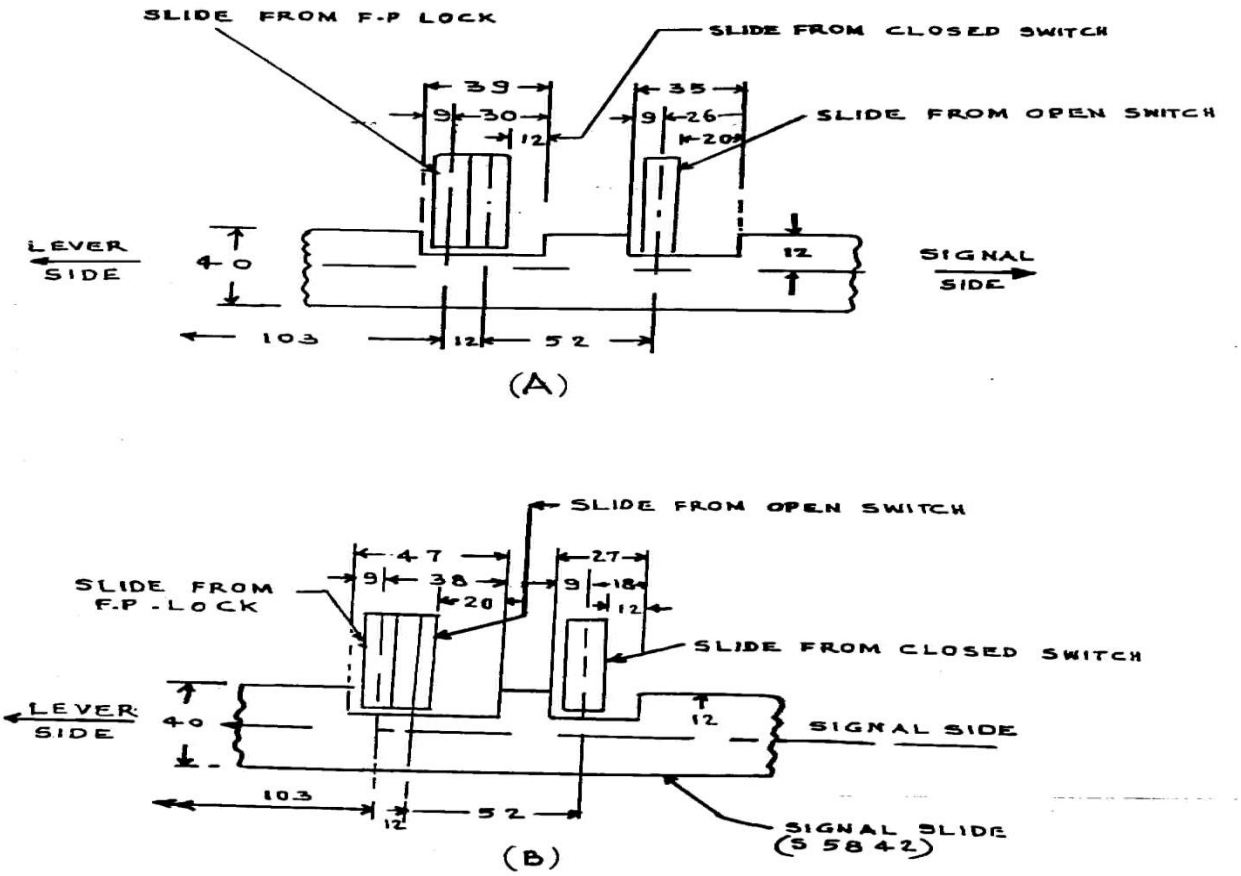


Fig. No. 7.9.1 NOTCH ON SIGNAL SLIDE

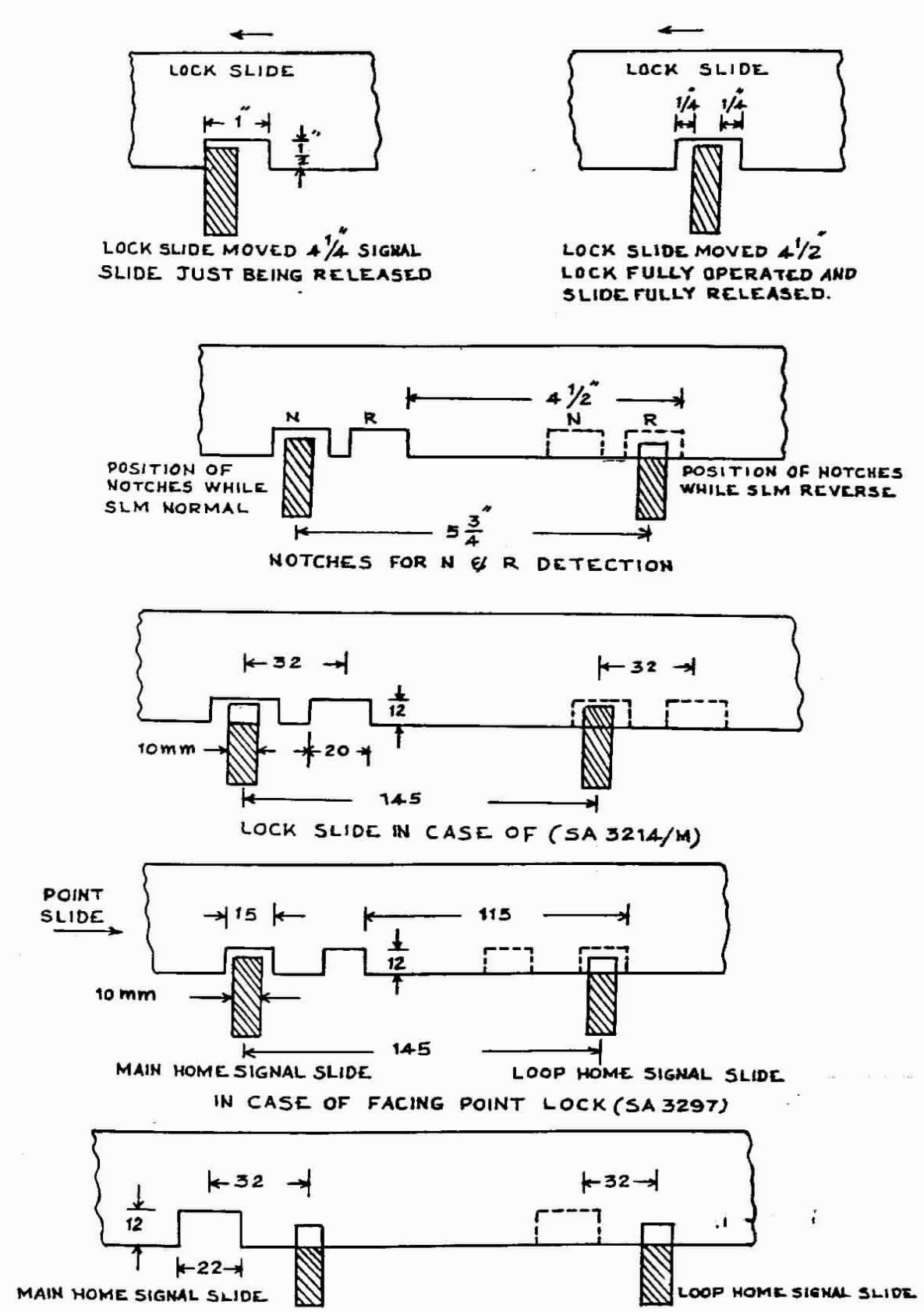


Fig. No. 7.9.2 ALTERNATE LONG NOTCH FOR N & R DETECTION

7.11 Conflicting Notches

Where three or more signals read over diverging routes it is necessary to exercise care to see that the notches in the point slides do not conflict i.e., make it possible to give a signal with the points in incorrect position. Therefore, to avoid such a situation the spacing between the two adjoining detectors has been made 145 mm (5 ¾") for apart, whereas the throw of the switch is only 115 mm (4 ½") for BG Consequently, whatsoever manner the notches are cut, a case of conflicting notches will not arise a 115 mm (4 ½") throw of the switch will never be able to foul a signal slide situated 145 mm (5 ¾") apart.

7.12 Instructions for the installation of mechanical point detectors

(a) Detectors must be provided strictly in accordance with interlocking plans and must be installed as shown in the standard drawings.

(b) Where practicable, detector must be placed in the main wire run.

(c) When a signal detects more than one point, the wire from cabin must be carried first to the detector farthest from the signal and then through the other detectors to the signal.

(d) Wires must lead away from detectors in a horizontal straight line otherwise signal slides will bind. Care should be taken to avoid the following of wires in the point slide notches which may be protruding beyond the detectors.

(e) The wire should be so adjusted that the signal slides will travel back to their stops when signal is returned back to 'ON'.

(f) Slides must be so adjusted that signal cannot be taken off when 3.25 mm obstruction is placed between tongue rail and stock rail 150 mm from the toe of tongue rail.

(g) When it is difficult to maintain a signal wire in proper adjustment either due to a number of detectors in the wire run are due to detectors being far from the signal, electrical detection may be resorted to.

(h) Detector slides must be kept clean and well lubricated.

CHAPTER- 8: SIGNALS & FITTINGS

8.1 Semaphore Signals

Semaphore Signal with a few exceptions has been the universal signal for main line working in consists of a post on which an arm is fitted in horizontal position and is capable of being operated to a position 45 deg to 60 deg below horizontal or 45 deg & 90 deg above horizontal for multiple aspect upper quadrant signals.

On Indian Railways 2- aspect lower quadrant semaphore signals are generally worked by single wire transmission. A signal arm is fitted to the cast iron spectacle having arrangements for a red and a green roundel being fixed to it for the display of the night aspects of the signal. The spectacle is mounted on a semaphore bearing either keyed to a spindle or mounted directly on a stud pin of a semaphore, according to the type of spectacles in use. A few inches away from the fulcrum of the spectacle there is a stud pin fixed to this spectacle to which an up and down rod connection is made. The other end of the up and down rod is connected to the counter weight balance lever. The counter weight balance lever itself is fitted below on the post at a minimum distance of 4 feet from the fulcrum of the spectacle. The counter weight balance lever is pulled downwards by a wire connected to it by the operation of a lever in the cabin. The other end of the counter weight balance lever across the fulcrum pushes upwards the up and down rod connected to the spectacle stud. The spectacle stud in turn is pushed up causing the signal arm to lower in the lower quadrant. The day aspect of the signal is made out from the position of the arm 'ON' when the arm is horizontal, ‘OFF’ when the arm is at an angle of 45 to 60 deg below to the horizontal for the night aspect a lamp is fixed behind the red roundel of the spectacle the lamp itself being mounted on a separate lamp bracket which is rigidly fitted to the signal post. When at night, the lamp is lit, the light passes through the red roundel indicating the arm is in the 'ON' position. When the signal is taken to 'OFF' the green roundel comes in alignment to the signal lamp, exhibiting a green light to the driver through the green roundel. Thus the 'OFF' aspect in night is the green light and the 'ON' aspect is the red light. The spectacles of all Semaphore Signals have been designed in such a manner that whenever there is a disconnection of the Up and Down rod from the spectacle, the return torque of spectacle is sufficient to bring the signal arm to 'ON' position. In order to prevent the arm from going up in the upper quadrant position due to its heavy spectacle an arm stop has been provided behind the spectacle. A projection from the spectacle casting rests on the arm stop when the signal is in the 'ON' position and it prevents the spectacles from going further down, or then arm going up.

8.2 Signal Fittings

See Fig.8.2, There are two sets of signal fittings standardized on the Indian Railways, one for use on tubular post and the other for lattice post. Each one of these is having two types of fittings one with type 'A' spectacle (SA 2070) and the other with type 'B' spectacle (SA 2085.

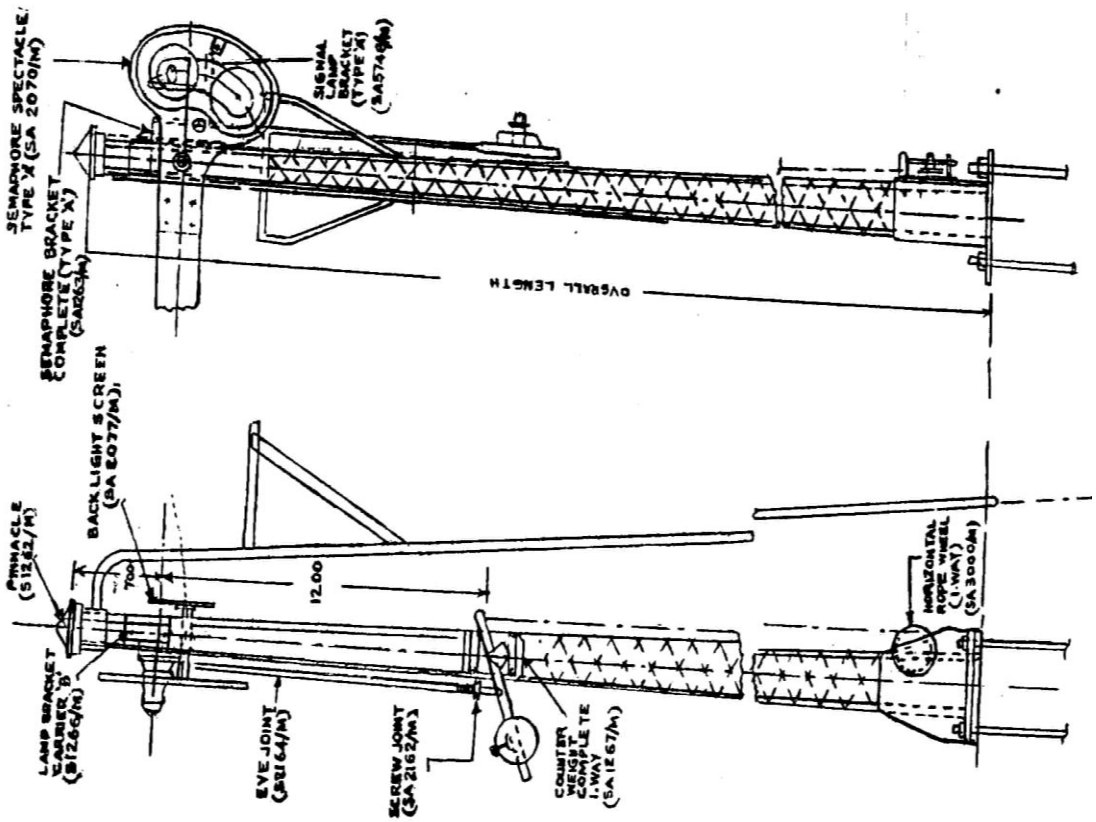


Fig. No. 8.2(i) SIGNAL-1-ARM TYPE 'A' (ON LATTICE POST) (SA 1231/M-36/M)

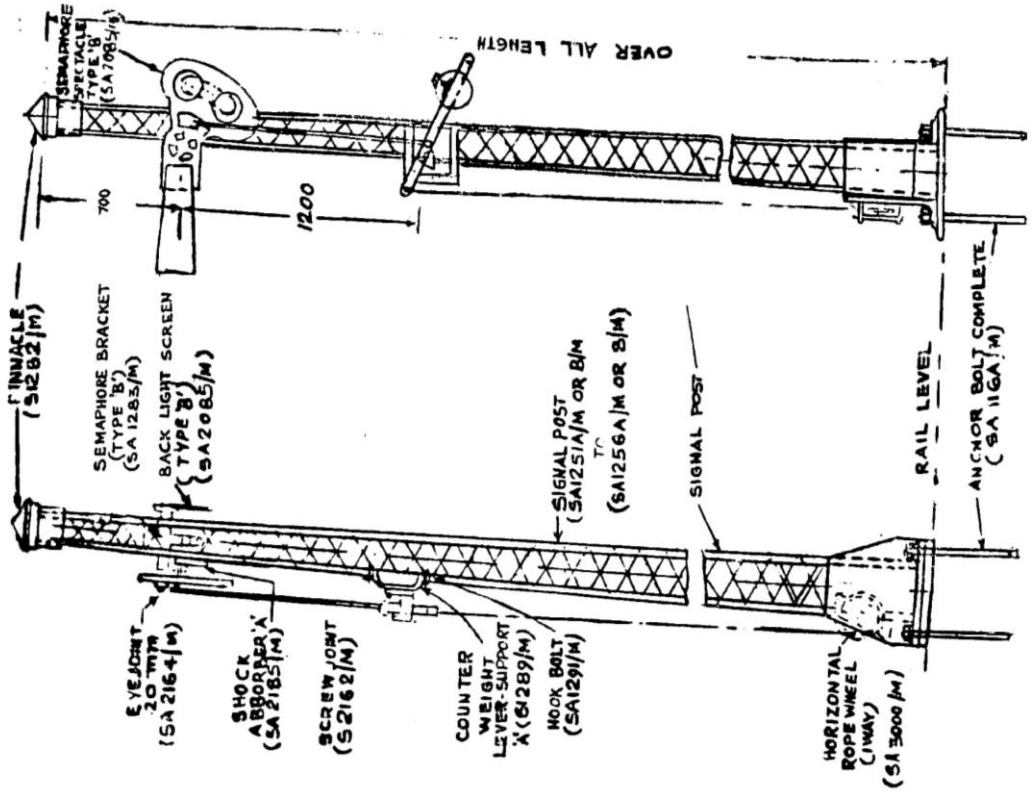


Fig. No. 8.2 (ii) SIGNAL-1-ARM TYPE 'B' (ON LATTICE POST) (SA 1241/M-46/M)

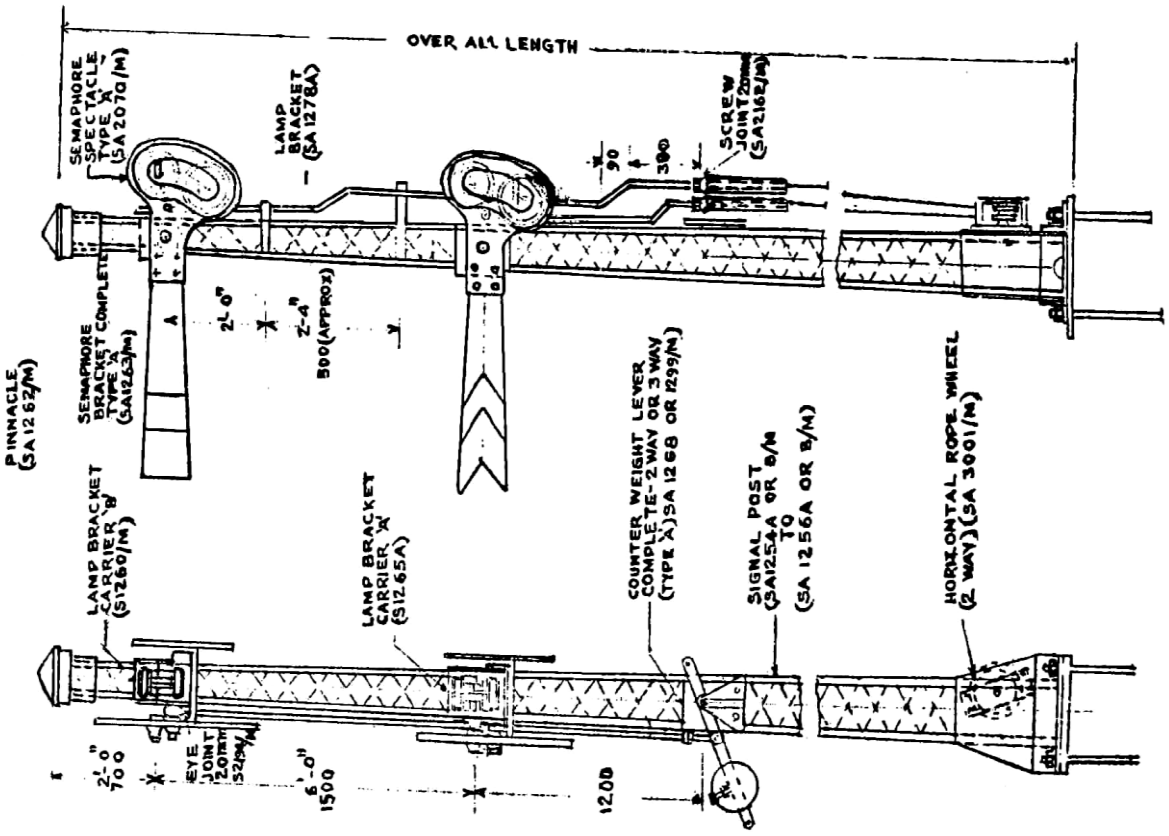


Fig. No. 8.2 (iii) SIGNAL-2-ARM TYPE 'A' (ON LATTICE POST) (SA 1237/M-39/M)

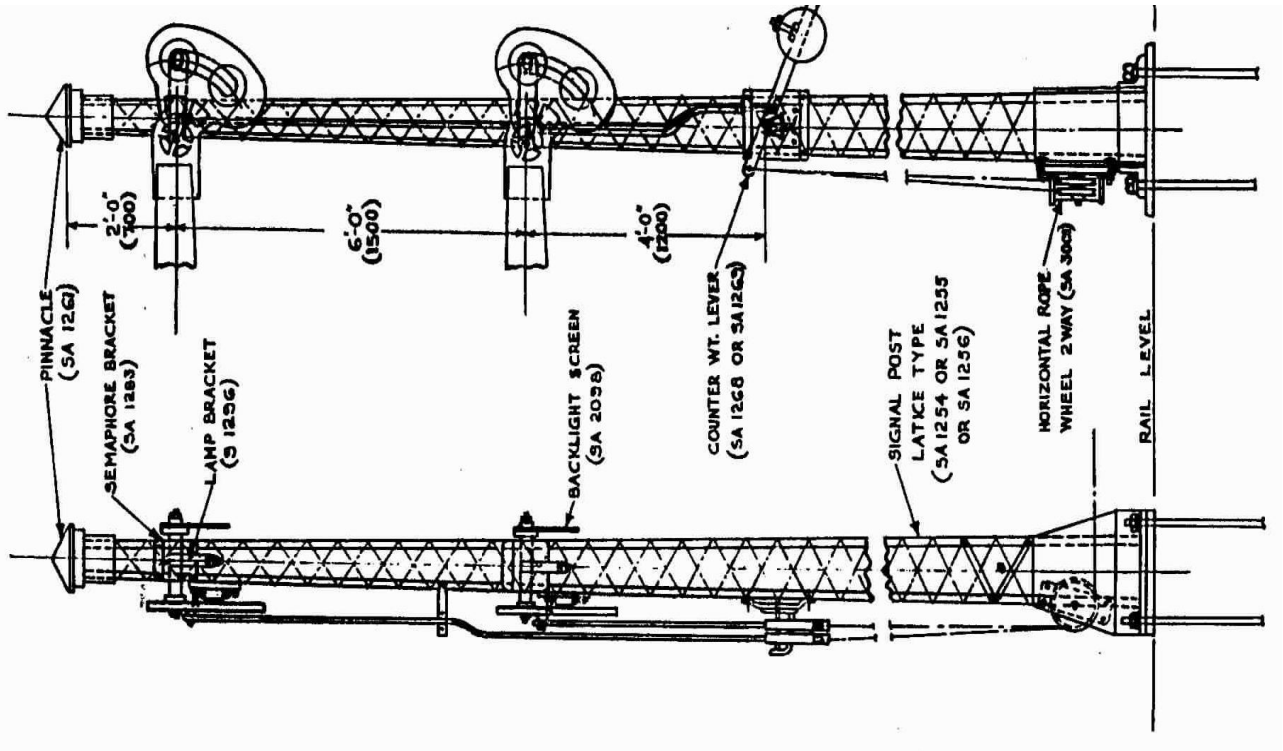


Fig. No. 8.2 (iv) SIGNAL-2-ARM TYPE 'B' (ON LATTICE POST) (SA 1247/M-49/M)

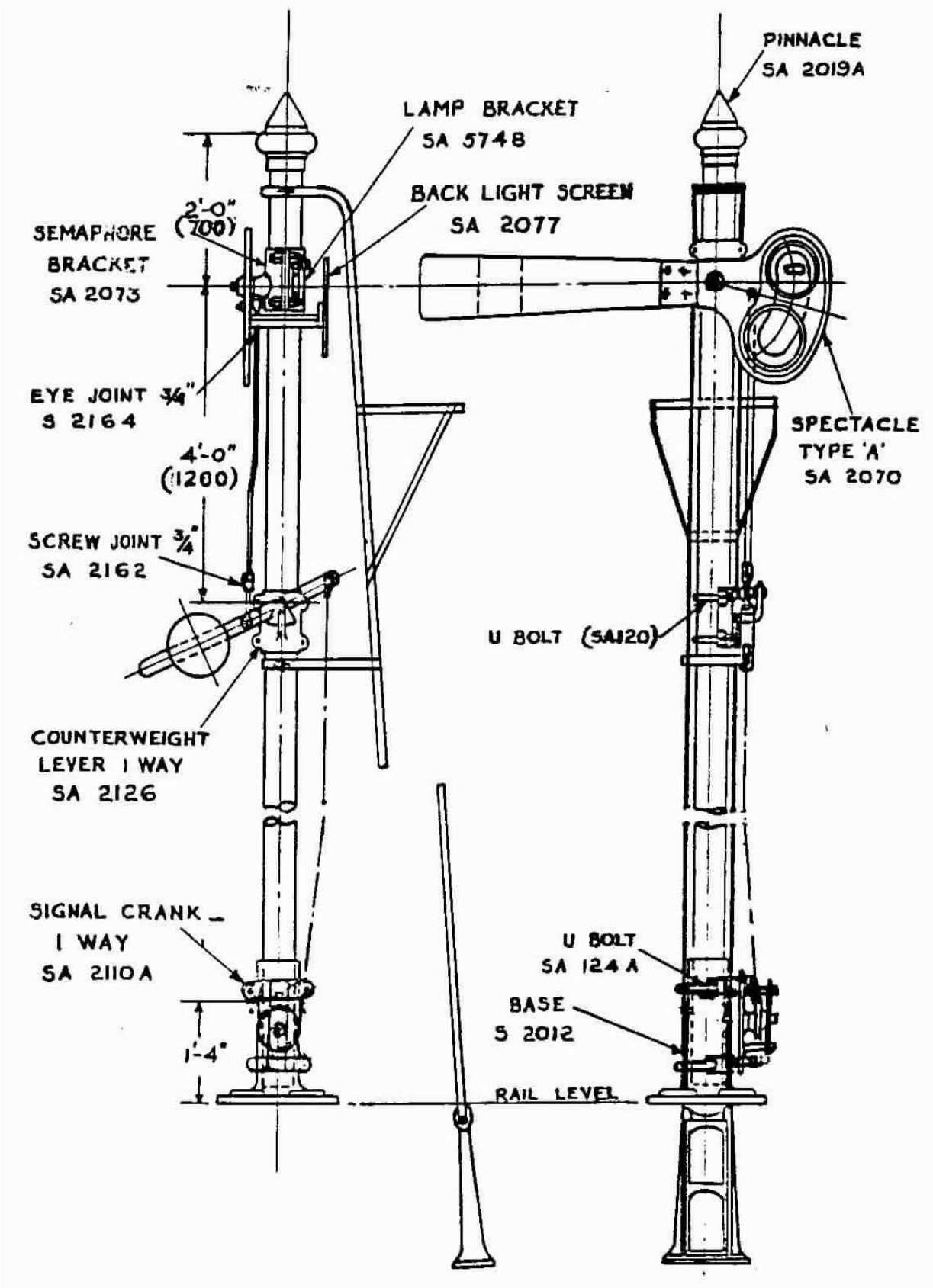


Fig. No. 8.2 (v) SIGNAL-1-ARM TYPE 'A' (SA 2000)

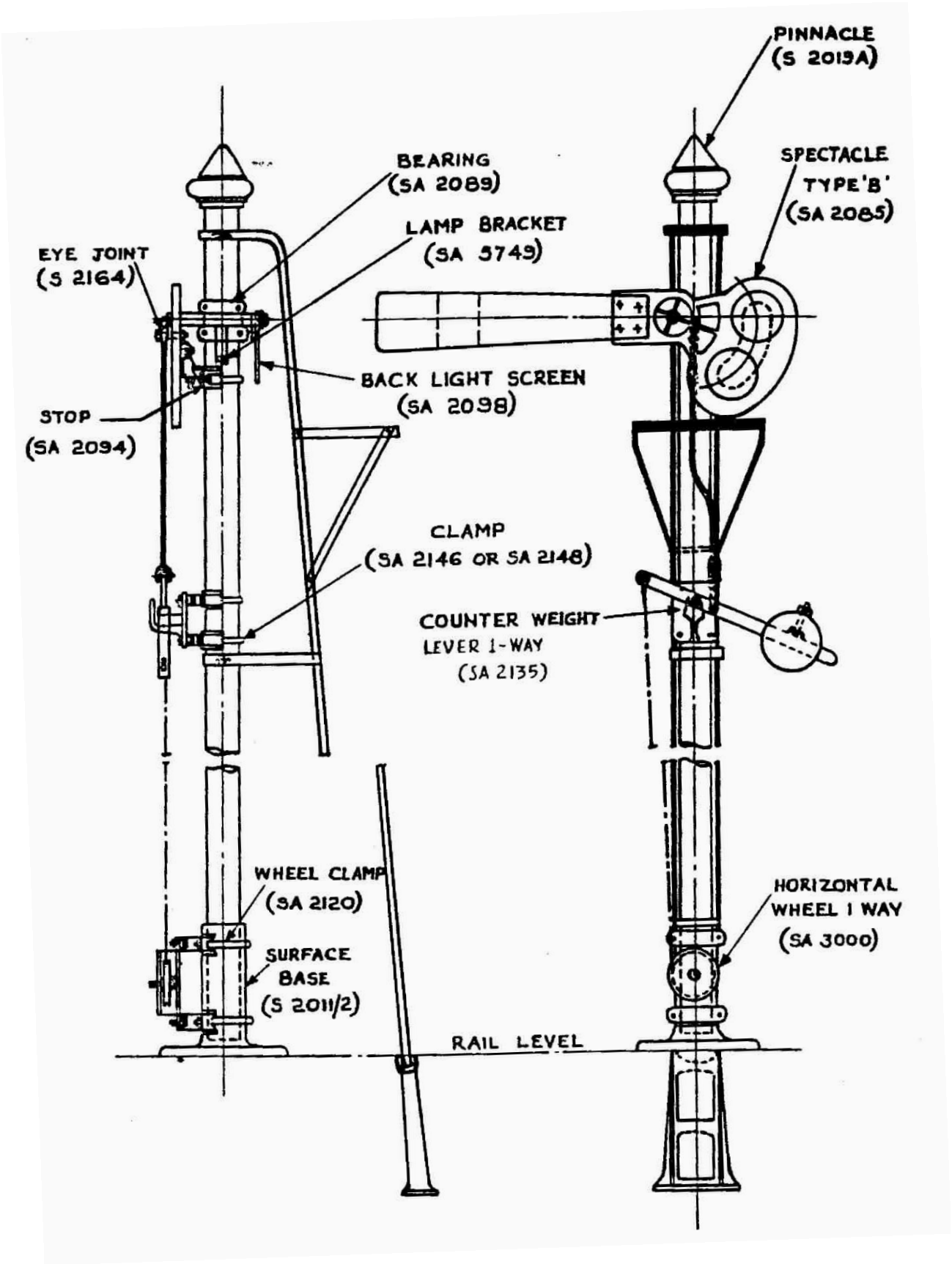


Fig. No. 8.2 (vi) SIGNAL-1-ARM TYPE 'B' (SA 2005)

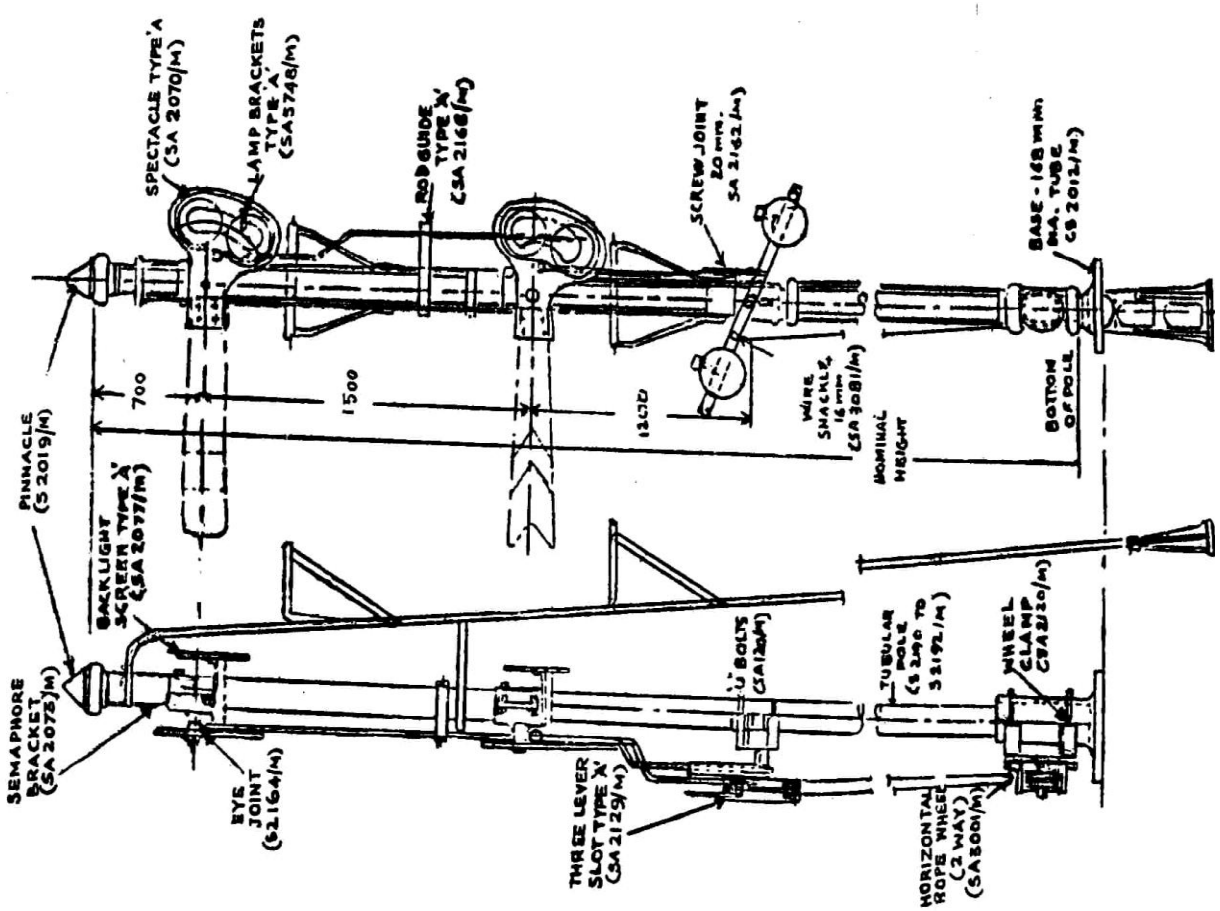


Fig. No. 8.2 (vii) SIGNAL-2-ARM TYPE 'A' (SA 2001/M, 01A&B)

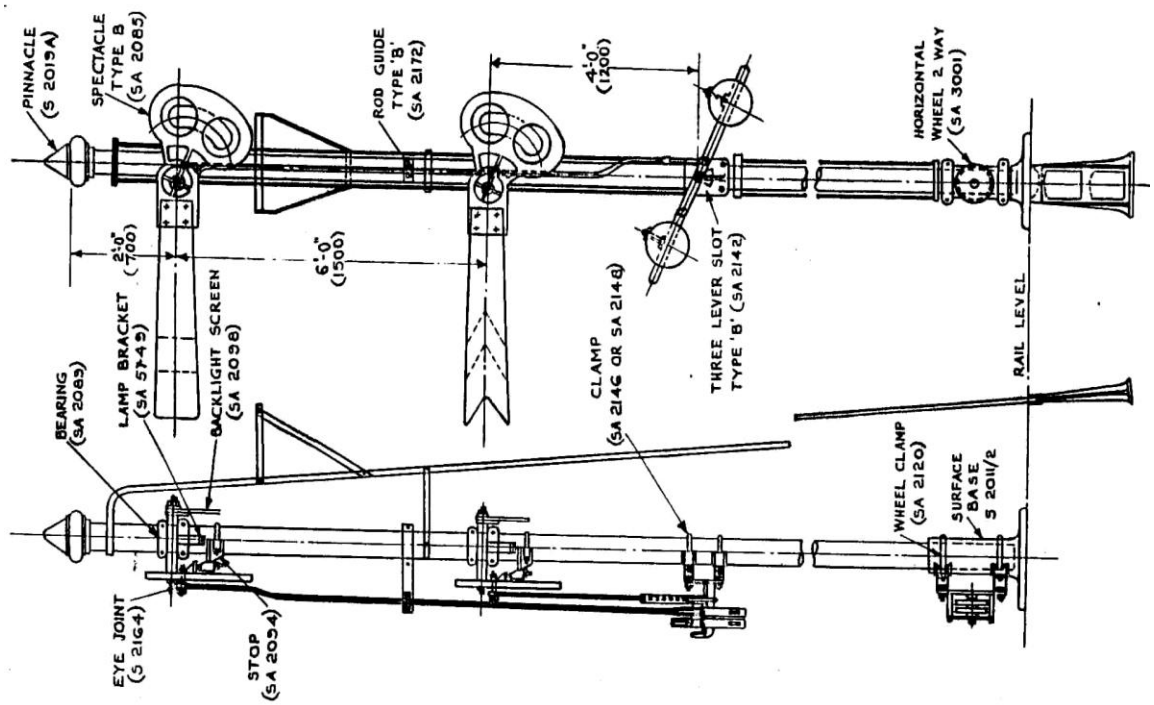


Fig. No. 8.2 (viii) SIGNAL-2-ARM TYPE 'B' (SA 2006)

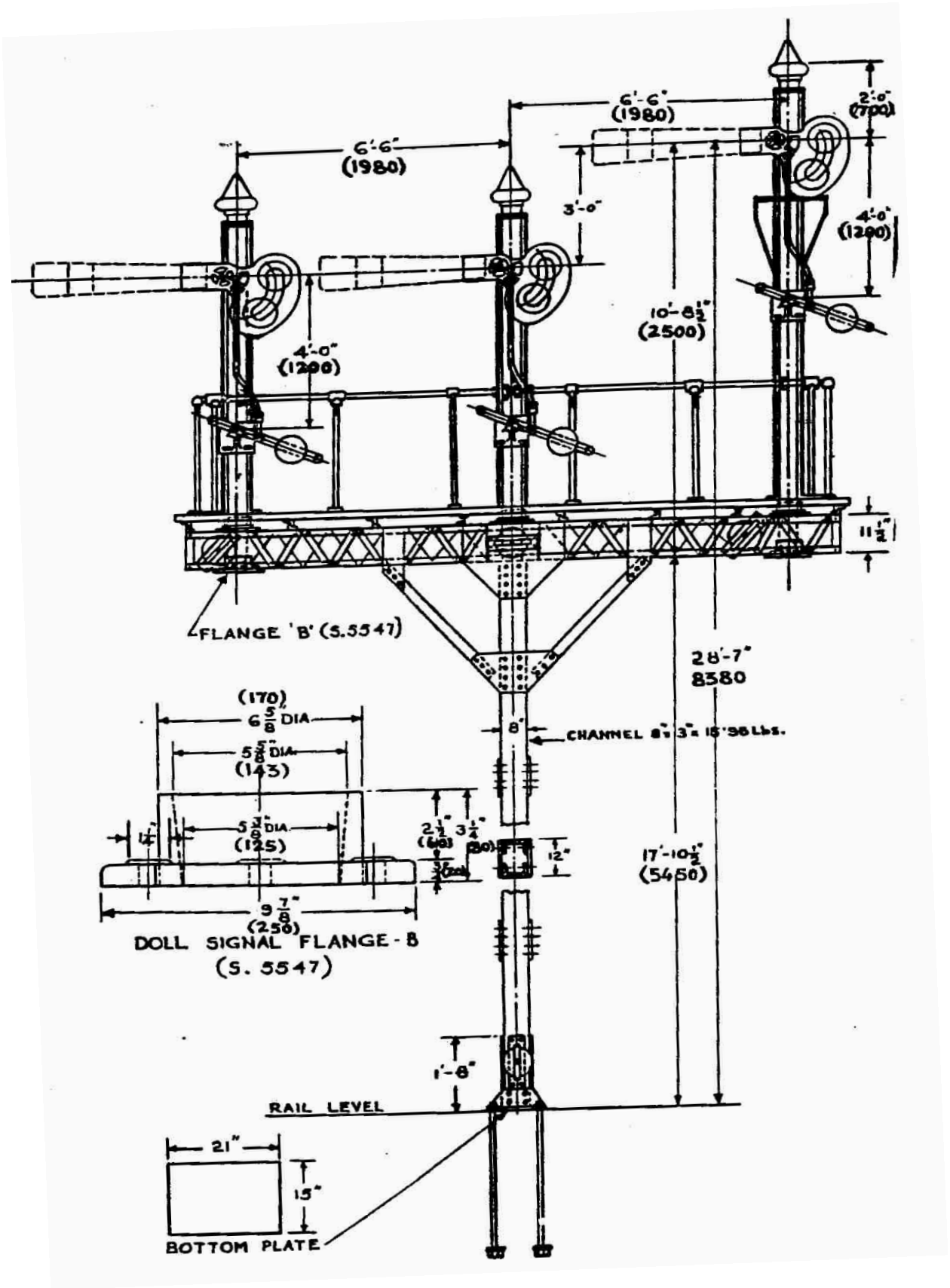


Fig. No. 8.2 (ix) SIGNAL BRACKET – (CHANNEL TYPE) 3 DOLL (SA 5538)

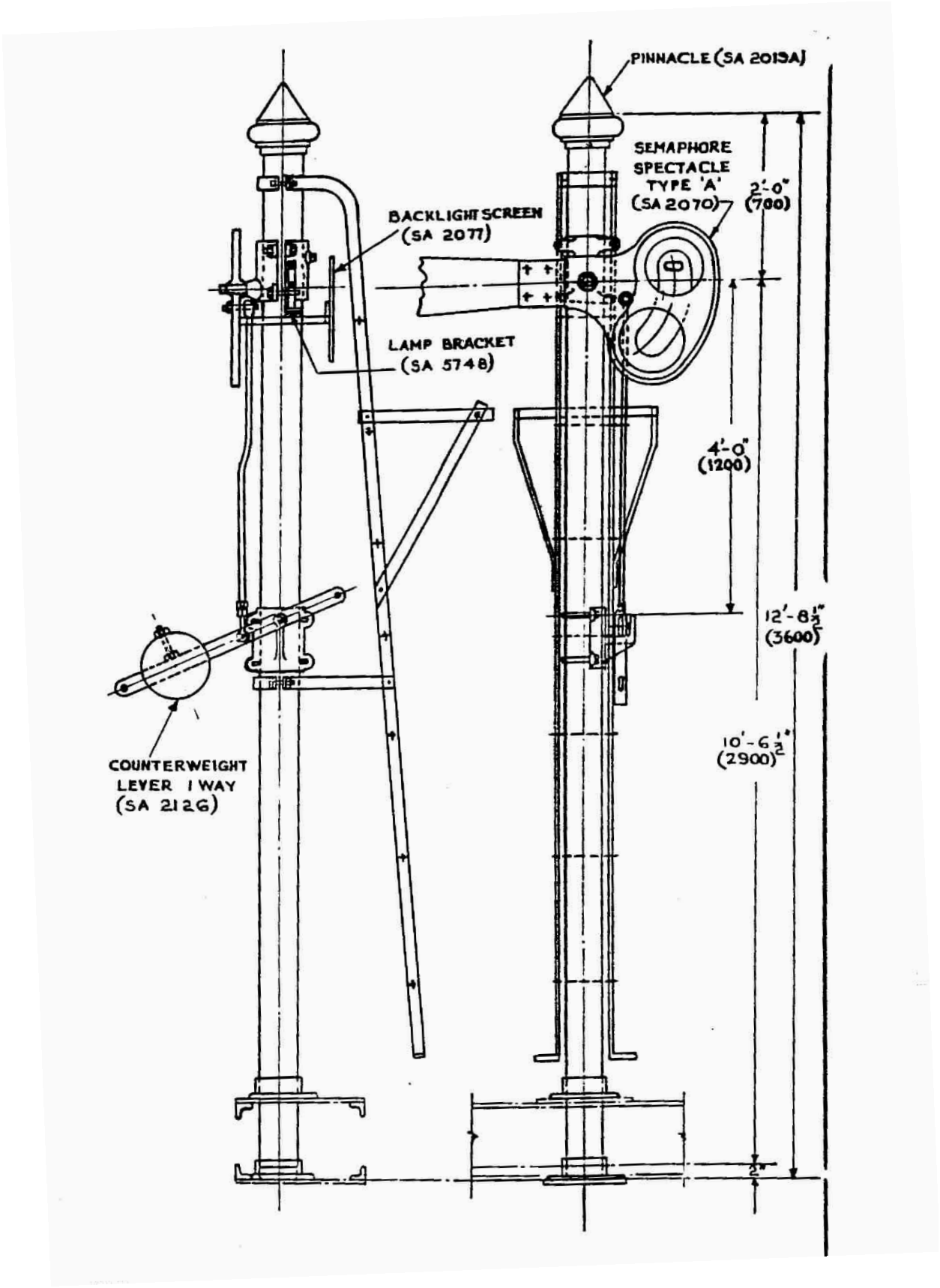


Fig. No. 8.2 (x) DOLL SIGNAL TYPE 'A' (SA 5543)

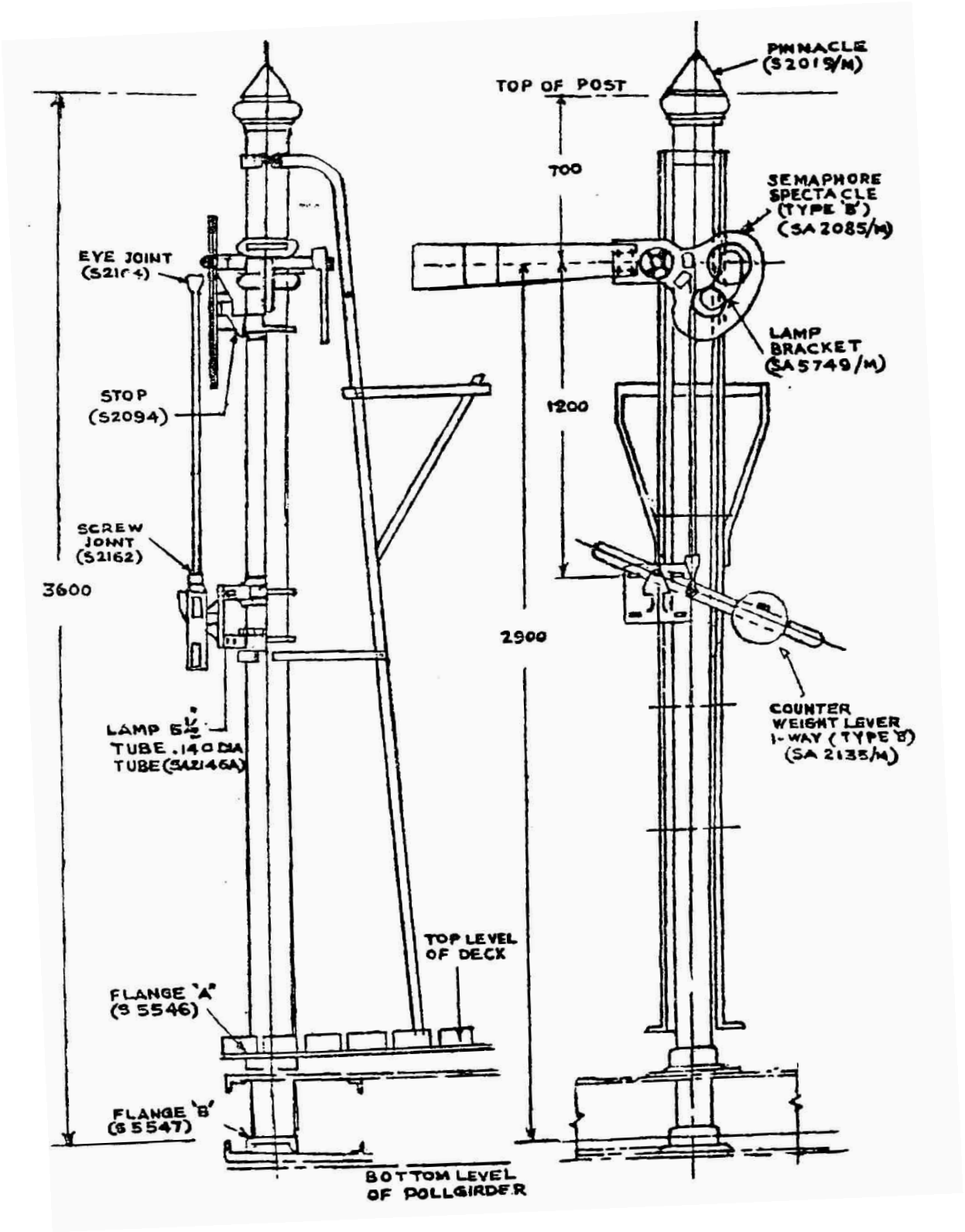


Fig.No.8.2. (xi) SIGNAL BRACKET DOLL SIGNAL 3.6M OR 11' 6"- 1 ARM (TYPE'B') (SA 5545/M)

Sl.no	Description	Lattice Post	Tubular Post
1	Signal 1 arm Type A	SA 1231-SA 1236/M	SA 2000/M
2	-do- B	SA 1241-SA 1246/M	SA 2005/M A to E
3	Signal 2 arm Type A	SA 1237-SA 1239/M	SA 2001/M
4	-do- B	SA 1247-SA 1249/M	SA 2006/M
5	Signal Bracket (Channel type) with signal fittings type 'A' 2 doll		SA 5537/1
6	-do- 3 doll		SA 5538A/M
7	-do- With signal fittings Type 'B' 2 doll		SA 5537B/M
8	-do- 3 doll		SA 5538B/M

NOTE: The 2 doll and 3 doll posts are available only with tubular posts.
NOTE: Parts of signal fittings are at Annexure-H.1 to Annexure-H.5.

8.3 Type of Posts

Signal Posts used on Indian Railways for mounting semaphore signals are mentioned below:

(a) Tubular Post

(b) Lattice Post

Bracket Signal Posts

Only the tubular and the lattice posts have been standardized.

8.3.1 Tubular Post

The main post of tubular type has been standardised under Drg.No.S-2181 & S - 2182. It comprises of poles of two different sections. The bottom portion is called section 'A' and has fixed lengths of 4.4 Mts. (14'6") or 6 Mts. (20') and has an outside diameter of 275 mm (103/4") with a thickness of 10 mm (3/8"). The top portion is called section 'B' and is available in length of 2.26 Mts. (7'-6") with 10 mm (3/8") thick metal. Thus the overall length of the main post is 6.7 Mts. (22'-0") and 8.4 Mts. (27'-6"). The bottom pole is inserted in signal base which itself is bolted firmly to the foundation bolts. The metric drawings for these have not been issued so far.

These are usually of two types

(a) Poles with base at rail level to Drg. No. S 2187 to 2192.
(b) Poles with base buried to Drg. No. S 2198.

A signal post (pole) consists of two tubes of section 140 mm (5 1/2") and 168 mm (6 5/8") outer diameter having each a thickness of 7-9 mm (5/16"). The two portions are joined together by inserting the smaller dia. pole into the large one to an extent of 460 mm (18") and then pressing hard the outer tube against the inner tube by swaging process. While making a complete signal pole care is taken to ensure that the top portion of the tube is always of 5.9 Mts.(18ft) length having an outside diameter of 140 mm (5 1/2") the bottom portion of the tube is of a larger diameter i.e., of 168 mm (65/8").

Advantages of tubular post

It is very easy to assemble the tubular post fittings on the pole Drilling of holes on the post to fix the fittings is completely eliminated and the fittings can be easily turned through any required angle. However, tubular posts suffer from one drawback that it has not get very tall poles, the maximum height being only 105 Mts. (34'0"). The post being light in construction, transport and handling is very easy.

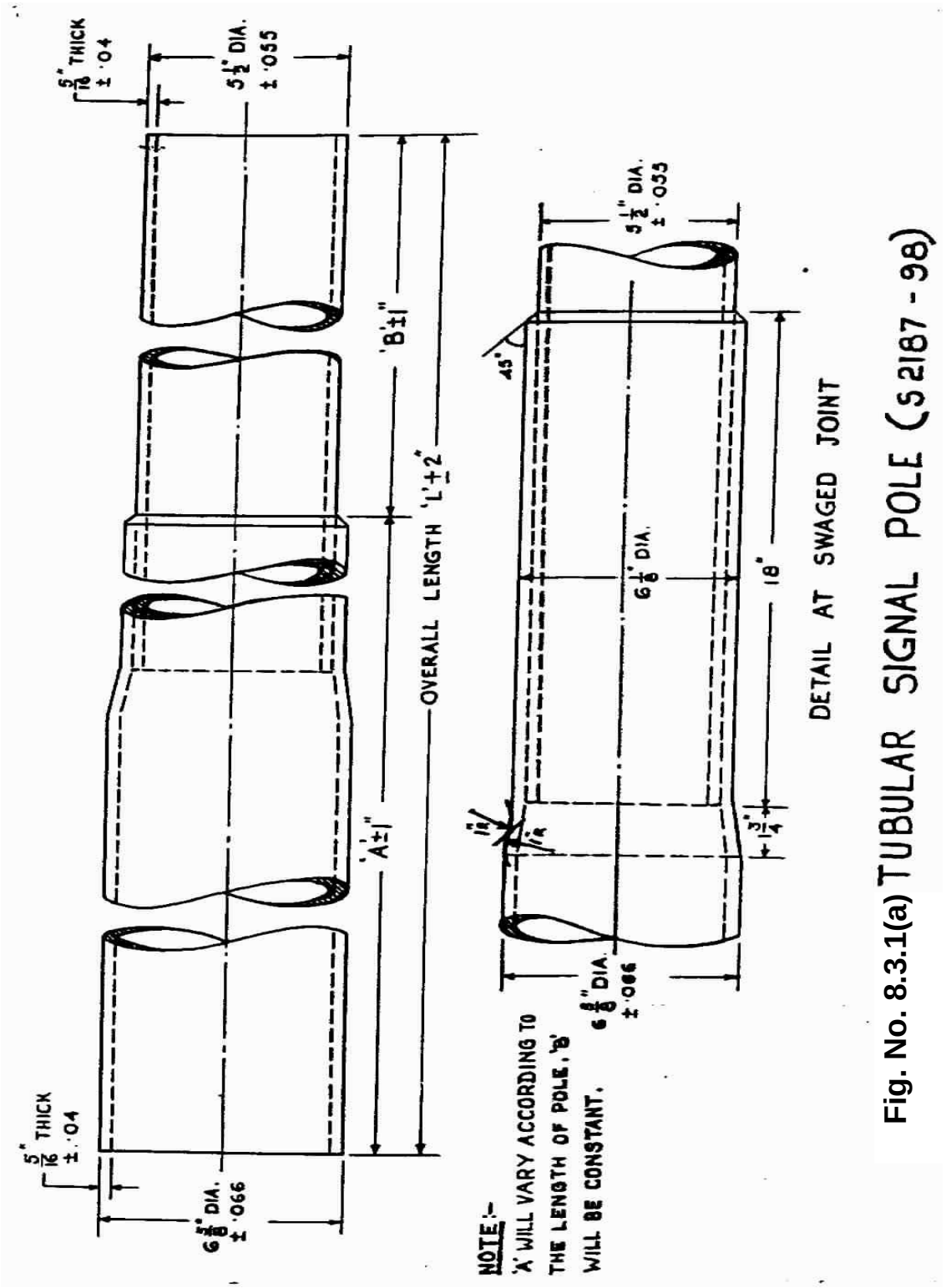


Fig. No. 8.3.1(a) TUBULAR SIGNAL POLE (S 2187 - 98)

8.3.2 Lattice Post

These are available as per standard Drgs. No SA 1251 A&B to 1256 A&B (A for rivetted construction and B for welded construction).

Advantages of lattice posts

Next to tubular posts lattice posts are used on Indian Railways Apart from being light in construction it affords easy means for fixing the fittings without involving any drilling work. The fittings are, however, secured to the post by friction grip, the parts being clamped on with straps and bolts. Once the post is in service, there is little or no trouble experienced from the fittings slipping if they have been properly tightened up to commence with.

8.3.3 Bracket Signal posts

Where two or more lines diverge to the signals must be fixed on a bracketted post. The present standard bracket post consists of a main post either made of channel or tubular sections on which is fixed a cross boom (girder).

(a) Bracket Signal Main Posts

Following types of main posts are usually used for bracket posts on Indian Railways:

(i) Channel Iron Post (SA 5541) (Obsolete).

(ii) Tubular Post (S 2181 & 2182).

(iii) Lattice post.

(b) Lattice Posts

These are in common use on Indian Railways. It has a mild steel plate base at the bottom which is bolted to the bracket post foundation bolts. The cross beam is made to the pattern as described in the case of the channel iron post. Although existence of lattice dolls may be found yet, tubular dolls are preferred. Details of these tubular dolls are similar to these used with channel iron post.

In some Railways doll bases similar to signal bases are used for mounting the dolls on the bracket.

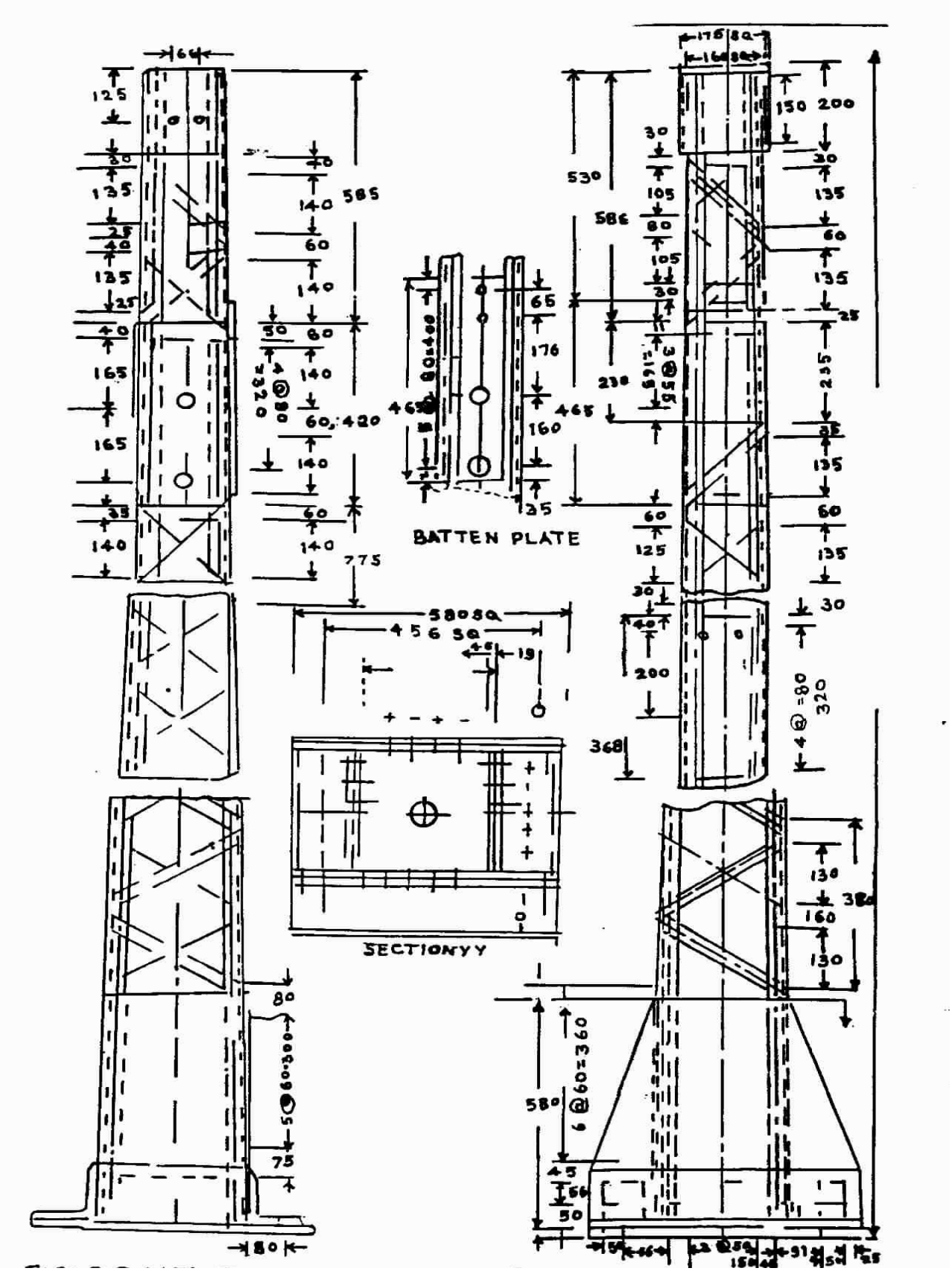


Fig. No. 8.3.1(b) SIGNAL POST 6 Mts. (LATICE TYPE LQ) (SA 1251 A&B/M)

8.4 Signal Gantries

Where the number of signals is considerable, a more convenient arrangement for fixing the signals would be on a signal bridge or a signal gantry. In this case, the signals are fixed on separate signal dolls carried on to the signal bridge and grouped so that the respective signals are clearly distinguished for each line and placed as nearly as possible over the lines to which they refer.

8.5 Signal Ladders

Signal Ladders are provided on all signal posts, usually the ladder is fitted to a mild steel clamp (SA-2062) on the signal post fixed at 225 mm (9") from the top of the post. The ladder is chosen according to the length of the post. To enable a person to balance properly while he is working on the signal assembly a guard rail (SA-2061) is provided on the ladder near the spectacle assembly.

8.6 Pinnacle

(SA-2019A) for tubular post and S1261 for lattice post) It is a dome shaped cast iron cap fixed on the post It is secured tight in position against the post with the help of a side set screw. The function of the pinnacle is to prevent rain water etc; from entering the inside of the post Pinnacle makes the post look more elegant.

8.7 Signal Foundation

Some railways prefer a tapered square block of concrete for this purpose. About 5 bags of cement is mixed with other ingredients in the ratio of 1:3:6. One part of cement is mixed with 3 parts of fine aggregate and 6 parts of coarse aggregate and a proportionate quantity of water Four anchor bolts to Drg.SA116/A of size 900 x 25 mm (3" X 1") are embedded in the concrete block when the same is under preparation. About 75 mm (3") of the threaded ends of the four bolts remain above the top of the foundation level. The top level of the foundation is usually in level with adjacent rail level.

8.8 Spectacle

There are two standard types of spectacles in use on Indian Railways

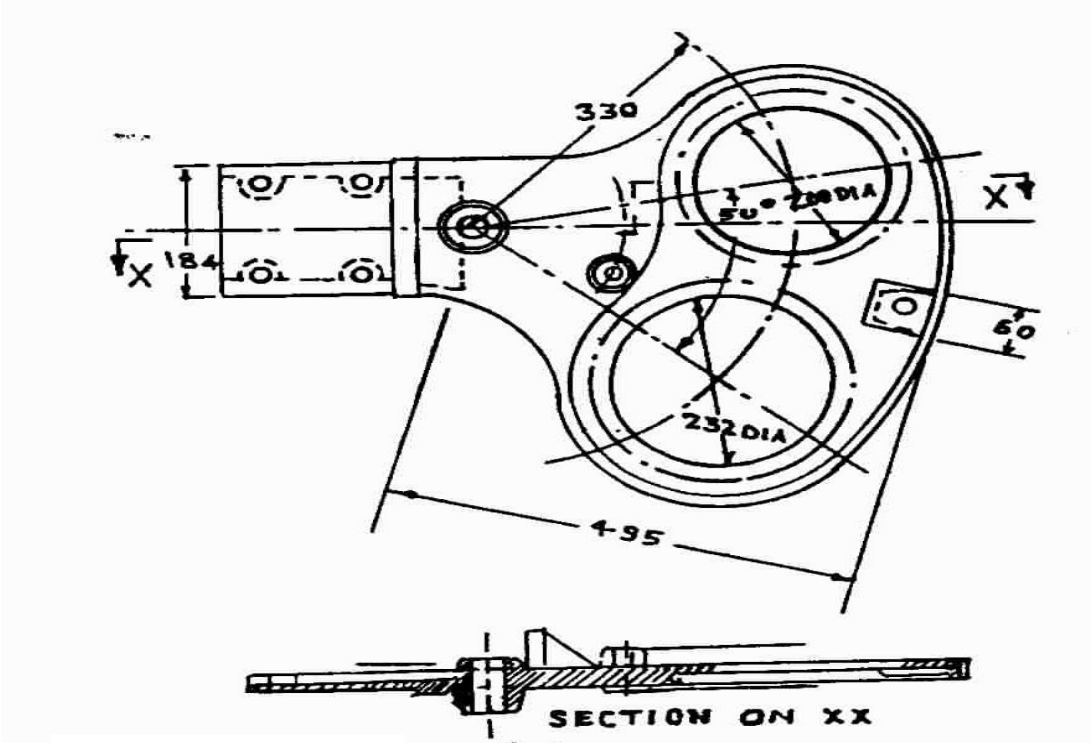
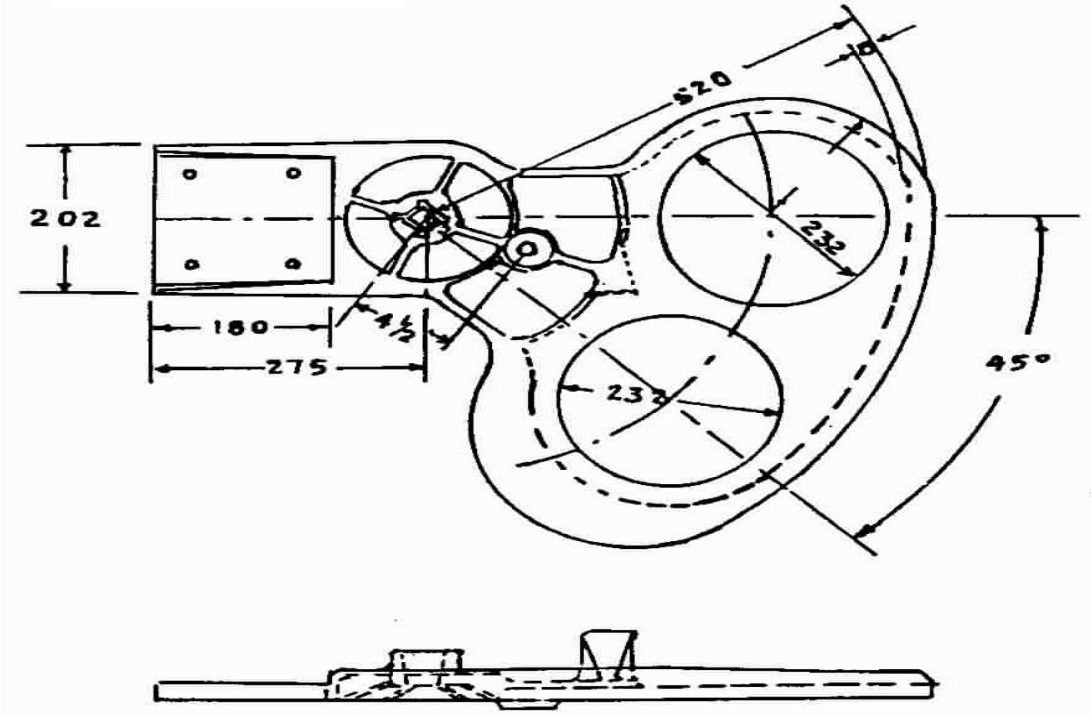


Fig. NO. 8.7 YPE 'A' S 2072



TYPE 'B' S-2087/M
Fig. NO. 8.8 SEMAPHORE SPECTACLES

8.9 Difference between spectacles type A and B

The main differences between the spectacles are enumerated below (See Fig 8.7 and 8.8)

Sl.no.	Description	Type 'A'	Type 'B'
1.	Size of roundels	(a)Smaller red roundel 213 mm (83/8") dia. (b) Green roundel 245mm (95/8") dia.	Both roundels are of the same size 245 mm (95/8") dia.
2.	Dead space	63 mm (2 1/2")	37 mm (1 1/2")
3.	Range of operation with a 136 mm (5-3/8" dia.) lens	+ 5° to -58°	+5° to -52 ½°
4.	Hole at the fulcrum for its angular movements	It has a round hole It is mounted on stud pin	It has a square hole. It is mounted on a Spindle and rotates along with it on a separate bearing
5.	Distance between the fulcrum and the down rod connection	154 mm (6")	118 mm (4 1/2")
6.	Angle subtended by the centers of the two roundels at the fulcrum	50°	45°
7.	Range of lowering with 53/8" dia. (136 mm) lens	50° ± 8°	45° ± 7 ½°
8.	The vertical lift of the counter weight balance	Placed at placed 154 mm from the fulcrum for 50° lowering is 130mm	Placed at placed 118 mm the fulcrum for 45° lowering is 90mm
9.	Center of gravity of the spectacle	Closer to the horizontal line passing through the fulcrum when the arm is horizontal	At a greater distance from the horizontal line passing through the fulcrum
10.	Return Torque	Less when the signal is at 50°	Greater when the signal is at 45°
11.	Back Light Screen	Directly connected to the spectacle casting	Connected to the spindle
12.	The centers of Red & Green roundels are at a Radius of	330 mm from the fulcrum	355 mm from the fulcrum
13.	Stop	Consists of two projections one each in semaphore bracket & spectacle is casting	Provided separately on a bracket and spring loaded
14.	Down rod connections	Connected in rear of spectacle	Connected in front of spectacle
15.	Roundel Rings	Fixed in front of spectacle	Fixed in rear of spectacle

8.10 Clamp (SA 2146/2148)

B type counter weight balance levers casting has a flat base and therefore, cannot be fitted directly to the tubular post. These are fitted on special clamps It consists of a "U' bolt and a cast iron channeled casting. A pair of these is used for holding the counter weight balance lever bracket (SA 2135). It would be seen that an off set in the "Up & Down Rod" could be completely avoided if the rod were connected straight to the counter weight balance lever without giving any side set In this case, however, an "Up and Down Rod" will appear slightly out of plumb.

8.11 Stop (SA 2094)

A spring stop is fitted in a cast iron casting and is designed for stopping the spectacle going down under its own weight and thereby provides for a limiting stop for the spectacle type 'B' to rest in horizontal position It is clamped to the post with the help of a 'U' bolt and placed in position which maintains the spectacle in its normal position. The spectacle, however, has got a projection in the casting which is meant to rest on this spring stop. A provision has been made in the design of the stop to adjust the stiffness of the spring. The spring stop also serves the purpose of reducing the strain on the signal rod when the spectacle returns to ON position. Further, the buffer spring absorbs the impact shock of the spectacle and thereby reduces the chance of breakage of the roundels. Normally, the stop should be so adjusted, that the spectacle casting projection at the back of the spectacle just rests on the stop and the balance lever is just clear of the counter weight lever bracket.

8.11.1 Shock Absorber (SA 1285)

The stop provided to prevent the spectacle type 'B' from going down due to its own weight in the case of a lattice type post is called a shock absorber. It consists of a rectangular cast iron bracket having a spring loaded stop. There are two slotted holes for mounting the stop on the lattice post. In the case of two arm signal fittings on the lattice type post the size of the bracket will have to suit the size of the lattice post at different heights to cater for this two types of shock absorbers (a) Shock Absorber A (SA 1285) (b) Shock Absorber B (SA 1286) have been standardized.

8.12 Back Light Screen

It is different at night to decide correctly from behind whether the signal has gone back to 'ON' position. When the lever is put back to normal, as a remedy a back screen is provided which works in conjunction with the spectacle and allows the signal back light to be seen by the cabin man only when the signal arms in a position between 0 deg and 5 deg. When the signal assumes a position beyond 5 deg, the back light is shunt off from the view of the cabin man and he comes to know that the signal is not correctly in the ‘ON’ position.

Back light screens used with 'A' type and 'B' spectacles are different from one another Screens used with 'A' type spectacles are manufactured according to the Drg.No.SA-2077 whereas those used with 'B' type are manufactured as per Drg.No.SA-2098. In the case of 'A' type screen is bolted to the spectacle frame at point near the outer rim Back light screen for B type spectacle is, however, mounted on the spindle.

8.13 Lamp Bracket (See Fig. No. 8.13)

It is an L shaped mild steel strap which has an oblong horizontal hole on top and another ordinary round hole vertically below to enable it to be fitted to the semaphore bracket in the case of 'A' type tubular fittings. The oblong hole provides the facility for turning the lamp bracket

slightly (5 deg) in the vertical plane about the bolt in the round hole as a pivot. The lamp bracket also carries a lamp tray. The lamp tray to which the lamp is actually fitted has again two holes and it also has an upright rod riveted to it which is known as spigot. The hole in the lamp tray nearer to the spigot is round one and is used for bolting the tray to the 'Lamp' bracket. The other hole in the lamp tray is oblong and it enables the lamp tray to turn about its first hole as a pivot. This arrangement helps in turning the lamp in horizontal plane (10 deg). The lamp bracket described here is of the fixed type i.e., the lamp is kept fixed to the lamp bracket and is not removed for cleaning purposes.

The lamp brackets used for different types of fittings are enumerated below (See Fig. No 8.13)

(a) Lamp bracket for type A

(i) Tubular SA 5748

(ii) Lattice fitting SA 5748

(b) Lamp bracket for type B

(i) Tubular SA 5749

(ii) Lattice SA 1296

(c) Lamp bracket for shunt signal – SA 5750

In case of lattice fittings type 'A' the lamp bracket is mounted on the lamp bracket carrier (S1266), whereas in type 'B' lattice fitting the lamp bracket is directly bolted to the plate on the lattice post.

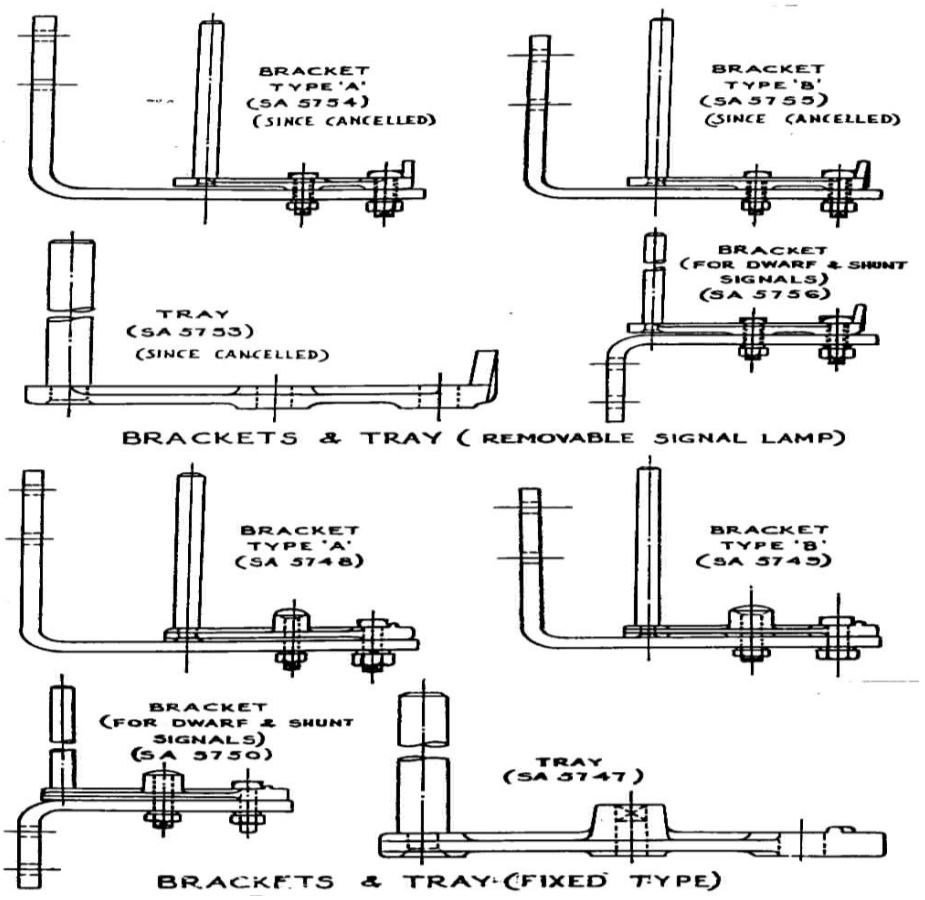
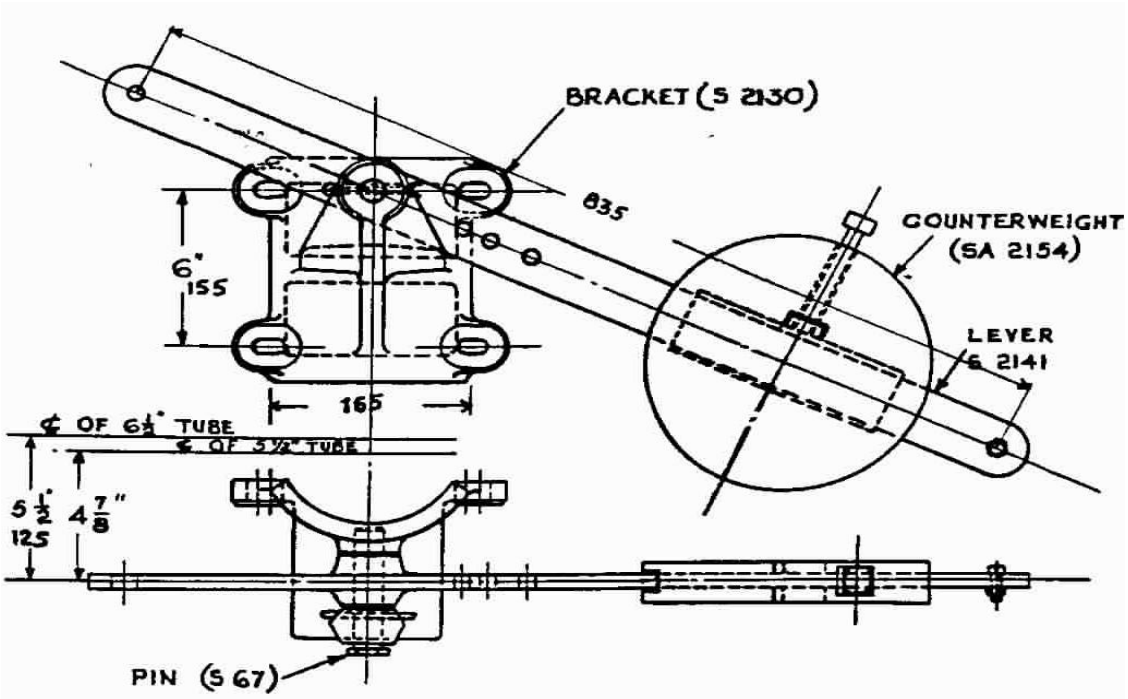


Fig.No.8.13

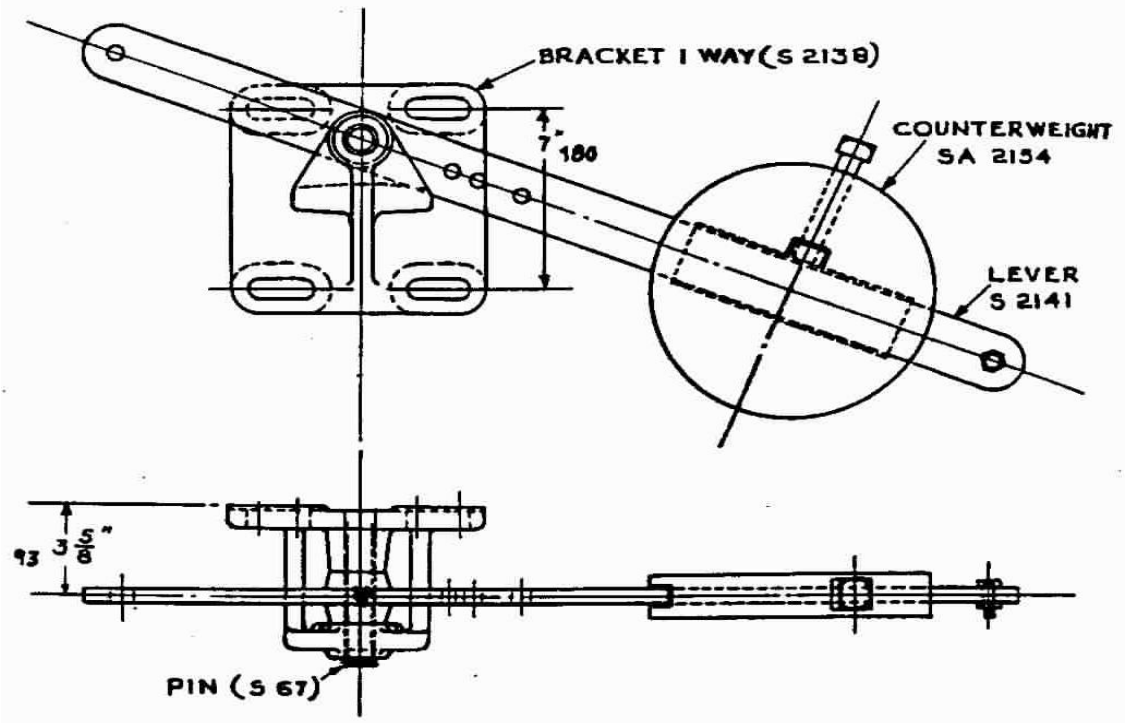
8.14 Counter Weight Balance Lever 1 way (See Fig8.14)

It mainly consists of a mild steel straight lever (S 2142) and a bracket on which it is pivoted. The bracket consists of a cast iron casting which has a projecting jaw. A 24 mm dia. pin is supported on a hole made in the jaw and the main casting. The balance lever is placed in the space between the jaw and the main casting and the pin put through the jaw, lever and the casting. The balance lever thus can turn about the pin in a vertical plane to the extent of 50° (when it moves by 25° from either its normal or reverse position), the lever assumes a horizontal position. The length of the long arm of the lever is 610 mm and the short arm is 225 mm. Three 16 mm dia. holes are drilled on the longer arm at a distance of 92 mm, 118 mm and 154 mm from the fulcrum. Another hole of 105 mm dia. is drilled at the extreme end where a safety bolt is provided. The shorter arm of lever has a 16 mm dia. hole drilled at its extreme end where shackle for wire connection is fitted. A suitable weight is mounted on the long arm which is held secured to the lever with the help of a long stud bolt passing through the weight casting. The weights can be sided over the lever as required that it shall pull back the slack wire unaided by any other force when the corresponding signal lever is restored to normal position. It should be clearly understood the main function of the counter weight of the balance lever is to assist in returning the signal wire to normal position and not to return the arm to danger as the return effect of the arm is obtained from the counter balancing effect of the spectacle casting. The function of the safety bolt at the end of the long arm of balance lever is to safeguard against the slipping down of the counter weight in case of loosening of the counter weight bolt.

The counter weights are available in 4 Kgs. (9 lbs) (S 2151/M), 8 Kgs. (18 lbs) (2153), 14 Kgs.(30 lbs) S 2155) and 17 Kgs.(38 lbs) (2157) weight. The weights of 4 Kgs. (9 lbs) and 8 Kgs (18 lbs) are fixed to balance levers with 18 x 75 mm (¾") x 3") square head nuts and bolts 18 x 118 mm (3/4" x 4 ½") size bolts and nuts, are used for 14 Kgs. (30 lbs) and 17 Kgs (38 lbs) weight. It should be carefully noted that for actual taking off on the signal the stroke at the balance lever is reduced at the up and down rod connection and a reduction in stroke at this stage is essential to safeguard against an undesirable lowering of signal caused due to contraction of wire or due to entanglement of wire run.



COUNTERWEIGHT LEVER - 1 WAY (TYPE A) SA 2126.



COUNTERWEIGHT LEVER - 1 WAY (TYPE B) SA 2135

Fig.No.8.14

8.15 Screw Joint (SA 2162) and Eye Joint (S 2164)

The connection between the counter weight balance lever and the signal spectacle is made through an up and down rod. The up and down rod comprises of 20 mm rod of the length of about 1200 mm or more having an eye joint (S 2164) at the top end and a screw Joint (SA2162) at the balance lever end. The eye joint is fitted to any one of the 3 holes in the balance lever according to the type of spectacle used For instance, if 'B' type spectacle is used, the screw joint to be connected to the hole, placed at 118 mm from the fulcrum. When it is 'A' type spectacle it should be connected to hole 154 mm from the fulcrum and if it is a disc, shunt the same should be connected to the hole 92 mm from the fulcrum. It should be noted that it would not be correct to connect the "Up and Down Rod" connections in any other way than the one mentioned above. It should also be noted that to take "OFF" the signal to full 50°, the schedule end of the balance lever has to be pulled by 190 mm. This would cause a 995 mm movement of the down rod connected to B type spectacle and 130 mm) movement of the Up and Down rod when the same is connected to an 'A' type spectacle to lower the same by 50°.

8.16 Off-Sets in Up and Down rods

An offset in the signal up and down rod is the most undesirable and weak point in the working of the semaphore signals. Breakage in these rods mostly occur at the angles of the sets It is for this reason some railways have issued instructions not to give off set in up and down rods. The method employed to have straight, up and down rods is very simple. All that is required is to turn the counter weight balance lever bracket, until a straight down rod is possible. The rod however, does not assume a perfect vertical position and has to be left slightly in an angle without giving set to the rod for perfect vertical drive. This arrangement has been found to work very satisfactorily. The method employed on the lattice posts is slightly different. A fixing plate and counter weight lever support (S 1289 or S 1290) is attached to the post between the post and the counter weight lever bracket. This fixing plate extended slightly beyond the post. The counter weight lever bracket is then fixed on to the extension plate directly below the spectacle stud pin so that a straight Up and Down rod is possible.

8. 17 Signal Crank 1 way (SA 2110/A)

This is used at the bottom of the post and clamped to base (S 2021) of the post. This crank is of the size of 225 mm X 300 mm and works in vertical plans, the 225 mm (9") end being always connected by wire to the short arm of the counter weight balance lever which in this case, is fixed in the direction at right angles to that of the signal arm. The long arm 300 mm (12") arm of the crank has 3 holes provided at the distance of 225 mm, 265 mm and 300 mm from the fulcrum of the crank for wire connections being made to any one of these from the cabin end. The crank is mounted on a pin which is riveted to a cast iron clamp, the concave face of which has a suitable curvature for being fitted to the signal base (S 1012). The crank base casting is clamped firm by means of the two U bolts (S 124). This arrangement is used for 'A' type spectacles mounted on tubular posts. In the metric standard drawings, the horizontal rope wheel one way has been used in place of signal cranks.

8.18 Comparison of A type and B type fittings on tubular post

From what has been described about A type & B type fittings it would be seen that these fittings differ widely The differences are enumerated below.

(a) Mounting of the spectacle in B type unlike 'A' type is on a single keyed to the spectacles and the spindle itself is free to turn in the semaphore bearing designed for this purpose.

(b) The back light screen (SA-2098) is of a different type and is keyed to the spindle (SA 2093A) unlike in A type where the screen is fitted directly to the spectacle casting.

(c) A separate stop (SA -2094) is used in the case of 'B' type assembly and unlike in 'A' type it does not constitute a part of the semaphore bearing. It is a spring stop separately clamped to the post to prevent the spectacle from going the normal position.

(d) The counter weight balance lever bracket used for 'B' type spectacle is of the 'B' type (SA 1235) and therefore, cannot be directly clamped to the post as it is done with 'A' type brackets (SA-2126).In this case a separate clamp (SA-2146) is required to be first fixed on the post and then the counter weight balance lever bracket is bolted to cast iron channels provided in the clamp. It should be noted that unlike 'A' type fittings the counterweight balance lever 'B' type is fixed in the front side of the post to that the balance lever is almost parallel to the plane of the signal arm. The down rod connection in this case is from the front of the spectacle unlike in the case 'A' type where the up and down rod is connected behind the spectacle.

(e) With 'B' type fittings a wheel is used at the base to divert the wire connection, the wheel base bearing bolted to a separate wheel clamp In the case of 'A' type signal cranks are used instead and the crank base is directly clamped to the signal base. In the standard drawings for metric dimensions wheels have been used even for 'A' type signal fittings.

8.19 Spectacle Roundels

The roundels and glasses used in signal spectacles are not lenses, they merely change the colour of the lighting from the lamp without affecting its distribution Roundels are pressed from solid coloured high transparence glass and are, therefore, much stronger and of more exact colour than cut sheet glasses. They are made in two forms, plane and curve. The edge thickness of these roundels is kept constant and the thickness of the roundel is the same as the main thickness of pressed lens of the same colour so that the colour beam given by a white lens and a coloured roundel is the same as that given by the corresponding coloured lens.

Roundels are fixed on the spectacles at the apertures with aid of roundel rings for 245 mm (9 5/8") (S2103) -213 mm (83/8") (S2182). These are bolted to the spectacle casting.

Sl.no	Description	Drg. No	
1	Roundel convex 89 mm	Green	S 2751
2	-do-	Red	S 2750
3	-do-	Yellow	S 2752
4	Roundel Convex 213 mm (83/8")	Green	S 2754
5	-do-	Red	S 2753
6	-do-	Yellow	S 2755
7	Roundel Convex 245 mm (95/8")	Green	S 2757
8	-do-	Red	S 2756
9	-do-	Yellow	S 2758

8.20 Signal Arm

(a) Specifications

Arms shall be made of mild steel No16 SWG thick to IRS specification No. M16.

Arms are to be enameled as per IS10. The shade of the red colour will be signal red and that of yellow will be yellow as per British Standard Specification (BSS) 381G. All the holes shall be 14 mm (9/16") diameter.

The design of the signal arm should be such that it is able to withstand the wind pressure test. Described below is the standard method of carrying out the wind pressure test. Attach the signal arm to a standard semaphore spectacle, hold rigidly in horizontal position, the arm representing a canti lever with its surfaces parallel to the floor. Apply a load of 30 lbs per sq ft, at geometric centre of the portion of the arm extending beyond the fastenings. The test shall be made on first the front and then the back of the arm. During either of the above tests, the arm shall not take a permanent bend. Signal arms shall be bolted to the spectacles with the help of four bolt 12 mm dia. size bolts and nuts care should be taken to see that the enameling of the signal arm is not chipped off for this purpose.

The following items may be used to serve as a packing between the arm and hard steel:

(i) Lead Washers

(ii) Felt Washers,

(iii) Wooden Blocks

(b) **Type of Arms**

The different types of arms in use are described below:

(i) **Type A1:** is 1220 mm long square ended arm with 255 mm and 178 mm broad ends. The front is red enameled with 178 mm (7") broad white band 255 mm (10") from the outer end. The back is white enameled with 178 mm (7") broad black band 255 mm (10") away from the outer end (IRS Drg.No.S2694).

(ii) **Type A2 :** Fish tailed red or yellow arm of length 1220 mm (4'-0") other dimensions are similar to above except the band is in the shape of 178 mm (7") broad V IRS Drg. Nos. S-2695(Red) S-2696 (yellow).

(iii) **Type C1:** is used for shunt signals It has a length of 760 mm (2'-6") and the bar breadth is 125 mm (5"). It is red with a white bar in front and white with a black bar at the back. The outer end is 225 mm (8 7/8") broad the inner being 178 mm (7") as in all other types IRS Drg. No (S2707).

8.21 Signal lamps for semaphore signals

The majority of semaphore signals in India are lighted by kerosene oil Electric lamps have also been employed for lighting semaphore signals, but they are very few in number. It is rather difficult to make a general statement as to whether electric lamps are cheaper to install and maintain, but it is definite that these have less maintenance problems than oil lamps such as, cleaning the lamps daily filling up the oil, lighting the wicks, etc..

Standard type signal lamp has a 136 mm clear optical lens with 89 mm focus. On sharp curves, a 136 mm dia. clear streamline lens with 8° horizontal spread may be used. The standard signal lamps have doors on one side and not on the back since there is no much room left between the back of the spectacle and the lamp for inserting and taking out the founts.

Before the lamps are sent out by the manufacturers, they are required to be tested One of the tests is the wind test. Artificial wind is created with a specified velocity and is made to pass over a lighted lamp, the lamp is not to get extinguished. The exact test mentioned in the specifications is as follows.

Signal Lamp Lenses

A step lens is generally used in Railway signaling. It is an optical device to give a accurately parallel beam of light from a point source. An ordinary plane convex lens i.e., Bull's eye with an outer spherical cannot give an accurate beam owing to the fact that the theoretical radius of curvature should vary at different points across the lens. The difficulty is overcome by a step lens when a uniform spherical surface may be used and the residual in accuracies due to the use of such a spherical surface, can be removed by adjustment at the centre and radius of curvature of the inner side of the stop. This arrangement has the further advantage of enabling the weight of the lens to be considerably reduced but certain inevitable losses of light occur due to the light flux which fall on the under surface of the steps being sent out in a direction different from the main beam 36 mm dia. (5 3/8" dia.) 89 mm (3 ½") focus step lens (S 2749) - 136 mm dia. and 89 mm focus) is used with IRS Signal Lamps.

8.22 Shunt Signals

Miniature semaphore is used to control shunting operations in station yards. A miniature semaphore signal consists of a white disc with a red bar painted on it, the disc to be so operated that the red bar moves in the same manner as the signal arm in case of other stop signals. The disc consists of 450 mm (18") dia. mild steel plate of gauge No16 gauge having 89 mm (3 ½") dia. holes made in it to receive the red and green roundels.

8.23 Maintenance of Signals

The following points should be kept in mind for good maintenance of signals

(a) Signals post must be kept vertical and clear of all infringements.

(b) Ladders and guard rails must be kept in good condition and securely fixed.

(c) Nuts and bolts on bracket posts and gantries must be inspected to see whether they have become loose or corroded Missing or corroded bolts must be renewed.

(d) Arms must be securely fastened to the spectacle casting, enameled arms, discs, roundels and glasses must be cleaned as often as necessary by washing with special compound provided broken or cracked roundels shall be replaced.

(e) Bolts for enameled arms and discs must always be provided with correct felt or lead washers or other packing supplied to prevent damage to the enameling.

(f) Roundels must be packed in roundel rings with pieces of lamp wicks or with any other approved local methods.

(g) Back blinker should be fixed or kept adjusted that a colorless back light is shown only when the arm is 'ON'.

(h) Fixing bolts of counter weights must be kept tight to prevent weights from sliding down.

(i) The safety bolt at the end of the levers should be securely fastened.

(j) Spectacle 'B' type must be kept securely fastened on spindles and must rest on the spring loaded stop. Semaphore bearing brackets must be kept firmly attached to the posts.

(k) Up and Down rod connections to the counter weight balance lever must be made to the correct prescribed hole and there should be a slight clearance between the counter weight balance lever and its bracket, when the same is in the normal position. This arrangement is recommended to minimise the breakages of up and down rods.

(l) With 'B' type spectacles sets in the down rods should be avoided by suitably shifting the fittings.

(m) Arms spindles and counter weight lever connections and all other moving parts must be kept well oiled and should be working freely.

CHAPTER – 9: TRANSMISSION OF SIGNAL WIRE

9.1 Signal Transmission for single wire can be broadly classified as

(a) Short distance transmission

(b) Long distance transmission

Short Distance Transmission: Signal transmission up to 1000 ft (300 Mts.) of length comes under the category of short distance transmission. In this transmission, a wire shackle of 18 mm is connected to the lever tail where a stroke of or 250 mm or 300 mm is available. The connection between the lever tail and the wire rope has been indicated clearly in the drawing of inside lead out. The wire run from inside lead out is taken to the diversion wheel on the outside lead out and then the wire is lead out over a series of pulleys fixed on pulley stakes, and finally goes to the signal through a detector if provided in the run.

Details of some of the materials used in the transmission are given below

Pulley Stakes (S3065/M) (See Fig 9.1)

Standard pulley stakes are manufactured as per IRB's drawing No S 3065/M. It consists of an angle iron 40 x 40 x 5 mm of length 1220 mm, the one end of which is sloped at an angle of 30 deg. The pulley stake is galvanized all over and is made out of steel grade 'A' as per the IRS spec. S10. The weight of the pulley stake is about 3.56 Kgs. It has 4 sets of holes drilled in it to receive 4 sets of pulley brackets, one above the other. It is driven on the ground with the help of a drift so that the top of the pulley stake is not damaged. The drift is also helpful in preventing the stake from twisting while the same is being driven. The pulley stake should be placed vertically and the face of the stake on which the pulley is fixed should be absolutely parallel to the direction of wire transmission. Pulley stakes are fixed as far as possible in a straight alignment, the maximum spacing between the two pulley stakes being restricted to 10 M.

9.2 Wire Pulley

To support the wire, wire pulleys are used. The diagram illustrates its constructional details. These are available as one way flat [(IRS(S) SA-3050/M)] 2 way flat and 3 way flat. These are bolted to the pulley stakes through holes provided in stakes for this purpose. Pulleys should be absolutely free to turn; otherwise it would cause friction to oppose the movement of the signal wire (Fig 9.2).

9.3 Swing Pulley (SA3056) See Fig: 9.3

When a small angular diversion (10^0) is required to be taken swing pulleys are used. These are also available as 1 way, 2 way and 3 way. When there are too many swing pulleys installed on one pulley stake, it may be necessary to have the pulley stakes fixed in concrete.

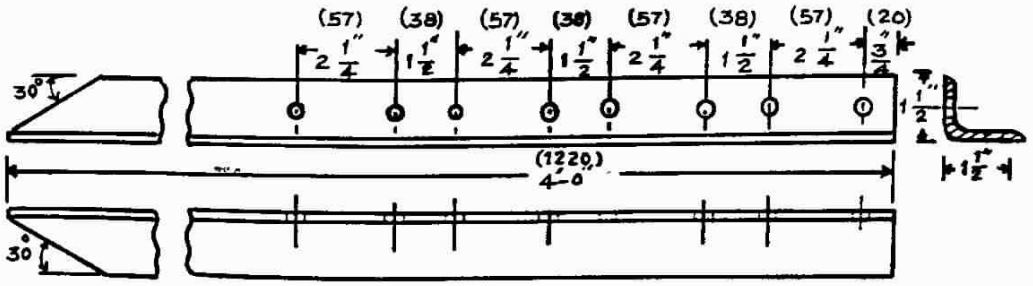


Fig.No.9.1 PULLEY STAKE (S 3065/M)

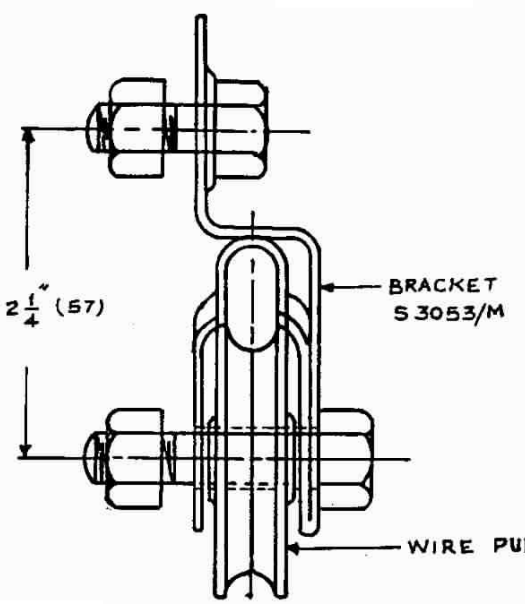


Fig.No.9.2 WIRE PULLEY-1 WAY-FLAT(SA3050/M

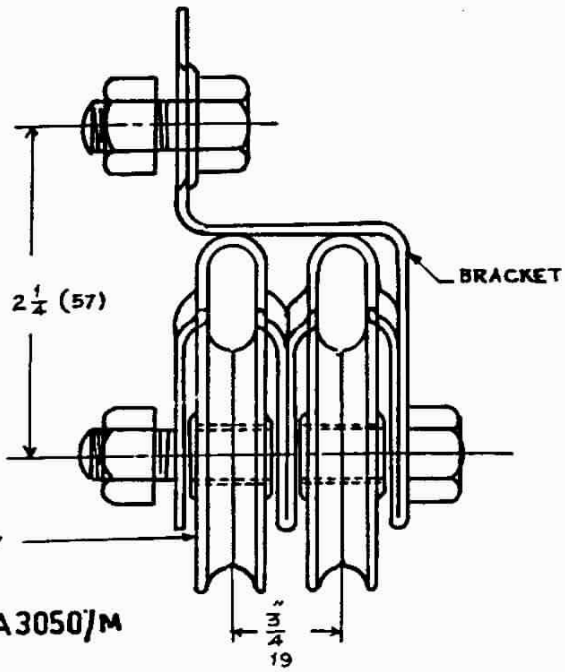


Fig.No.9.2 -WIRE PULLEY-2WAY-FLAT (SA3051/M)

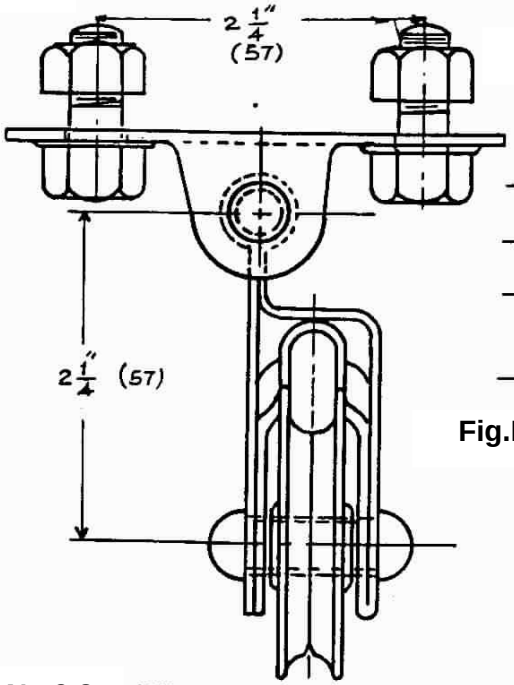


Fig.No.9.3 -WIRE PULLEY-1 WAY-SWING (SA3056/M)

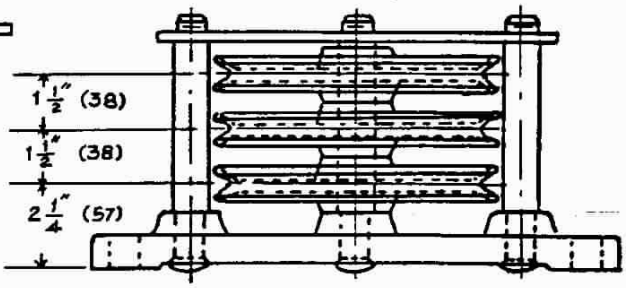


Fig.No.9.4 HORIZONTAL ROPE WHEEL 3WAY (SA3002/M)

STS.S1034/88

9.4 Horizontal Rope Wheels (SA 3000, SA3001, SA3002).

For a larger angular diversions more than 10^0, horizontal wheels are employed these are available as 1 way, 2 way and 3 way. The wheels are mounted on the centre stud pin fixed on a cast iron base which has two other stud pins rivetted to the wheel base in line with the centre pin. The two outer pins act as wheel guides and prevent the slipping of the wire rope. The wheel base has four holes for 19mm bolts and is bolted to CI base by means of 18 x 62 mm bolts with head underneath. The difference between 1 way, 2 way and 3 way horizontal wheel bases is only in their lengths of the stud pins. To prevent the wheel from coming out, top strap has been fitted on the three studs.

9.5 Wire adjusting screw (SA 3070, SA 3074)

For each of the signal transmissions of length less than 300 mm a wire adjusting screw is provided for adjustment being made for expansion and contraction due to atmospheric conditions. The adjusting screw can be shortened and lengthened as required. If the interlocking frame is sufficiently high from the ground level, the best place for the wire adjusting screw is on the vertical wire connecting the lever tail to the vertical wheel below. It essentially consists of two threaded rods of 12 mm dia. one with right hand thread, and the other with the left hand thread and fit into a turn buckle 450 mm (15 ft). The other ends of the rod terminate in eye joints so that they could be connected to the wire run by means of a split link.

9.6 Cabin Wire Adjuster (SA 3100 & SA 5976) (See Fig 9.6)

The signal wire transmission exceeding 300 Mts. (1000 ft) is provided with a cabin wire adjuster to enable the expansion or contraction in wire being adjusted by cabin staff as and when required. It is fixed on top floor of the cabin close to the concerned lever and is firmly secured to the cabin flooring by means of four bolts and nuts. The wire from the cabin wire adjuster is first taken to the vertical wheel installed in the ground floor constituting a part of the inside lead out. It is next taken round the draft wheel (SA 6000) attached to the lever tail and then wrapped round another vertical wheel fixed adjacent to the first one, and finally it is taken to the horizontal wheel of the outside lead out for onward transmission.

Cabin wire adjusters, are available in the following types:

(a) Cabin wire adjuster, type 'A' (Slide Type SA 3100).Fig. 9.6(a).

(b) Cabin wire adjuster, type 'B' (Ratchet Wheel Type, SA 5976).Fig. 9.6(b).

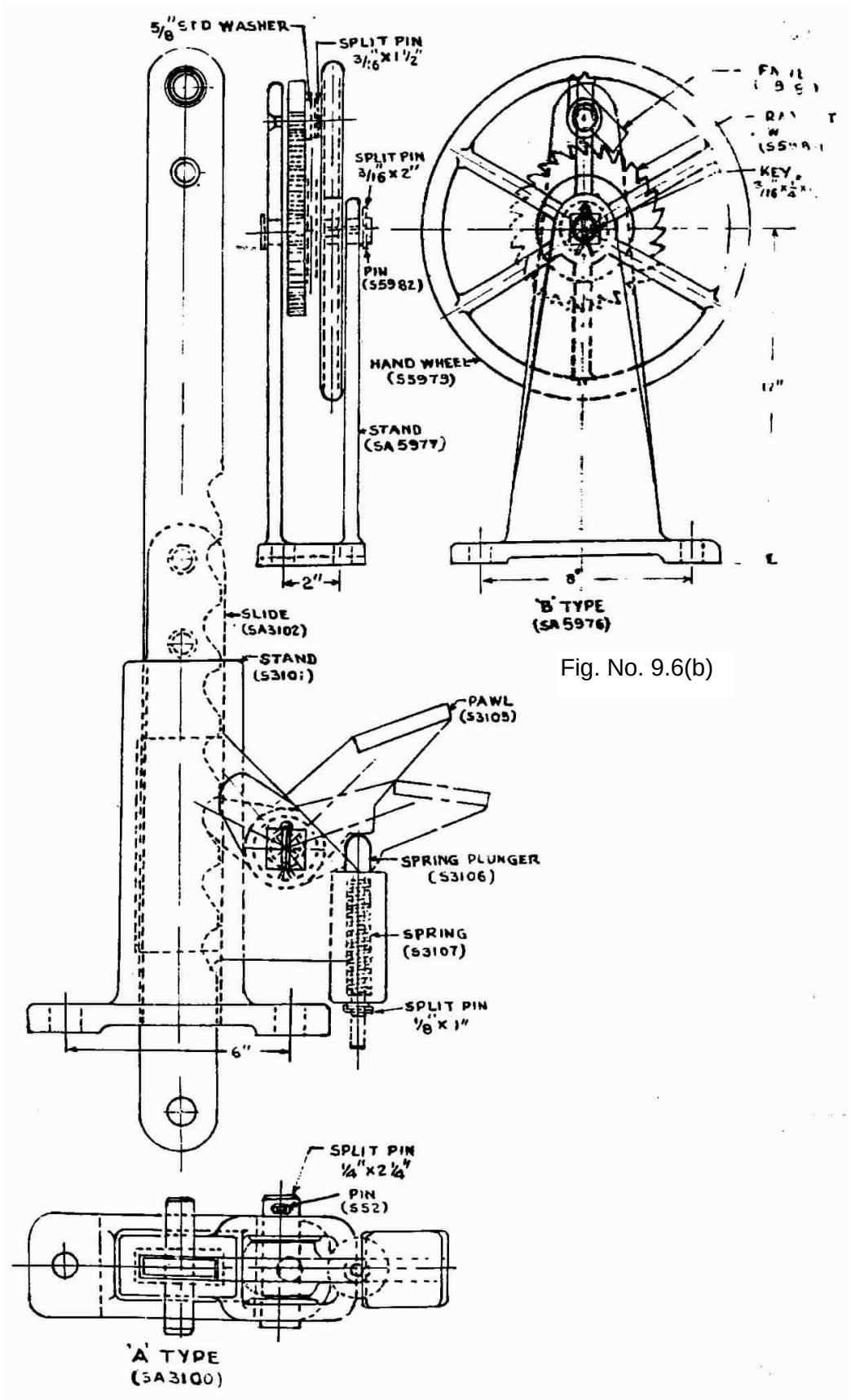


Fig. No. 9.6(b)

Fig. No. 9.6 (a) – CABIN WIRE ADJUSTER

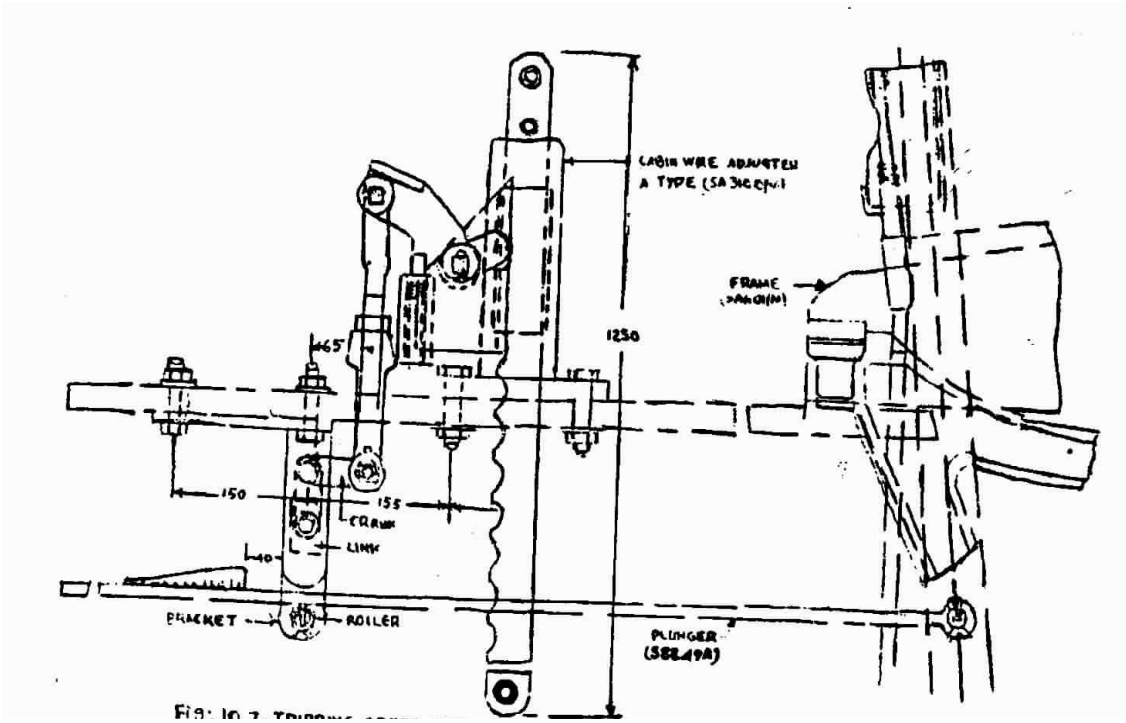


Fig. No. 9.7 (a) TRIPPING DEVICE WITH CABIN WIRE ADJUSTER (FOR CATCH HANDLE LOCKING) (SA 8240/M)

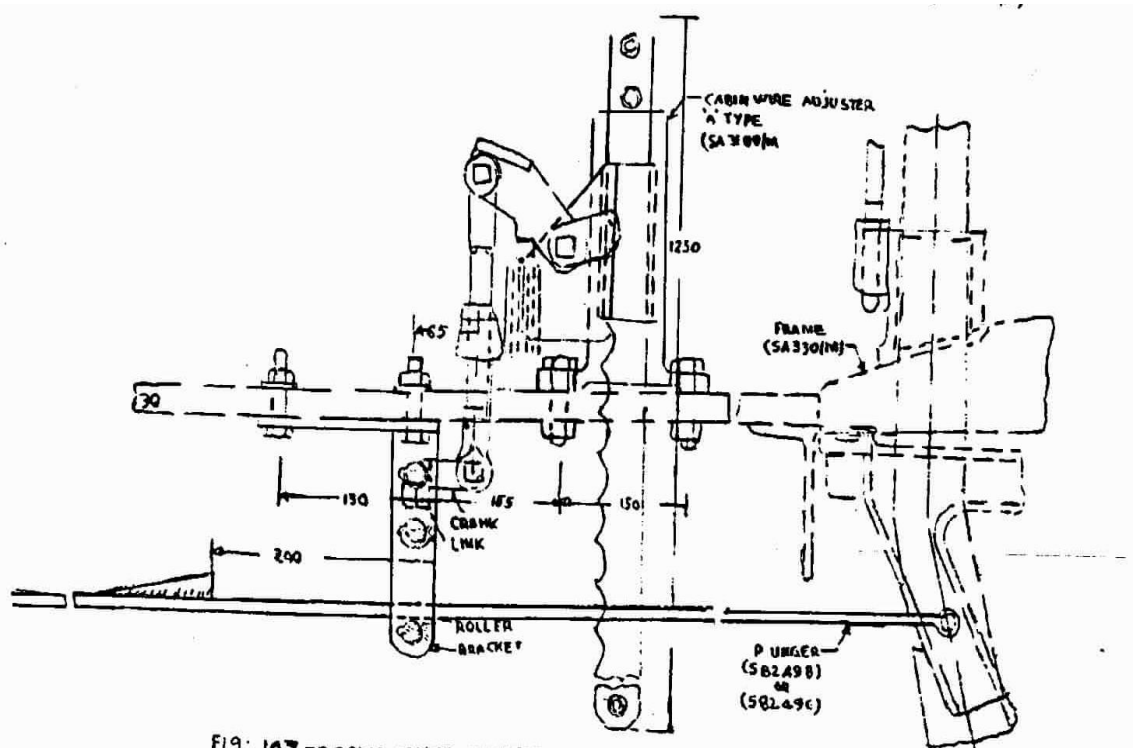


Fig. No. 9.7 (b) TRIPPING DEVICE WITH CABIN WIRE ADJUSTER (FOR DIRECT LOCKING) (SA 8241/M)

9.7 Signal Wire

The wire used for transmission is of two recommended types

(a) SWG No 10,315 mm

(b) No7/17 SWG Strand Wire IRS spec. S1-62

No.10 SWG galvanised wire is supplied usually in a coil of about 550 Mts. weighing 45 to 55 Kgs.

Before running the transmission, it is necessary to have this coil wound round a special drum provided for this purpose. Wire from the drum should be gradually released by turning the handle on the drum and the released end should be taken over by the wire pulleys. Kinks and twists in the wire should be strictly avoided. If, however, a kink is developed, it should be straightened out immediately. This type of wire has been observed to have caused more cases of wire breakage. Perhaps it is because of the fact that it is difficult for a Maintainer to locate the weak spot in the wire transmission during his routine maintenance rounds and hence, often the wire breaks without any pre-warning No7/17 SWG strand wire has an approximate diameter of 5 mm and tensile strength of 95-110 kg/sq.mm and a minimum breaking load of 950 Kg. and is made to IRS spec. S2 Coils of 7/17 SWG signal wire have an approximate length of 600 yards and weight approximately 50 Kg. The wire comprises of 7 strands of galvanised wire of gauge 17 has much more flexibility than No10 SWG wire and is easier to run out from a wire drum. It has been observed that signal failures due to breakages of this type of wire are very few. This is because of the fact that the Maintainer comes to know well in advance before the wire finally snaps. The moment the Maintainer sees one or two broken strands of wire, immediate step to repair it is taken.

9.8 Wire Rope

For making a wire round a diversion wheel 7 x 7/22 wire rope is used. It is much more flexible than the solid or strand wire and consists of 7 ropes of wire each having 7 strands of 22 SWG wire. It has an approximate diameter of 6 mm. The wire rope used in signal wire is quite different from that used in double wire where 6 x 19 wire rope is used. It comprises of 6 ropes of wire with a centre core of hemp each of the wire rope has 19 strands of wire. This wire rope is much more flexible than 7 x 7 wire rope and has a diameter slightly less than 6 mm.

9.9 Wire Joints

The types of joints usually used on Railways are illustrated in the diagrams some of the materials used for making wire joints are listed below (See Fig. No. 9.9).

Sleeve for strand wire joint, sleeve for solid wire and wire rope sleeve (S-3086), thimble (S-3084), split link (S-3085) and bifurcated rivets.

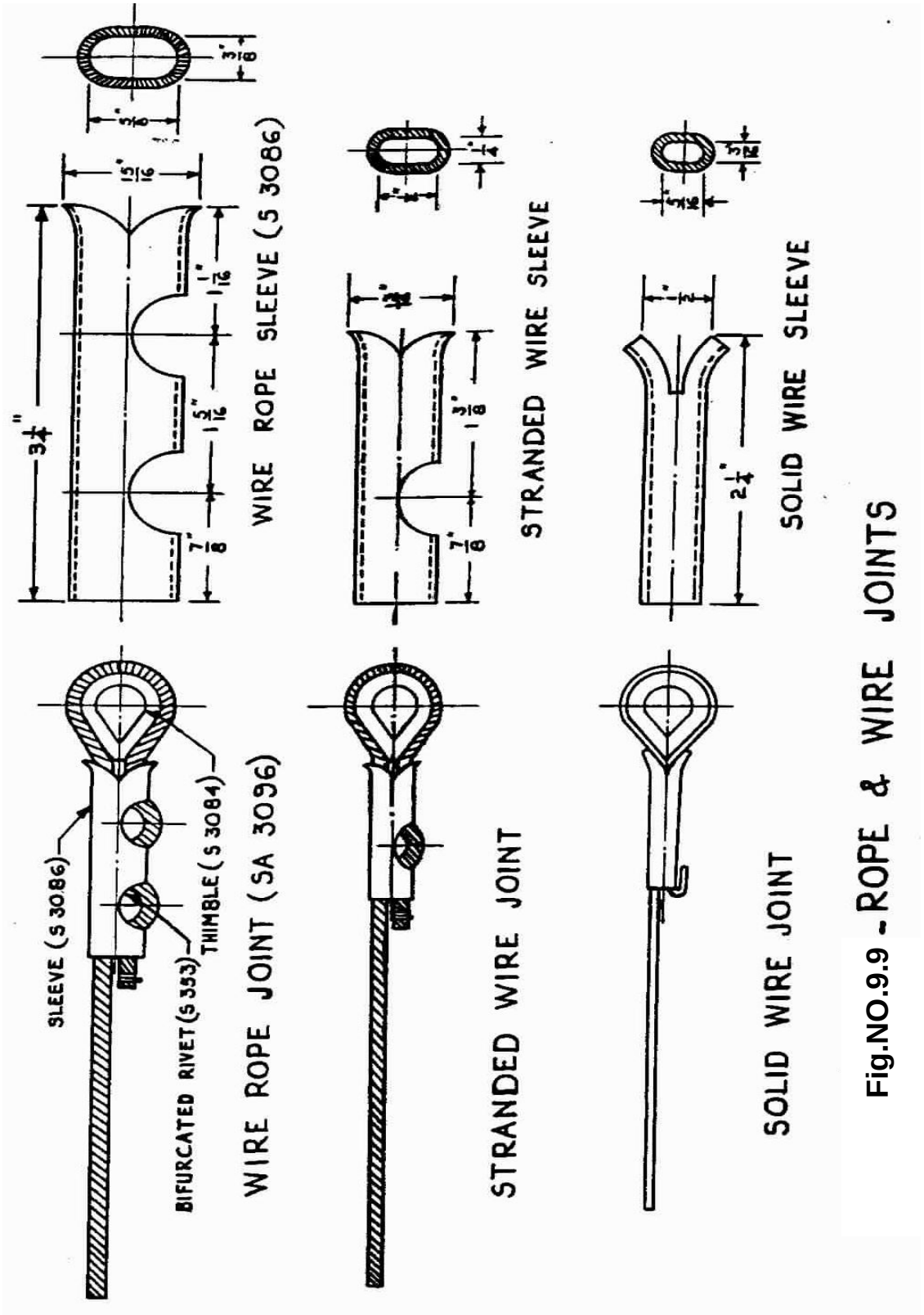


Fig.NO.9.9 - ROPE & WIRE JOINTS

It is a good practice to use always a thimble in a wire rope joint or in ordinary wire joints. It prevents a direct contact between two wires and wire is also given a smooth bend at the joint (the radius of bend is the radius of the thimble used) and hence, eliminates the chance of weakening the wire caused through rubbing against one another.

For joining wire in the main transmission in between two pulley stakes, lapped joint is recommended where 7/17 strand wire is used. In this joint the two ends of the wire are made to overlap one another and each end should extend beyond the centre line of the joint by about 375 mm (15"). The strands of one end of the wire are next opened out. The two wires are next held firmly at the point of joint and one strand is twisted round the wire and remaining strands of the wire for seven turns. The portion of the wire strand left over after the completion of seven times, is then cut off. The process is repeated with each of the seven strands at one end Similarly joint in the other end of the wire is made. The overall length of the joint made in this fashion is about 175 mm (7") long.

It may be noted that 6 x 19 wire rope should not be used with wire rope sleeves (S3086). If 6 x 19 wire rope is used in a wire rope sleeve, it is observed that often the short end of the wire rope in the joint pulls out of the sleeve because of its being slack fit in the sleeve.

9.10 Wires to Detectors

Where there is more than one detector in a wire run, wire run from cabin should be carried to the farthest points from the signal then through detectors, and back to signal. Wires must not join shackles of signal slides at sharp angles as this will cause signal slides to bind. If necessary, additional stakes or bridge pulley stakes can be used to prevent wires from falling in and fouling the points slide notches. The wire run should be so adjusted that all signal slides of detectors travel back just to their stops when signal is returned to ON position.

9.11 Method of running wire transmission

The efficiency of wire transmission depends upon the wire being run in such a way that it encounters least friction to achieve this; it is advisable to follow the following procedure.

(a) The wire run should be carefully divided into a succession of straight with minimum number of diversions. To obtain a straight alignment two pulleys stakes should be fixed vertically on the ground at the two ends of each of the straight run taking care that the proposed wire run does not infringe the requirement of minimum clearances laid down in the schedule of dimensions. The intermediate pulley stakes can then be fixed vertically keeping in line with the two extreme stakes of the straight line.

(b) The maximum spacing between the pulley stakes should not exceed 10Mts.(30 feet) and the face of the stake on which the pulley brackets are fixed should be truly parallel to the wire run so that no friction is caused. The level of the pulley stakes should be equal as far as the ground conditions permit. To reduce the sag in the wire run, sometimes, pulley stakes are fixed at closer spacing than 10 Mts. (30 feet).

(c) Joints on the wire should be sufficiently clear of pulley stakes, wheels, etc, so as not to cause any obstruction in the working. On each diversion, horizontal wheels with wire ropes should be used and the diversion wheels should be far away from the pulley stakes so that less friction is experienced.

(d) The lowest transmission wire should be about 150 mm (6") clear from the ground and the wire should be arranged in such a way that the nearer signals drop out first without having to cross the transmission wires meant for far off signals.

(e) To ease the operation of long distance signals a facile stroke lever may be employed at a distance of 60 to 80 Mts. (70 to 100Yards) from the signal. By this, the transmission wires are pre-tensioned and sag in the wire reduced. This has been found to reduce loss of strokes in the transmission. Reduction in loss of strokes permits the signal connection being taken off nearer the fulcrum of the lever and thus increases the mechanical advantage on the lever. Higher mechanical advantage means easier operation of the signal. The facile stroke lever shall be fixed on a rigid foundation.

(f) A horizontal wheel is fixed on the side of the post on a vertical plate to take the wire run for being connected to the counter weight balance lever.

(g) Whenever there is a chance of entanglement of one wire with the other, it is recommended that they are separated sufficiently apart by placing the wires one above the other. This is particularly recommended for the Outer, Warner and Advance Starter. Signal wire runs at way side stations where due to the cattle trespassing, the wires often get inter-twisted and cause failures.

9.12 Maintenance of Signal Connections, Wheels and Cranks

(a) Wheels must work freely and be kept clean and well oiled Wheels with broken, chipped or damaged flanges must be renewed.

(b) Wire runs - must be kept so adjusted that signals can be pulled properly, 'OFF' and returned fully to 'ON' position so that detector signal slides if any travel fully back to their stops. Threads of wire adjusting screws must be kept clean and oiled and lock nuts kept tight.

(c) Special attention must be given to re-adjustments of new runs until the initial wire stretch has been absorbed.

(d) Bent pulley stakes must be straightened and all broken or missing pulley wheels and brackets renewed. Pulley stakes must be kept in good alignment, and their faces strictly parallel to the direction of wire transmission.

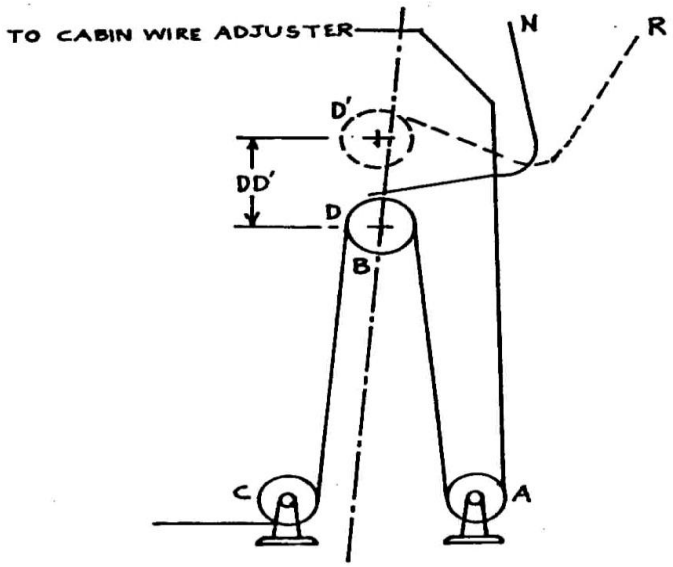


Fig. No.9.17 DRAFT ROPE WHEEL

CHAPTER -10: LEVEL CROSSING GATES

10.1 INTRODUCTION

(a) One of the major problems in Railway working is to provide adequate facilities for the roadways crossing the lines and having provided these to protect the road user from coming into collision with trains for many reasons the problem of avoiding such accidents has invariably devolved upon the Railway Authorities.

(b) The obvious solution is to avoid crossings, or where this cannot be obtained to cross the Railway by means of over-bridges or subways. It will be realized, however, that geographical conditions and economic considerations very often render this impossible and so it is observed that the roadway crosses the railway by means of what we know as a level crossing that is a crossing where the roadway and the railway tracks are on the same plane.

(c) The next problem arising is the question of the protecting the road users from the trains particularly at places where the road traffic is very heavy In India, these crossings are classified according to the amount of traffic passing over them and generally it is on this basis that signalling is provided for protecting the road users. Where the road traffic is very light, the interlocking is not provided and instead a notice board warning the public is displayed. The safety of this type of crossings is entirely dependent on the vigilance of the road users. There is, however, a number of isolated level crossings, where road traffic is not very heavy, but due to curvature, trees or cuttings, inadequate sighting distance is obtained. It is, therefore, necessary to interlock them since collision with road vehicles may cause serious derailment with disastrous effect.

10.2 Classification

In India, the classification of level crossings is settled in consultation with local Governments and Administrations concerned, based on a joint consideration of the

(a) Nature of the road

(b) The number of road vehicles

(c) The number of trains

And are classified as follows

(i) Special		
(ii) ‘A’ Class		
(iii) 'B' Class		for roads
(iv) 'C' Class		

(v) 'D' Class for cattle crossings

(Note: Details of each class may be seen at Notes on Signalling General.)

10.3 Types of Gates

Generally there are four types of gates in use in India, e.g.,

(a) Swing type

(b) Lifting barrier type

(c) Movable barrier type

(d) Electrically operated type

Out of these the swing type gates are most commonly used in this country but where density of road and rail traffic is heavy faster methods of operation of gates have been introduced e.g., lifting barrier type.

(a) Swing type gate

This consists of gate leaves single or double on one side of the road supported and hinged on gate posts. This gate wings were previously made at wood, but now-a-days these are made out of steel. The gates open either towards or away from the track, but only in cases of special class gates they open across the tracks. Swing type gates are commonly fitted with following types of gate locking:

(i) 'E' type gate locking

(ii) 'EC' type gate locking

(iii) Succession 'E' type gate locking

'E' type gate locking

One of the gate wings or the post is fitted with a key hanging from a chain which when inserted in the 'E' type lock on the other gate wing or the gate, releases a bolt which is connected to the lever in the cabin or ground frame at the gate. The lever when reversed pushes the bolt into a hole in the other gate or post and so holds the two wings or the gate and the post together Fig 10.3 (a). With this arrangement, the gates on either side are locked at one time. This type is particularly suitable where two gatemen have been provided, as each gateman can go to the gate allotted to him, close it and insert the key in the lock. Where the gate is worked from the cabin, the lever man on being informed by the Gateman can at once reverse the gate lever where the gate is locked from a ground frame near the gate, the nearest gateman should proceed and reverse the gate lever. Only on very busy gates, two gatemen are provided in each shift.

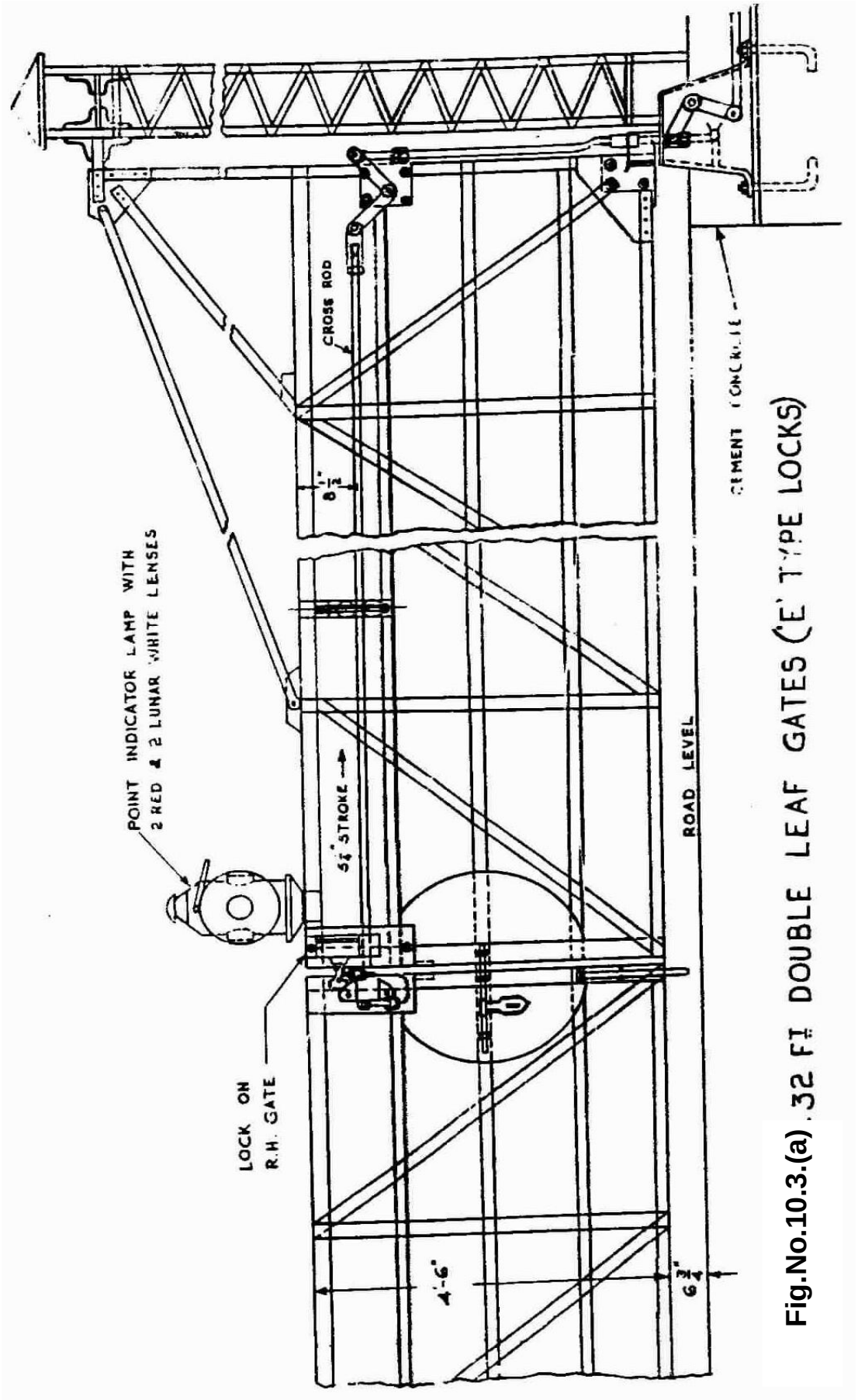


Fig.No.10.3.(a) 32 FT DOUBLE LEAF GATES ('E' TYPE LOCKS)

'EC' type gate locking

One of the gate wings or post is fitted with a key hanging from a chain which when the other gate is closed can be inserted in one of the locks of a double gate locks fitted to the gate wing, and a control key can be released from each gate. The two keys released are taken to a ground lock 'E' type (SA 3141/M-42/M) fitted near the ground frame or cabin and when inserted in the locks release the gate lever connected to a slide inside this lock [See Fig 10.3 (b)]. This method is rather elaborate and costly and is being gradually replaced.

Succession 'E' type gate locking (Triple 'E' type)

(a) A triple 'E' type lock is fitted to the gate leaf located on the side closer to the ground lock or ground frame or gate lodge and a double lock on the gate leaf located on the other side. A key with cabin is fitted to each of the two posts for gate leaves.

(b) The gate carrying the double lock is first closed and the key with chain is inserted in the double lock to release the other key.

(c) The released key is taken to the triple lock and is inserted in one of its locks. The gate is then closed and the key with chain connected to the post is inserted in the second lock. A control key can then be released from the third lock.

(d) The control key is then taken to the ground frame or cabin and inserted into a lock fixed to the gate lever if the gate is far away from the cabin and no GF is provided, the control key is electrically transmitted to the cabin or Station Master where it is interlocked with signals.

(e) This type of interlocking is suitable for most of the level crossing gates.

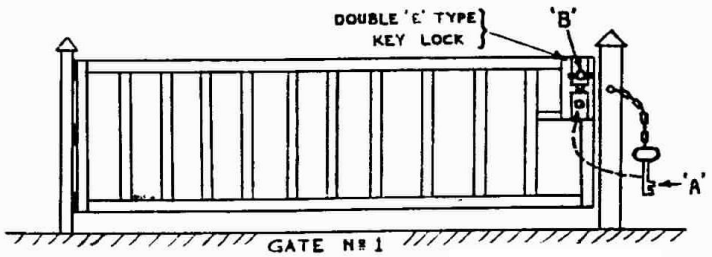


Fig.No.10.3(b)

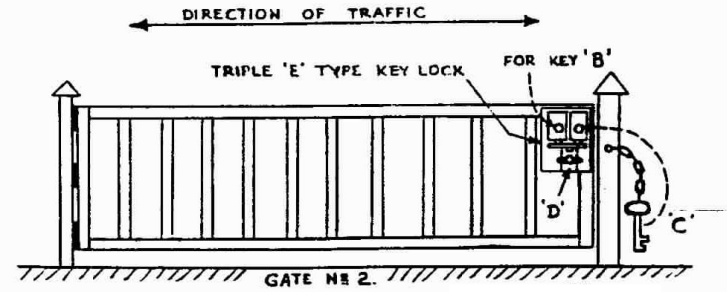


Fig.No.10.3(c)

SEQUENCE OF OPERATION:- GATE No1 TO BE CLOSED & LOCKED WITH KEY 'A' WHICH WILL RELEASE KEY 'B'. KEY 'B' WILL BE INSERTED IN THE LOCK ON GATE 2. KEY 'C' ALSO WILL BE PUT IN THE RESPECTIVE LOCK. KEY 'D' CAN BE TAKEN OUT ONLY AFTER THE INSERTION OF 'B' & 'C' WHICH WILL CONFIRM THE CLOSING AND LOCKING OF BOTH THE GATES.

Disadvantages of Swing Gates

(a) Swing gates operate in the horizontal plane and when the gates are long, the operation of opening and closing takes considerable physical effort and time on the part of the gateman. This is made more difficult should the wind pressure also be heavy.

(b) Gate stops have to be located in roadway and the driving connections for the gates where provided, and stops are located below road surface Maintenance and drainage becomes a serious problem.

(c) The operation of opening and closing of gates take long time and, therefore, is not suited for heavy traffic.

(b) Lifting Barriers (SA 7973 to 7980)

(a) Lifting barriers are probably one of the best methods for the quick operation of rail and road traffic across level crossings. It consists of two conspicuously painted balanced booms, extending across the roadway, but raised to the vertical or nearly so, when vehicles may pass. The shaft is located near one end of the boom, the LB boom length of LB boom is determined with respect to the width of the roadway to be closed the shorter end is used to carry the balance or counterweight.

(b) Boom gates are provided in single and/or double units on each side of the line according to the width of the roadway and are mechanically or power operated according to the density of the road traffic and frequency of train service. Posts are available in sizes of 10 Mts. (30'), 8 Mts. (24'), 6 Mts. (18') and 4 Mts. (12').

(c) The lifting barrier equipment consists essentially of the following

(i) A balanced boom (tubular pole) and a shaft. Fringes (light) are usually fitted to provide a barrier between the boom and road surface so that small animals or children may not pass through.

(ii) A pedestal which supports the shaft bearings and driving equipment the pedestal is mounted on a concrete pit.

(iii) In the case of mechanically operated gates, an operating unit which is consisting of driving wheels and releasing lever, is located in the cabin or GF.

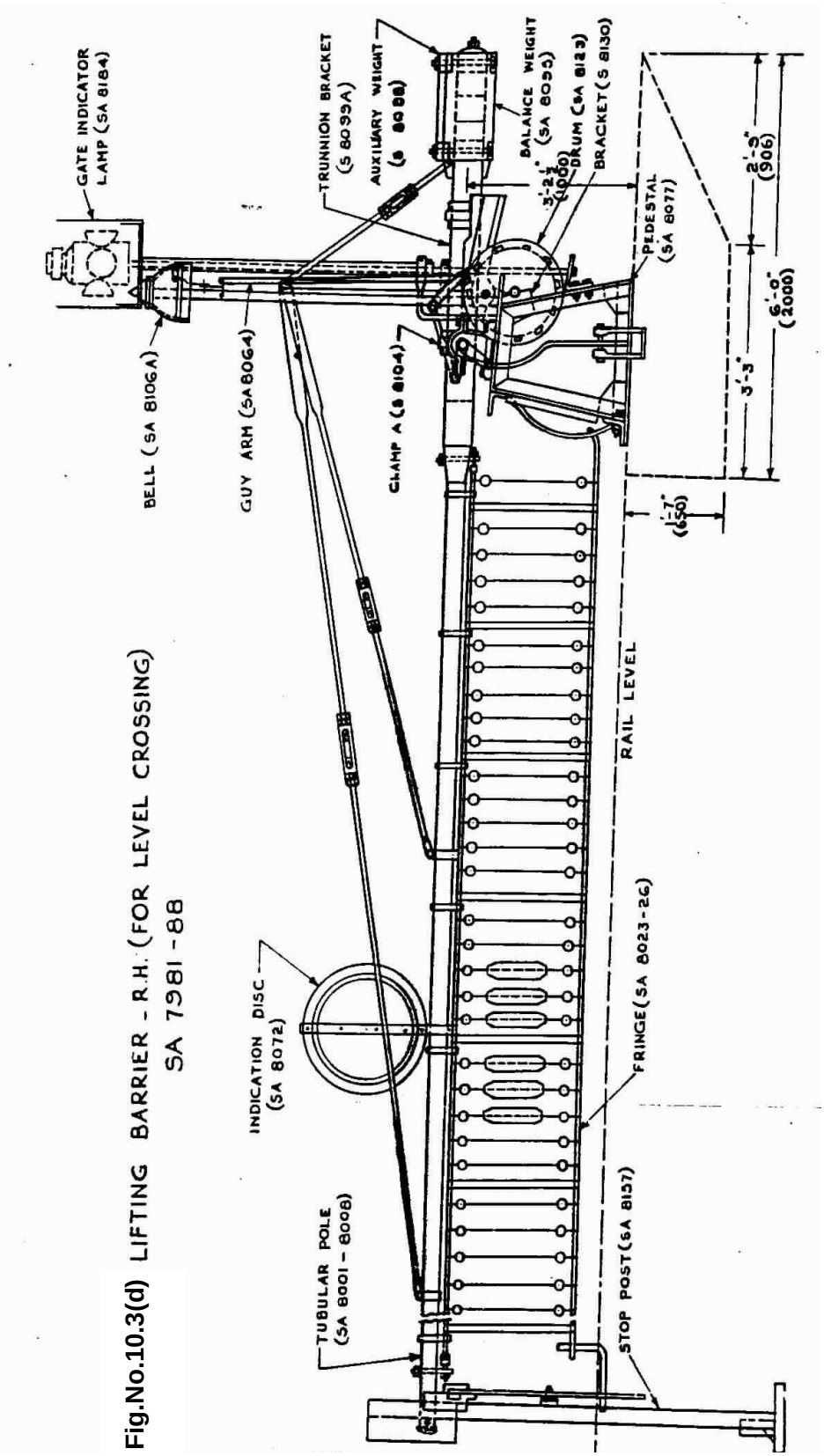


Fig.No.10.3(d) LIFTING BARRIER - R.H. (FOR LEVEL CROSSING) SA 7981-88

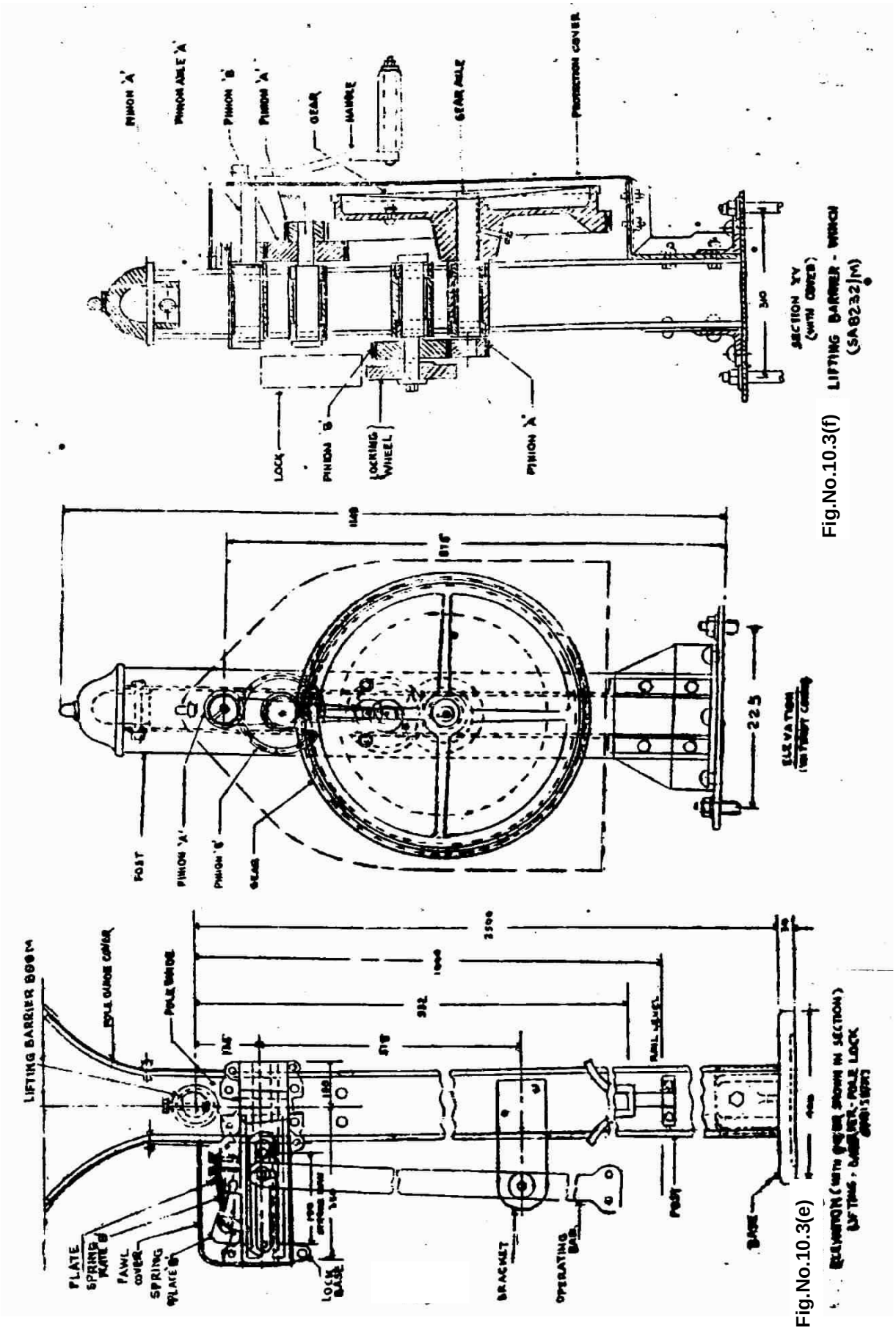


Fig.No.10.3(f)

Fig.No.10.3(e)

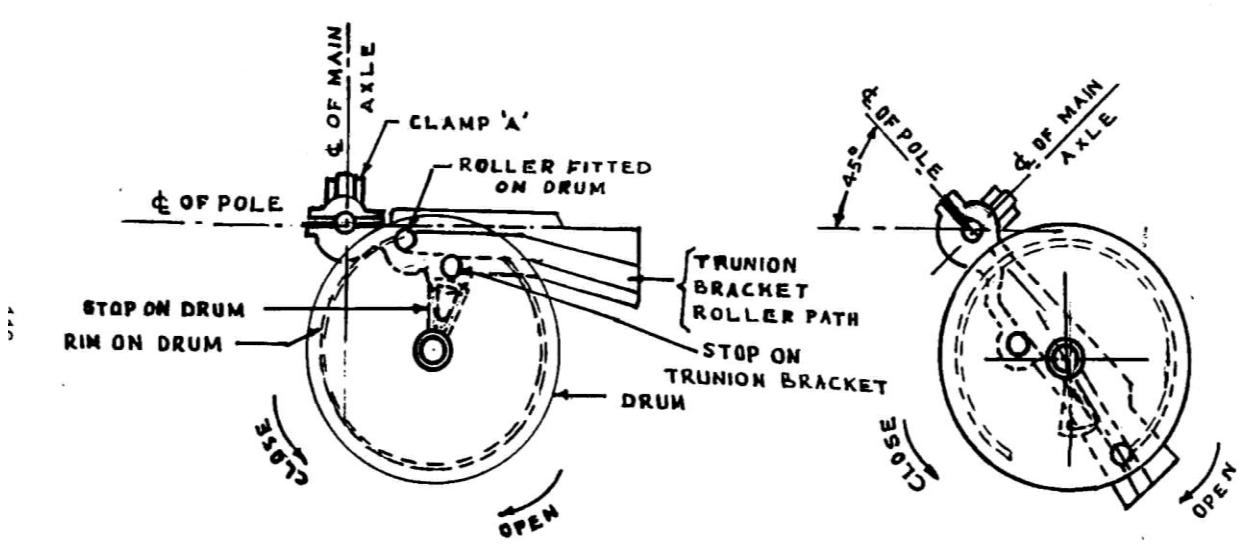
Handle is connected to the pinion 'A' which, in turn, is intermeshed with pinion 'B' pinion 'B' drives the gear through a compound train of gears to achieve a high velocity ratio. The lifting barrier drum is connected by a double wire transmission with gear on the winch.

The gear axle operates another set of pinions 'A' and 'B' on the other side of the post which is employed to actuate a locking wheel to achieve winch locking by means of an E type lock. To ensure that the key from the E type lock can be extracted only in the closed position of the barrier the total movement of the lock wheel is made less than one complete revolution.

The winch is located close to the gate or inside in the cabin if the cabin is located close to the level crossing gate. The range of winch operation of lifting barrier from the point of operation is 150 Mts.

After the barrier is closed key can be extracted from the E type lock on the winch. This key is taken to release the gate lever, which when operated may release the gate signal. Sometimes gate lever is also used for locking of the pole of the barrier by means of a pole lock. In addition a detector is provided to prove the barrier is closed before the gate signal is taken off. It has been decided that both locks and detectors need not be provided.

Recently Railway Board have issued instructions about installation of lifting barriers with arrangement of locking the copy of this letter is given in Para: 10.4.



BARRIER AT CLOSED POSITION

IN THIS POSITION THE ROLLER FITTED ON DRUM, ENGAGED INSIDE THE TRUNNION BRACKET ROLLER PATH, HAS MOVED THE BARRIER TO THE HORIZONTAL POSITION. THE STOP ON DRUM IS ENGAGED WITH THE STOP ON TRUNNION BRACKET HOLDING THE BARRIER IN THIS POSITION.

BARRIER AT 45° POSITION

IN THIS POSITION THE ROLLER FITTED ON DRUM IS AT THE LOWEST POSITION IN THE TRUNNION BRACKET ROLLER PATH

Fig.No.10.3(g) LIFTING BARRIER - WORKING ARRANGEMENT OF TRUNNION BRACKET & DRUM (SA 7997)

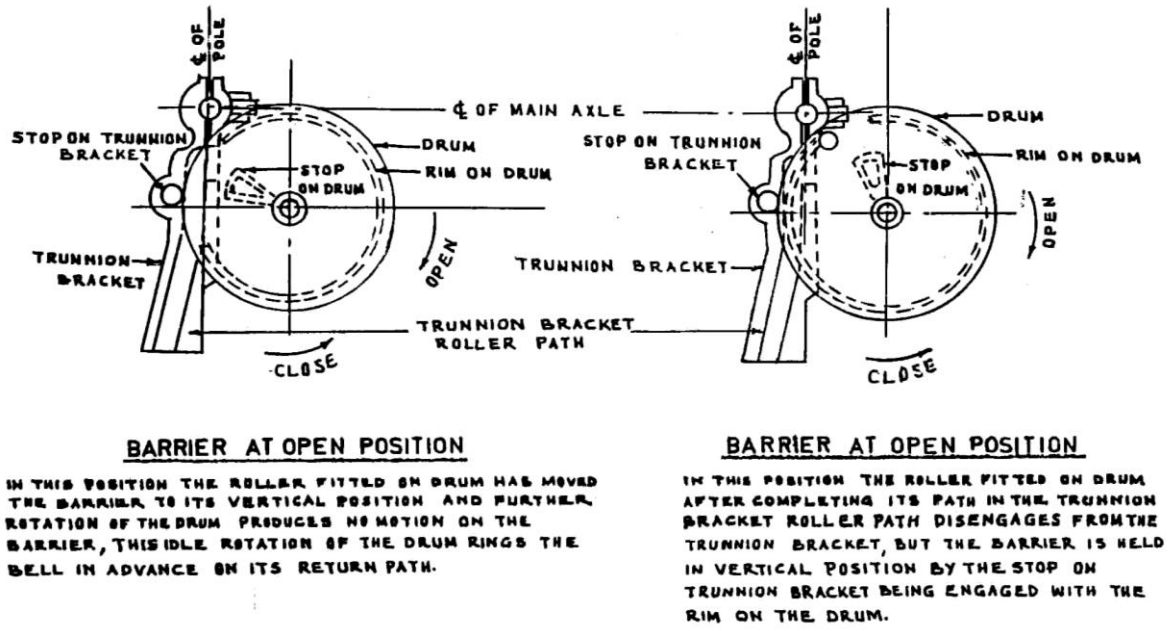


Fig.No.10.3(h) LIFTING BARRIER WORKING ARRANGEMENT OF TRUNNION BRACKET & DRUM (SA 7997)

Advantages of lifting barrier type gates are

(a) Boom gates operate in the vertical plane and being balanced, require comparatively less effort on the part of the operator when being raised or lowered.

(b) The effect of the wind on the gate is considerably minimized as in very few instances would it be necessary to operate the gate indirect opposition to the direction of the wind and even then the area of surface exposed to wind pressure will be much less.

(c) Gate stops in the road eliminated since the wind pressure are does not influence the lifting barrier.

(d) The boom and operating gears are lighter in construction and by reasons of its moving in the vertical plane, it is much more economical in space requirements as compared against swing type gates.

(e) As the boom never swings towards the traffic, it assists in speeding up the clearance of road traffic to a great extent.

(f) The entire operation is much quicker than that of swing type gates**.**

10.4 Copy of Rly. Board's LrNo69/W3/sg/G/3 dated 05.09.1969.

(a) "With a view to effect economy in gatemen, the Railways were advised to replace the level crossings near cabins by lifting barriers and arrange their operation from the nearby cabins wherever possible. As per the extant practice level crossings within about 300 ft from the cabin and those located at longer distance and having a good view from the cabin are worked by means of power operated lifting barriers.

(b) In view of the high cost involved for provision of power operated lifting barriers and difficult position of indigenous supply of these barriers. Northern Railway tried winch operation of a lifting barriers situated at a distance of 150 M from the cabin providing effective hook locking by having the transmission partly as a rod run and partly as a wire run . The trial has been successful and the level crossing is working effectively.

(c) The Board desire that similar arrangements may be adopted by all the Railways and the range of winch operation of lifting barriers from the point of operation be increased to 150 M from the cabin under favorable local conditions, of visibility of the approach road from both the sides. It is further desired that efforts may be made to install as many more gates as possible with lifting barriers to effect economy in Gateman".

10.5 Method of Interlocking

(a) For heavy traffic where special and 'A' class gates are provided, following types of gate locking are used.

(i) 'E' type gate locking or a similar type with two or more gatemen.

(ii) Lifting Barrier Type.

(b) Where traffic is medium, i.e., in 'B', 'C' class gates succession 'E' type gate locking may be provided and only one gateman will be required. Where a 'C' and 'D' class gate is situated near a cabin and if the traffic is very light, and therefore, interlocking is not justified, the cabin or lever man should ensure that the gates are closed before he lowers the signal.

(c) Where there is no cabin near a 'C' or 'D' class L.C.gate, a telephone should be provided at the gate. Where the gate is to be interlocked the control key should be electrically transmitted either to the SM or cabin and interlocked with the signals. Where no interlocking is provided then the gatemen will be responsible for the closing and opening of the gate in accordance with rules.

10.6 POLE LOCKING (DRG NO SA 8158/M)/ Boom locking arrangement

The positive pole locking is achieved by installation of one lever GF Rodding is run to both the poles at post. An approved type of lock with plunger is provided. The plunger is driven by an operating bar (fitted on the post) connected to rodding operated from one lever GF. After the winch is operated to close the gates, winch is locked and ‘E’ type lock key is extracted, this key is inserted into lock fitted on one lever GF for operating it to lock the poles. Once the poles locking is done by operating the lever to its reverse position another key is taken out and transmitted to cabin for, lowering of signal or for releasing the gate control lever in the cabin.

Normally pole is locked by the pawl by means of a notch cut on the side of the locking plunger. When the pole is dropped properly and housed in the pole guide the lock pawl is lifted up and disengages the locking plunger to allow locking the pole positively.

These arrangements will ensure the proper operation of the pole and will not allow to move the plunger to lock the pole unless pole comes to its proper position and rest in pole guide.

This ensures that the gate boom cannot be opened, once the gate signal is taken off for a train. A lever, when operated, pushes a plunger in both the booms, thereby locking the gate boom in the reverse position of the boom lock lever only, the signal lever gets released in the ground frame during inspection, S&T officials should check the positive boom locking.

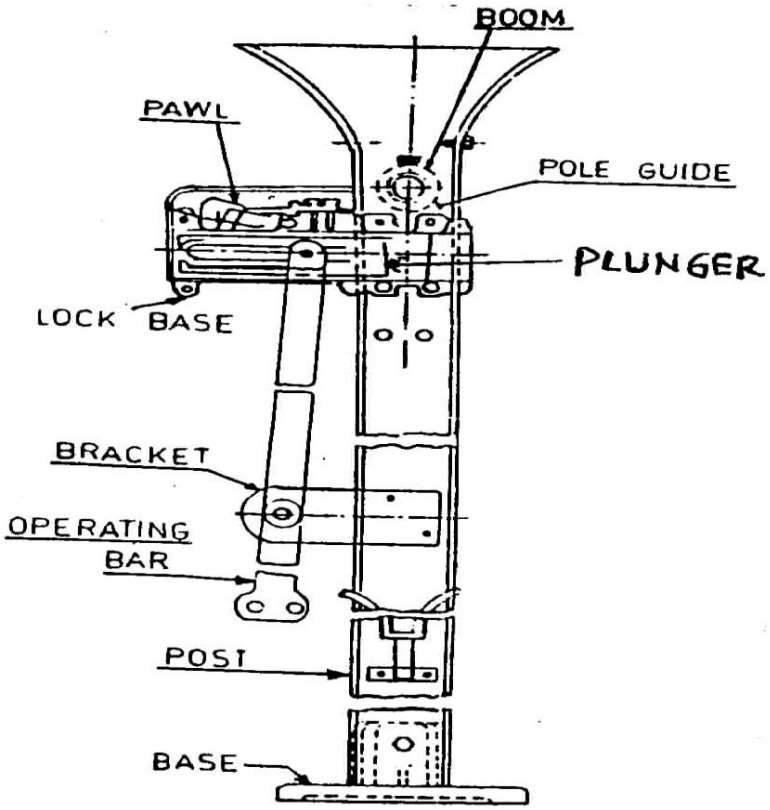


Fig. No. 10.6

(c) Movable Barriers

Some railways movable barriers are in use. These barriers are bodily sided away over light tracks placed parallel to the railway line on either side of it and thus allows the road traffic to move. When these are closed against the road traffic, they can be locked in position by a lever, the operation of which releases the gate signals. Although these are much quicker in operation than the swing type, yet due to maintenance difficulty these are not much in use. The bearing rails often get choked with dirt, dust etc., and cause an obstacle in the smooth operation of the movable barriers.

MAINTENANCE

10.7 Routine maintenance

Points to be noted, while inspecting interlocked LC gates

(a) The approach road should be in level.

(b) The gate equipments should be in good working order as prescribed in the working rule.

(c) It should be ensured that the "Whistle Board" and "Warning Board" are provided.

(d) The view for Road Users and the gateman of an approaching train is not obstructed.

(e) The telephone communication is in proper working order.

(f) The working instructions of the LC gate are in the local language besides Hindi and English.

For trouble free working of mechanical lifting barrier, following procedure may be followed. The maintenance intervals may be modified to suit local conditions at the discretion of DSTE/ Sr. DSTE It includes both mechanical / electrical Gates and also electrical equipment in case of mechanical gates.

The maintainer should ensure that he has tools and consumables like cotton wastes, oil, grease and wires etc required for maintenance.

Maintenance is to be carried out as given below

10.8 Boom

(a) Operate gate and see that both the booms are moving simultaneously. If the operation is hard then for any obstruction in the entire wire transmission, i.e., winch to function, rectify the same.

(b) Check booms are moving simultaneously or not if not then adjust stay guide and balance weight of the boom by trial & error method and correct alignments pull & return wire near drums of both Boom.

(c) See that booms are resting properly on its boom stop when closed; if not then correct the alignment.

(d) See that there is no crack on the boom if any may temporarily put right by providing the iron strip/angle and such booms must be replaced on priority.

(e) Repair the boom fringes, if broken and Check the stop boards of the boom on either side and ensure that red reflectors are already fixed.

(f) Ensure the free roller movement in the cam path during boom operation Cam path should be free from dust and oil mud it should be cleaned and oiled. The gap between roller on the drum & cam path should be minimum.

(g) Check the gate indicator is properly fixed, if not then adjust it and verify its visibility from a distance of 100 Mts.

(h) Check that all pieces of the boom are in perfect straight alignment cross bolts at the joints are fully tight.

(i) Ensure tightness of balance weight, auxiliary weight and cylindrical weight in their respective place. There should not be a slightest displacement possible during the course of opening and closing of the gates.

10.9 Procedure for positive boom lock check

(a) Close the gate and try to reverse the gate boom locking lever by lifting one boom, it shall not operate Test the second boom similarly.

(b) In the closed condition of the gate, gate boom locking lever can become reverse try to lift the boom one after it the other & should not lift.

(c) Ensure that minimum movement of lock plunger is not less than 100 mm (4”) inside the notch.

(d) Try to lift the boom in closed and unlocked position; it should not be possible to lift at the free end.

10.10 Pedestal Unit

(a) Tighten the pedestal nut & bolts of the foundation, if they are loose.

(b) Check and tighten the trunnion bracket, guy arm nut bolts properly.

(c) Check the gate bell and whether it's functioning is proper or not i.e.,16 beats of pre-warning, ringing during closing operation of the gate and no sound while opening operation of the gate clean the associated wheel teeth and lubricate the same by graphite.

(d) For loudness of the warning bell beats, the bell gong must be kept fully tight in its seat and stroke of hammer strikers should be touch and go type, meticulous adjustment of spacing with inner face of the gong.

(e) Ensure timely replacement of bell actuating paths, which are worn out and cause loss of stroke.

(f) Clean the pedestal drum and its teeth; it should be free from the dust since dust is accommodating on it frequently due to rail and road traffics lubricate the drum after removing the dust.

(g) Ensure that not a single tooth is broken on drum, also check minutely for crack developed on teeth.

(h) Ensure that roller on the drum is free to rotate and lubricated, free from muck and its bolts is not getting worked out from thread-worn in the drum.

(i) Ensure that the wire rope wrapped around the rope drums and winch gear has sufficient turns for full opening and closing of lifting barrier.

(j) Check whether any diversion wheel is not excessively worn out or wobbling also ensures that no foundation is shaky.

(k) Ensure that periphery of not a single diversion wheel is broken and all wheels guides are located at right places and fully tightened.

(l) Ensure that there is no excessive sag developed in rope due to any jamming in pipes or on diversion wheel or due to mal adjustment of length.

(m) Ensure that the wire rope is not overlapped at the winch and rope drums and there is no tendency of working out from rope ways.

(n) Ensure that guy rod has sufficient tension for smooth operating and booms are perfectly straight without a bulge or sag.

(o) Check the adjustment of gate lamp, warning bell/buzzer and flasher light, adjust if required specially the light aspects of lamp should be adjusted for skew and curved approach roads from a sufficient distance.

Winch and Wire run

(a) Remove oily mud/waste with kerosene.

(b) Provide lubrication by applying grease on gear of train, i.e., teeth of gears.

(c) Check whether locking key is possible to extract from the winch in gate in open condition it should not be possible.

(d) Check if winch drum is locked in closed condition and if it is possible to operate when key is extracted. It should not be possible even the handle of the winch should be locked with locking plunger.

(e) All gate locking apparatus must be examined regularly and working parts oiled Gate locks must be kept in working order.

(f) Heavy repairs, renewals or alterations to gate enter locking must not be carried out until the inspector concerned has arranged for protection of the traffic.

(g) Check whether brass brushing of heavy gears has developed excessive wear and needs replacement.

(h) Erase excessive side play of locking plunger and its lower handle on winch body by adding washers packing.

(i) The wire run within duct should have no obstruction.

(j) Check all wheel guides for correct alignment Wheel guide should be free from dust Provide lubrication oil in guide wheel.

(k) Wire run within duct should be cleaned every month positively and parallel wire should be provided.

(l) Check that transmission wires are free from kink and twist.

(m) Check that wire diverting pulley and guide are free from dust.

(n) Check 'E' types keys and EKT are maintained properly.

(o) The gate lever should operate uniformly.

(p) Transmission of keys should be as per sequence.

(q) Track circuits flashing light, warning bells and connecting cables should be tested and maintained so that approach indications(audible/visible) never failed.

(r) Electric Lever lock and 'E' type locks on winch and gate lever and EKT must always be kept sealed by maintainers.

Overhauling of Lifting Barrier

All moving parts subjected to regular wear and tear should first be replaced with similar new/overhauled parts once in two years, the replaced parts should be sent to division workshop/overhauling.

Inspection of interlocked LC Gates by supervisor and officer

General

(a) The approach road should be in level and the gate equipment should be provided as prescribed in the working rules.

(b) It should be ensured that the 'whistle board' and 'warning board' are provided. And the telephone communication is in proper working order.

(c) The working instructions of the level crossing gate are in the local languages beside Hindi and English.

(d) The height gauge should have proper clearance and should be located at a minimum of eight meters from the gate post in case of electrified section.

(e) Provision of speed breakers on either side of level crossing within railway boundary, preferably at a distance of 20 Mts. from the gate.

(f) Ensure that the boom locking is effective and that all S&T gears are in working order.

Troubleshooting

(a) (i)Breakage of transmission wires.

CAUSE	REMEDY
1)At the pipe and ducts	Replace the wire use parallel wires inside pipes and ducts
2)At the thimbles, insulation ball joints	Make the joint properly and solder it
3)At the diversion wheel	Replace the wire and adjust the alignment or replace the wheel if worn out

(b) Wire out from wheel or winch.

If the wire out from wheel then check for excessive wear of wheels and adjust it. If the wire out from the winch then replace the wire if not soft and provide new lubricated rope wire. Check winch gear wheel, Replace if worn out. See that there should not be joining in the wire run, adjust it.

(c) Roller out from cam path.

(i) If the drum bracket is loose then tight the drum bracket bolts. Provide suitable number of washers to left side of drum bracket so that drum periphery will be close to the trunnion bracket face which will prevent the possibility of roller out from cam path.

(ii) Replace center pin of drum if bent/worn-out.

(iii) Replace roller and its bolt if excessive play developed.

Do's and Don'ts

Do's

(a) Ensure protection of traffic, and then start heavy repair works, renewals and alterations on proper disconnection memo permitted by competent authority like CASM/SM on duty.

(b) Ensure that in all cases the signal can be taken off for rail traffic only after the gate is closed and locked against road traffic.

(c) Ensure that all components of the gate are functioning properly only then reconnect them.

(d) Ensure proper sealing of EKT's and interlocking with other locks.

(e) Ensure cleanliness in the cabin ducts for wire run and pits for pedestals.

(f) Replace the wire at ducts/GI pipes after every six month to avoid breakage of wire due to corrosion/water logging.

(g) Mechanical rotating parts should be cleaned and oiled regularly. Black mineral oil/graphite should be used at respective places.

(h) Ensure proper functioning of all electrical equipments in Mechanical/Electrical gates, cables, indicators (audible/visible) and power supply system.

(i) All necessary instructions relating to maintenance/testing/overhauling that varies from time to time should be properly followed.

Don’ts

(a) Don’t Use improper Grade of oil for lubrication.

(b) Don’t Use harder type wire rope on winch drum.

(c) Don’t allow wire/rod run to rub against ballast, base of rails and ducts etc.,

(d) Don’t allow damage items/wire/rod/pulley etc to remain in transmission.

(e) Don’t forget to take safety precautions while working on LC gate and don’t forget to test interlocking with proper sequence after installation.

(f) Don’t allow the boom to operate erratically and don’t start work without obtaining proper permission on disconnection memo.

(g) Don’t forget to get deal the items required to be sealed such as Kent’s, etc., and also don’t allow excessive gap between drum roller and trunnion bracket.

CHAPTER -11: KEY LOCKS

11.1 The following types of key locks are in use on the Indian Railways

(a) E type

(E type key lock only has been standardized in two sizes).

(i) Key lock (E type) (155 mm x 95 mm x 65 mm) SA 3376/M.

(ii) Key lock (Miniature) E type (100 mm X 75 mm x 65 mm) SA 3473/M & SA 3474A to E/M See Fig : 11.1

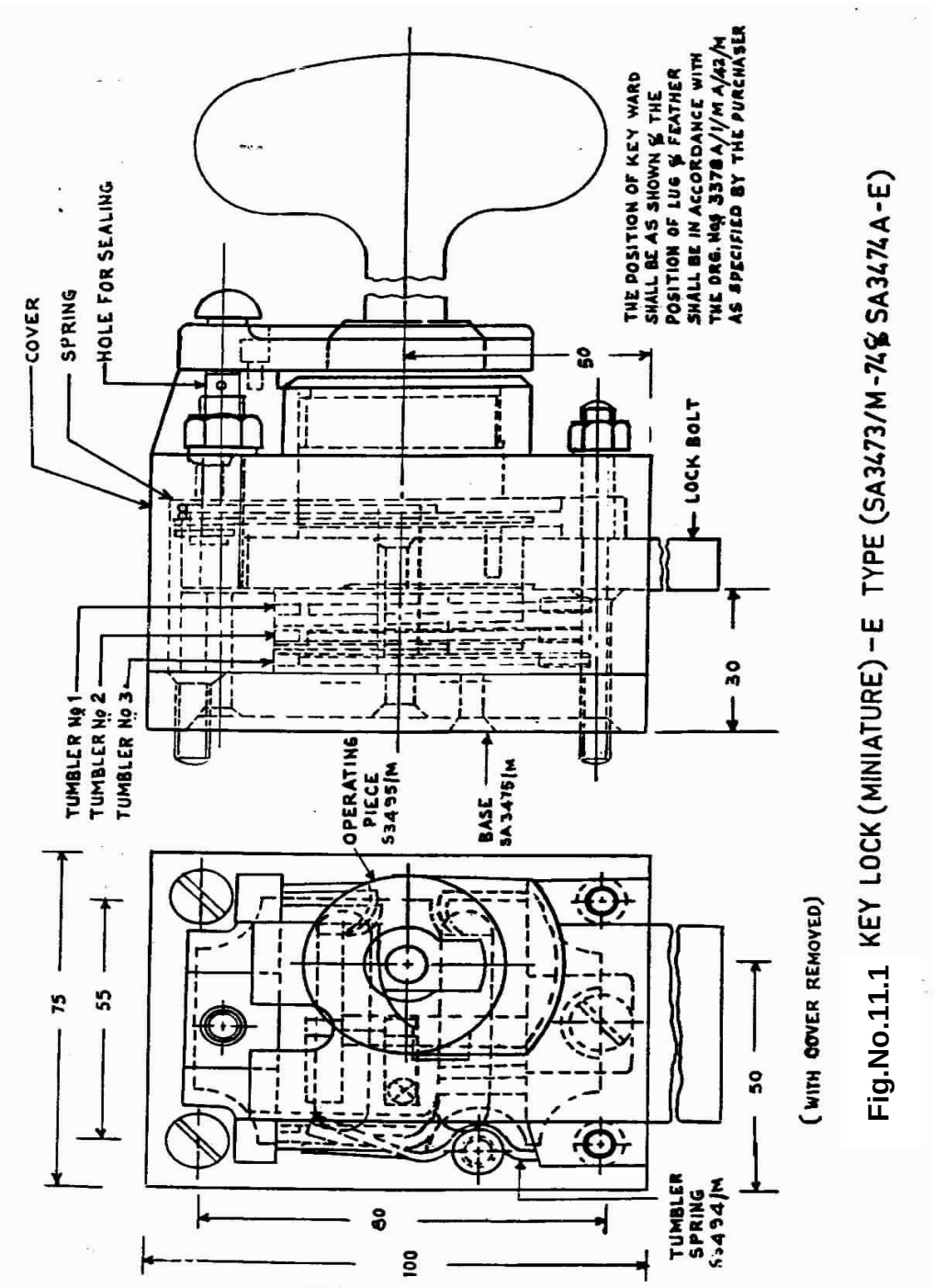


Fig.No.11.1 KEY LOCK (MINIATURE) - E TYPE (SA3473/M-74 & SA3474A-E)

11.2 A Key Lock E type consists of the following parts

Sl.no	Description	Drg. No. of Lock SA 3376	Drg. No. For Lock SA 3474	No required
1	Base	SA 3379	SA 3474	1
2	Cover	SA 3393	SA 3484	1
3	Lock Bolt	see table for different versions		
4	TumblerNo1	385	491	As req.
5	Tumbler No2	386	492	"
6	Tumbler No3	387	493	"
7	Tumbler spring	388	494	3
8	Operating Piece	390	495	1
9	Spring	392	496	1

11.3 Working

The key can only be taken out of the key lock when the lock bolt is out. Once the key is out, the slots on the three tumblers are out of alignment therefore the lock bolt cannot move because of its pin inside these slots. When the key is inserted in the lock and turned the ward combinations of the key bring the slots on the three tumblers in alignment with the pin thereby making it possible for the lock bolt to be free for movement.

Simultaneously the feather and lug combination of the key turn the operating piece and then the projection of the operating piece moving through the cam pushes the lock bolt in. Now the key can be taken out since the operating piece has come to its normal position and lock bolt cannot be moved as the tumblers will be displaced due to the springs provided.

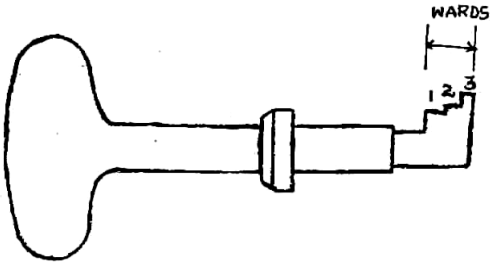
11.4 Uses

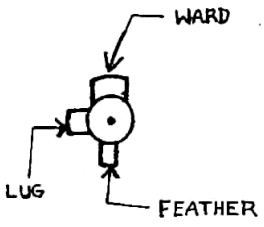
Key locks (E type) are used for various purposes i.e., Points in siding, Location boxes, Block instruments, siding Interlocking key. Key lock (E type) to Drg.No.SA 3576/M is used for key locking of points and ground locks. In these cases the key locks are directly fixed and no separate brackets are required Key locks miniatures E type are used for

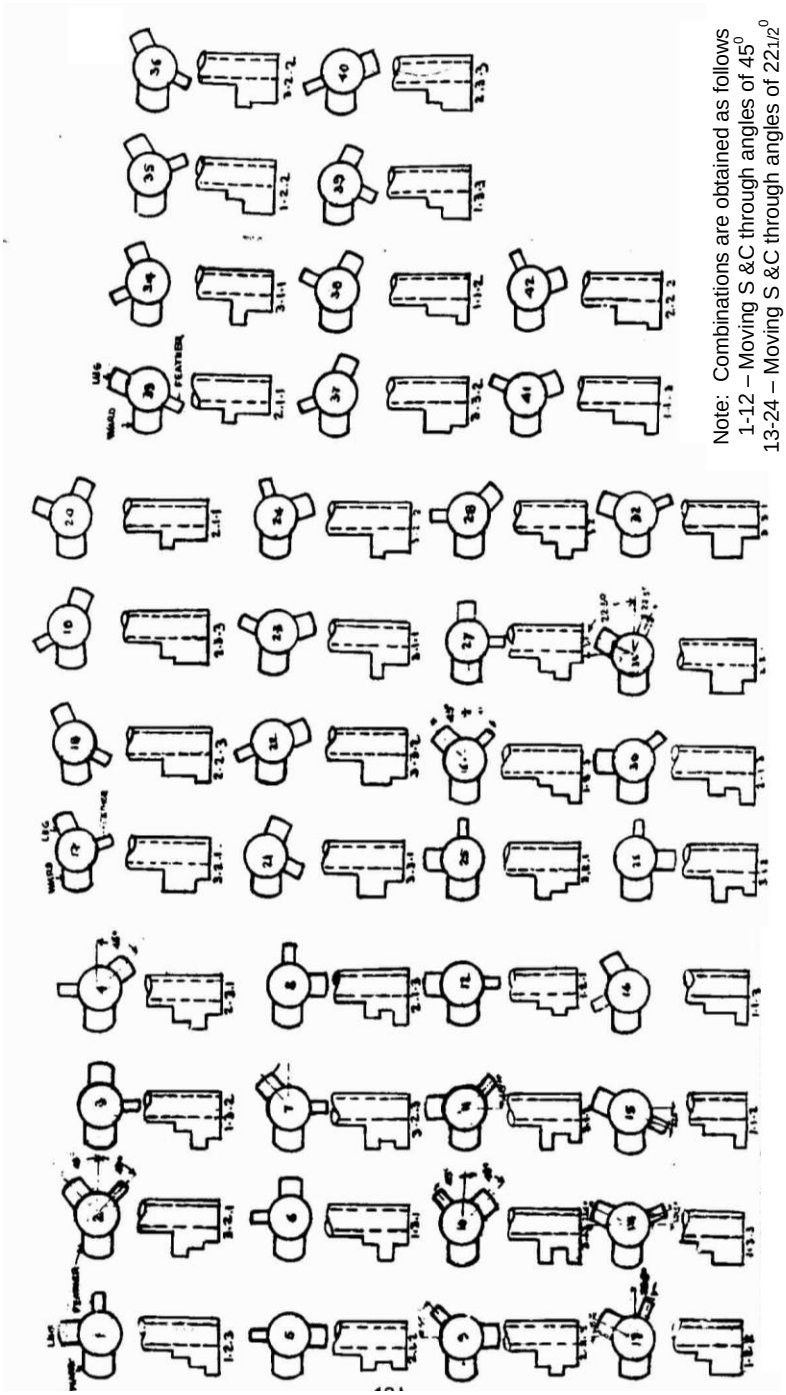
Sl.no	Description	Drg. No	Lock bolt Drg. No
1	Interlocking key box (Miniature)	SA 3464 A&D/M	SA 3497/M
2	Key Lock (Miniature) E type for lever single	SA 3345/M	SA 3497/M
3	Key Lock (Miniature) E type for lever double	SA 8225/M	SA 8229/M or SA 3497/M
4	Key Lock (Miniature) E type treble for gates	SA 3356/M	SA 3487/M or SA 3360/M
5	Key Lock (Miniature) E type double gates	SA 3355/M	SA 3487/M or SA 3380/M
6	Key Lock (Miniature) E type for signal post-single	SA 3650/M	SA 3487A & SA 3369/M
7	Key Lock (Miniature) E type for signal post-double	SA 3657/M	SA 3487A & SA 3367/M
8	Key lock (Miniature for interlocking frame mech. double wire)	SA 7510/M	SA 3487

11.5 Key lugs and key wards

Key wards and key lug combinations







Note: Combinations are obtained as follows
1-12 – Moving S &C through angles of 45^0
13-24 – Moving S &C through angles of $22\frac{1}{2}^0$

E – Type Lock Key combinations (s-3378A)

E – Type Lock Key combinations (s-3373A)

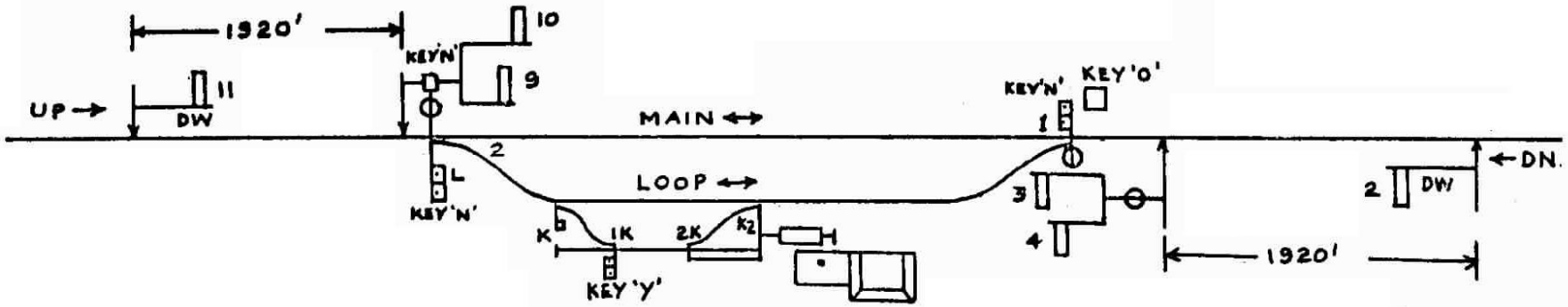
E – Type Lock Key combinations (s-3378A)

Fig.No.11.5

11.6 TYPICAL SIGNALLING LAYOUT STANDARD – 1 TWO LINE STATION (POINTS NORMALLY LOCKED)

SINGLE POST KEY LOCK TAKING
Key N - Up loop home signal (normally locked in H.P.double key lock at Points 2)

H.P.DOUBLE KEY LOCK TAKING
1. Key 'N' - Dn. Main Home Signal (Normally in the personal custody of SM when points are set & locked for main line) releases.
2. Key 'O' - Dn. Loop Home signal (Normally locked in the lock) when points are set & locked for loop line, it is released



H.P.DOUBLE KEY LOCK TAKING:
1. Key 'L' - Up Main Home Signal (Normally in the personal custody of SM when points are set and locked for main line) releases.
2. Key 'N' - Loop Home Signal (Normally locked in the lock) when points are set and locked for loop line.

H.P.SINGLE KEY LOCK TAKING
Key 'Y' siding points (normally locked in double key lock at points No.1-K)

DOUBLE KEY LOCK TAKING:
1. Key 'X' - SM's siding key (Normally) in personal custody of SM) releases..
2. Key 'Y' siding points (Normally locked in the lock)

12 LEVER FRAME - D.W.
DESCRIPTION OF LEVERS
6 Lever for 6 signals
(Nos.2,3,4,9,10 & 11)
1 Lever for SM's control No.6.
7 Working levers
1 spare lever (No.1)
4 spare spaces (Nos.5,7,8,12)
12 Total

SINGLE LEVER FRAME
STATION BUILDING
SINGLE POST KEY LOCK TAKING
Key 'O' - Dn. Loop Home Signal (Normally locked in HP double key lock at points (1I).

HP SINGLE KEY LOCK TAKING.
Key 'X' -.SM's siding key (Normally in the personal custody of SM).

11.7 Different versions of HP Locks

(a)Key lock facing points – (Drg. No. SA 3674 and 3675)

This type of lock is employed at stations interlocked to Standard I, modified non-interlocked or for control of siding points Key lock single is employed to lock the points in one position only whereas Key lock double is used for locking the points in either position. The only difference between key lock single and key lock double is that the former has one E type lock whereas the latter has two 'E' Type locks.

(b)Key lock facing point (hand-plunger type) single (Drg. No. SA-3148)

The standard key lock facing point HP type is made in accordance to DrgNoSA-3148. This is similar in constructional details to the 2 way lock which will be described later. The difference in this case is that instead of two key locks, only one key lock and one corresponding notch in the hand plunger is employed and therefore, the key can only be extracted when the point is locked in one particular position. See in Fig. no.11.7(a).

Uses: This type of key locking is used in siding points in Station Yards and in Intermediate sidings.

(c) Key lock facing points (Hand Plunger type) Double (SA 3149)

(i) A two way or double key lock is similar to 1-way lock in general arrangement except for the fact it allows for the extraction of one key when the point is set and locked in the normal position and the other key when the point is set and locked in the reverse position. In any other position, other than full normal or reverse position, the keys from a two way key lock cannot be extracted See Fig 11.7(b).

(ii) **Working:** For the extraction of the second key, the first key has to be inserted back into the 'E' type lock, and the key handle turned to release the plunger lock C The plunger lock is then unlocked and brought to about mid-stroke position, the point is next reversed and the plunger C is moved to lock the point in the reverse position. The second key handle can be turned since the notch on the plunger C now corresponds to the 'E' type lock bolt. The extraction of this key proves that the point has been set and locked in the reverse position.

(iii) Uses: Two way key locks are used to lock points where standard I interlocking is provided and also at some non-interlocked stations. When the points are properly set and locked the corresponding released key from the points is used in the following way.

- Taken by hand to the corresponding signal lever to release the signal lever, or
- Electrically transmitted for use in the signal lever lock or
- Taken to the signal post directly, to release the corresponding signal locks

(d) Key Lock, Facing Point (Hand Plunger type) Treble (SA 3150)

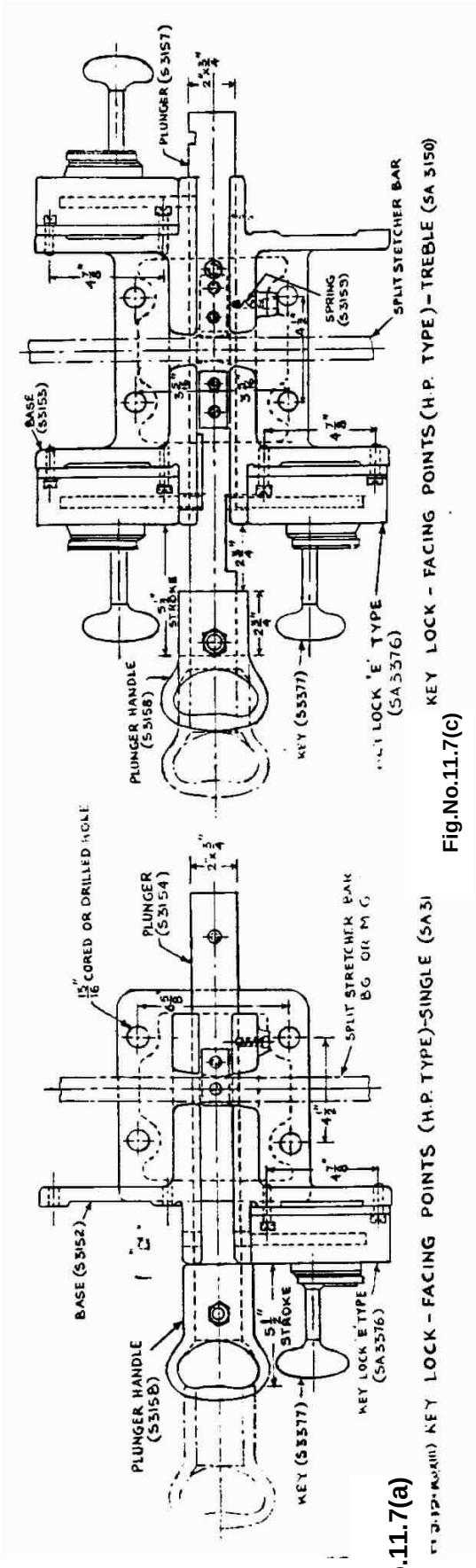
(i) When 2 way hand plunger key lock is employed the point is normally kept locked in the normal position and the key is sent to the points only when it is required to be reversed for the reception of a train or for shunting operation. The Station Master has to part with the signal control key even for a shunting operation in which case there is a possibility of the signal being taken off without the knowledge of the Station Master.

(ii) A better arrangement, therefore, is to have a Three Way Lock. In this the main casting of the base though similar to a Double Key Lock casting in all respects, is slightly different to it in regard to its overall dimensions and also in respect of the provision made in the casting for receiving two additional locks See Fig 11.7(c).

(e) Key lock facing points, quadruple (SA 3151)

HP Quadruple key lock taking four locks.. In this case too, the points are normally kept free. An additional advantage over the treble key lock arrangement is that two separate keys are released from the lock depending upon the point setting. In the previous case, as mentioned in Para: 11.7.(d), the person taking the control key was free to extract a common key applicable for either route. When a 4 way HP lock is installed on the facing points for reception of a train on the loop line, the Station Master sends the loop line release key. The points are first set in the reverse position and the lock plunger is next plunged, the points thus get locked. Then corresponding loop line key to release the signal can only be extracted. The signal key is taken either to the signal post or to signal lever to release the signal. The signal lever is next operated from the platform to lower the signal. See in Fig. no.11.7(d).

Earlier types of Hand Plunger Key locks suffered from one disadvantage. It was difficult to adjudge correctly whether the points had been unlocked as it could not be ascertained whether the bottom lock of the hand plunger had disengaged completely from the split stretcher notch. In the event of the bottom lock still being not fully withdrawn from the stretcher notch, the points could not be operated and thus often point failures were caused. To obviate this trouble the design was slightly modified and a spring loaded stud and a ball was provided in the key lock casting, a corresponding groove was also made in the plunger. When the plunger is moved to its mid-position to unlock the points, the groove comes opposite to the spring loaded stud and ball, and is held tightly in that position by the spring pressure and the point is kept free for operation. If, however, the points are required to be locked, an extra force has to be exerted to work the hand plunger against the spring pressure. This arrangement is available in all types of key locks FP HP type except single.



KEY LOCK - FACING POINTS (H.P. TYPE) - TREBLE (SA 3150)

Fig.No.11.7(c)

KEY LOCK - FACING POINTS (H.P. TYPE) - SINGLE (SA3

Fig.No.11.7(a)

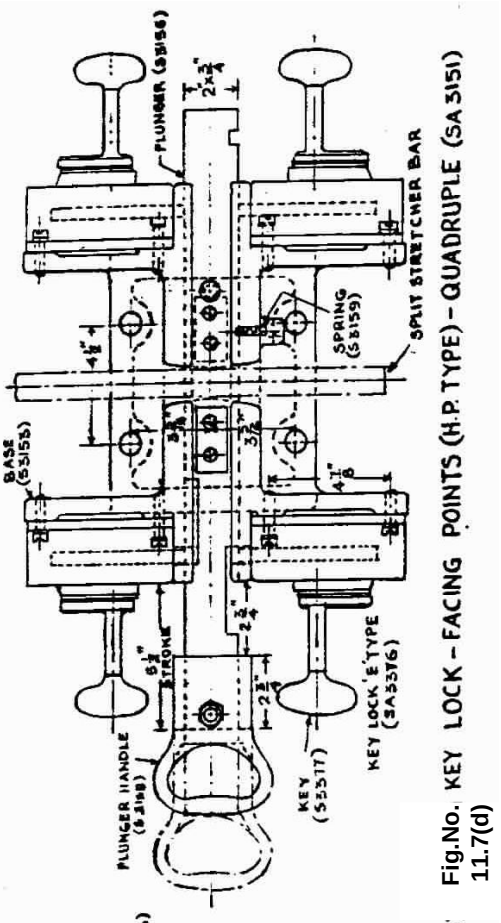


Fig.No.11.7(d) KEY LOCK - FACING POINTS (H.P. TYPE) - QUADRUPLE (SA 3151)

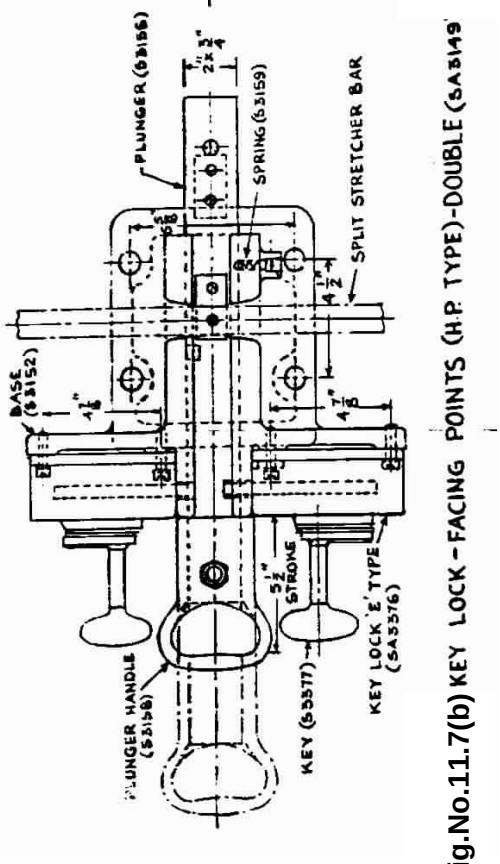


Fig.No.11.7(b) KEY LOCK - FACING POINTS (H.P. TYPE) - DOUBLE (SA3149

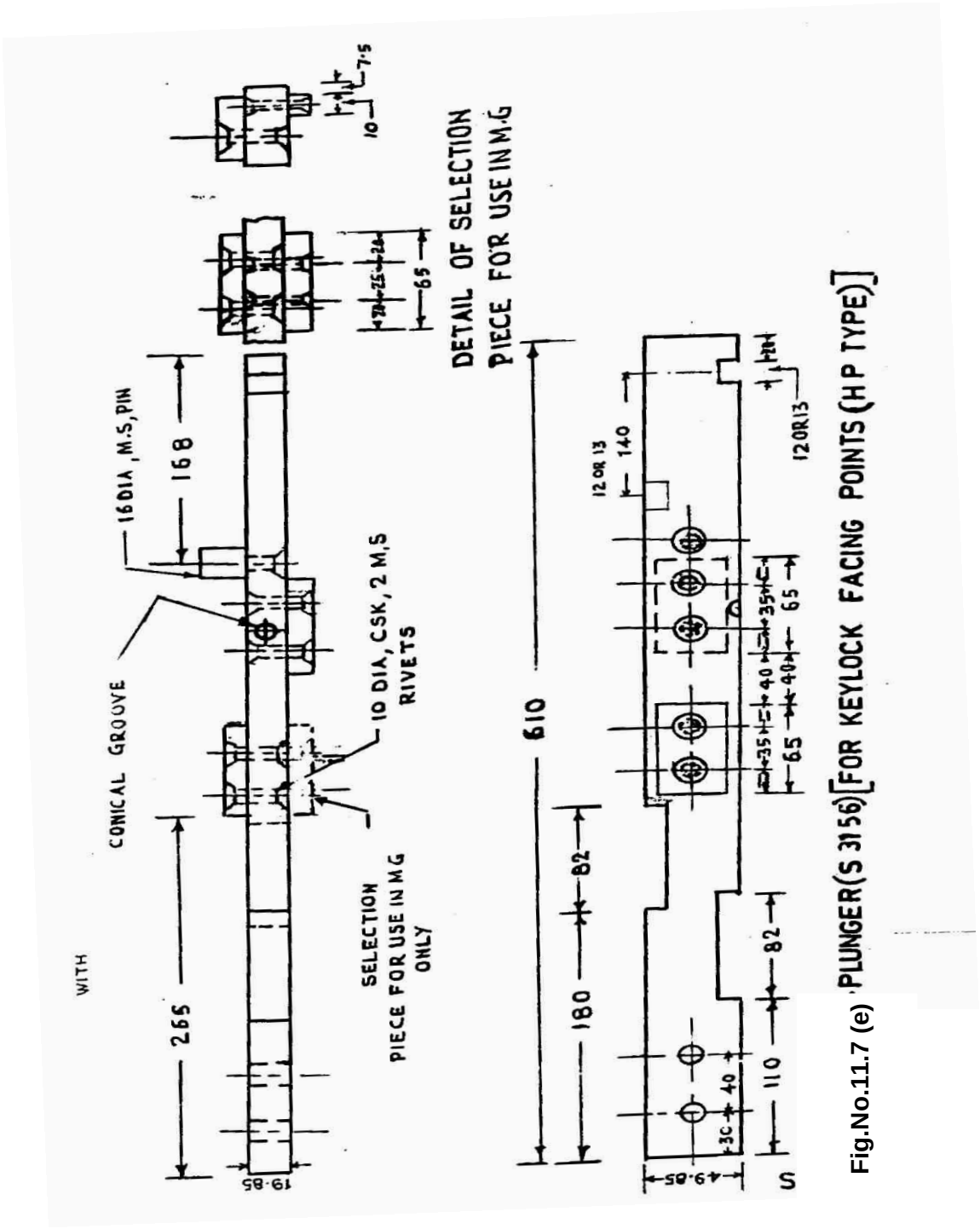


Fig.No.11.7 (e) 'PLUNGER(S 3156)[FOR KEYLOCK FACING POINTS (H P TYPE)]

f) Key lock facing point hand plunger type for meter gauge

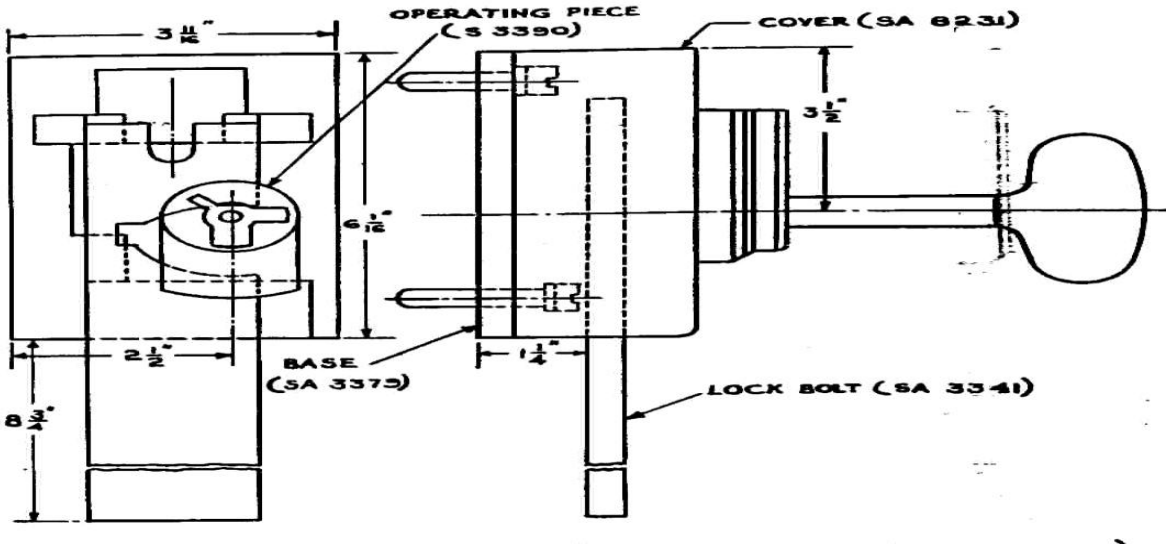
Normally key lock HP in broad gauge is fixed at 500 mm (20") from running face of the rail. Whereas in meter gauge it is fixed in the centre of the track in key locks facing points HP type double, treble and quadruple, there is a possibility of the split stretcher bars of left hand and right hand getting interchanged at the time of maintenance. This may cause a wrong key to be extracted. To prevent such an occurrence an additional mild steel strip known as selection piece is riveted to the plunger. This will need an additional notch on the stretchers for one of the position's of points Refer sketch S 3156/M.

(a) 'E' type lever locks are also installed on the above principles. Lock bolts of these locks are 220 mm (8 3/4") long.

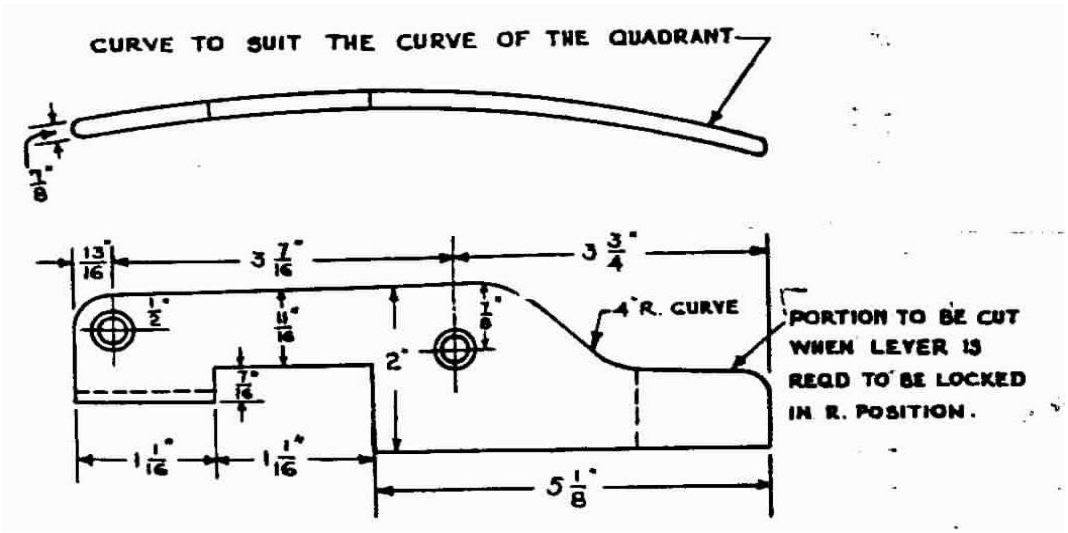
(b) Working: When the lever is controlled from another place, the key is either electrically transmitted or sent by hand to release the lever which has been kept locked in the normal position by the lever lock. The key is inserted into the lever lock and turned to unlock the lever. The lever may be now free provided other interlocking in the frame is not holding it. The key cannot, however, be extracted from the locks as long as the lever is away from its normal position.

(c) When the lever controls a lever situated at another place, the key is held in the lever lock in normal position and can only be extracted when the lever is reversed. The key is extracted after the lever has been reversed and transmitted either electrically or manually for the operation of the controlled lever. The controlling lever, however, cannot be put back to normal unless the control key is returned and the lever lock is operated to release the lever.

(d) It is not easy to make out a master key for these locks. The reason for this is that it has three different ward combinations which can be arranged in twenty four different ways, and accordingly, the lever locks are arranged to suit these twenty four different key ward combinations. Apart from these there are twenty four different lug and feather combinations. An inter-combination of lug and feather and ward gives many more new combinations.



LEVER LOCKS 'E' TYPE (WITH LONG LOCK BOLT) (SA 3345)
Fig: 11.7. (f)



BACK STOP FOR LEVER LOCKS
Fig: 11.7. (g)

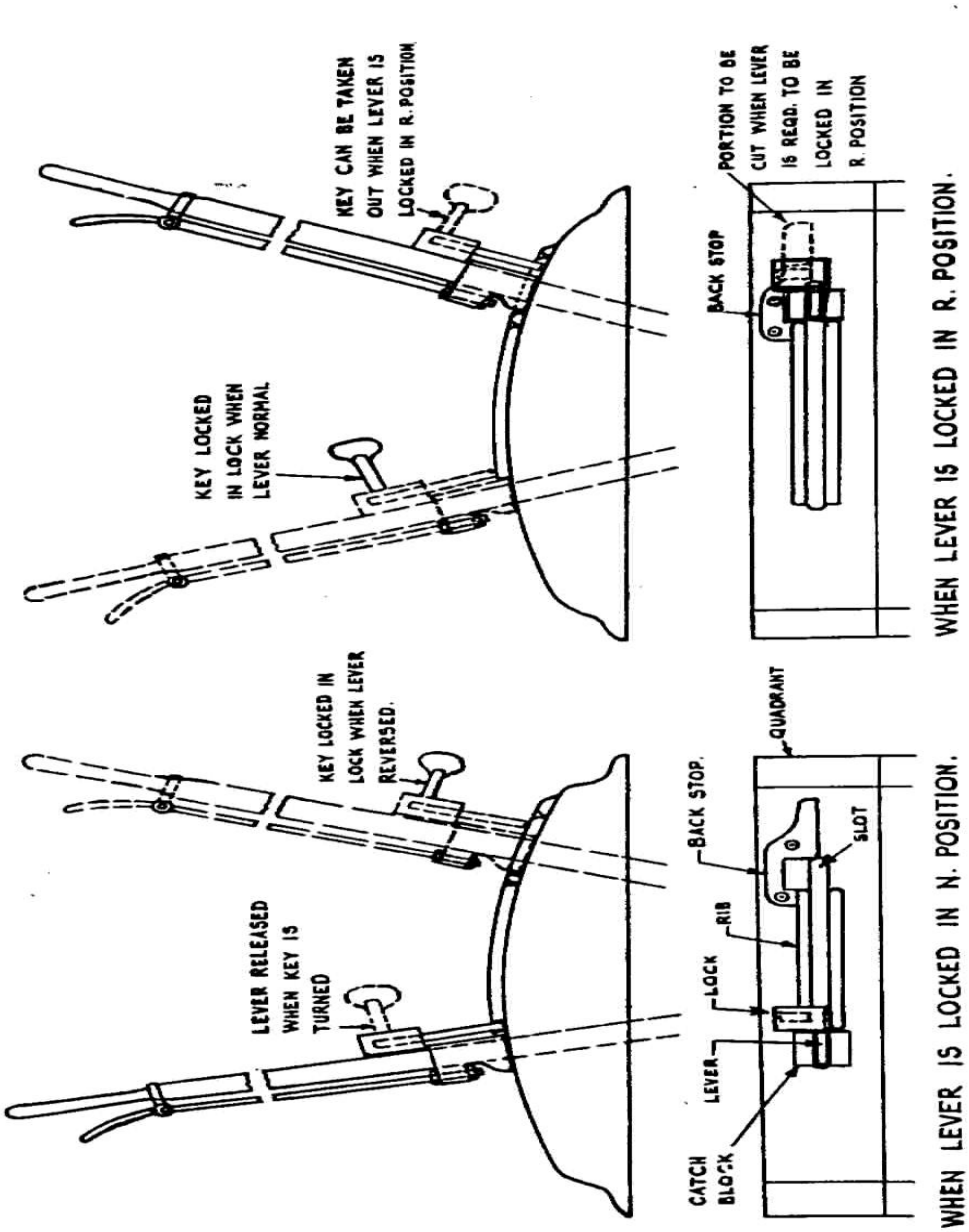


Fig.No.11.7 (h) -BACK STOP FOR LEVER LOCKS.

ANNEXURE

Annexure-A

CABINS FOR LEVER FRAMES

Procedure and choice of site and design of cabins: Cabin diagrams, lever badges, cabin equipments, etc

(a)Procedure

The following procedure is generally followed for fixing the cabin site on Indian Railways

First of all an engineering plan for the proposed layout is prepared and got approved by the Heads of Departments. The type of signalling and method of working points and signals is also decided in advance at the headquarters level. Copies of the approved engineering plan are sent to DSTE to enable him to choose the best site for cabin. DSTE will decide the site of cabin jointly with DEN and DSO. A cabin site plan is then proposed and after getting the signature of the divisional officers, copies of the site plan are sent to headquarters office for further action and record. On receipt of the cabin site plan from the division, the headquarters office will proceed with the preparation of the signalling plan.

(b) Normally every railway has got its own 'type plans' for cabin structure issued by CSTE. These type plans give the salient features of each type of cabin. Copies of these type plans are available in the Divisional Office. On receipt of the approved signalling plan from the headquarters, DSTE will place a work order on the DEN for the construction of the cabin. DEN will then prepare the detailed drawings for the construction of the cabin based on the type plan of CSTE and get it approved by DSTE. The work of cabin construction is then undertaken by engineering department .

(c) CHOICE OF SITE

The choice for the cabin site is based on the following considerations

(i) The cabin man should have a clear view of all points and signals etc, worked from the cabin unless track circuiting or other means are provided.

(ii) All units required to be operated from the cabin must be within the working range of the levers provided in the cabin e.g.,

- Rod worked single ended points operated by levers with 150 mm (6") stroke should be situated within 320 M (350 yards) from the cabin the distance being reckoned along the length of the transmission. In the case of double ended points on running line and points which are worked and locked by the same lever, the distance for operation should not exceed 180 M (200 yards) when the stroke at lever tail is 150 mm. However, these ranges of operation increase to 460 M (500 yards) and 275 M (300 yards) respectively when levers with 200 mm (8") stroke are used. However no new installation shall be commissioned with points mechanically operated and locked by the same lever.

- The distance up to which points may be operated by D/W lever with 500 mm (20") stroke drum is 500 Mts. (550 yards) for points and locks and 1200 M (1300 yards) for signals without detectors and up to 600 M (650 yards) for a single or coupled detector lever transmission.

- The range of operation can, however, be increased with the use of levers with greater stroke and also by improving the alignment of transmission.

- When the points are worked by power and the occupation of the track is electrically indicated in the lever frame of cabin, there is no limit to the distance up to which they can be operated e.g., operations of points in CTC areas.

It should provide sufficient room for the installation of a neat Lead out and should ensure as for as possible a straight alignment for transmissions with minimum diversions.

(iii) The cabin should be sited sufficiently clear from sand hump, dead ends, derail switches etc, so that derailment may not cause damage to the cabin buildings or the Lead outs.

(iv) The cabin should be built clear of all infringements as prescribed in the schedule of dimensions. For BG cabin buildings on platforms must not be less than 5340 mm (17'-6") from the centre line of the nearest track. But the recommended dimension is 5490 mm (18'-8") from the face of platform coping.

Cabins in station Yard must not be less than 2135 mm (7'0") from the centre line of the nearest track (BG) However; it is desirable that the cabin should not be less than 2360 mm (7'9") from the centre line of the nearest track (BG). The cabin for this purpose includes any projection from it if it is not above the minimum height as prescribed in the schedule of dimensions.

(v) The site for the cabin should be so chosen that there should not be any possibility of rain water collecting and stagnating inside the cabin.

(vi) It should not necessitate cutting down a large number of trees, particularly those on the platforms providing shade to passengers.

(vii) For control of cabin operations the location of a central cabin should preferably be in close proximity to station Master's office.

The approved site of a cabin should not cause an obstruction to any future development some consideration in this regard to cater for a few of the items concerning future developments commonly undertaken on the Indian Railways are discussed below.

In general the cabin on station side should be located at least 10,060 mm (33') away from the main line to cater for an additional loop on the cabin side of the main line. If the cabin is opposite SM’s office, then it should not be less than 15,240 mm (50’-0”) from the main line to cater for the future addition of the lines. The above dimensions should be increased whenever possible to comply with the recommended dimensions.

It should also provide for easy verification of the last vehicle.

Cabins at the ends of the stations should be so cited as to allow for future lengthening of loops to 686 Mts. (2250'). When such extensions to loops are done the farthest point should not be more than 730 Mts. (800 yards) from the DW Cabin generally.

The Lead Out of rodding run should be so arranged that it would not be necessary to shift the main run of rodding when loops are extended or yard is remodeled at a later date.

In addition the following points should be borne in mind while selecting the site and deciding on the number of cabins.

- Cabin site should be such as not to obstruct the view of Home and Last stop signal to the SM.

- Where end cabins are provided it is preferable to place them one on either side of the track. When this is not possible, both cabins should be located opposite SM's office. This will help in inspecting both the sides of a run through train. Single cabins placed centrally should be, therefore, placed in opposite position to that of SM's office.

- Where there are level crossings situated close to the points by providing the cabins near the gate, it would be possible to dispense with the gateman.

- In case of large stations separate cabins enabling good view of all the yard tracks and points should be provided. Where necessary separate cabins or ground frames should be provided for working points and signals of marshalling line.

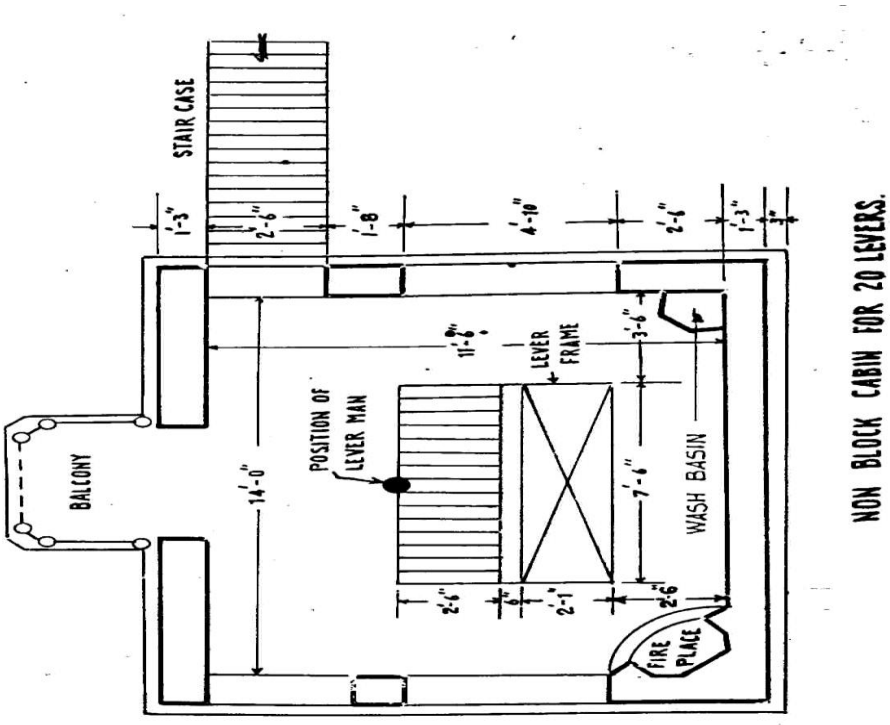
- It should not involve shifting of HT cables or alignment of P & T wires as far as possible.

- It should not involve a large amount of earthwork e.g., filling up low lying area or widening of cutting etc, as this will increase cost of cabins.

(d) (i) The cabin should be sufficiently commodious to allow the lever man to have free access, where necessary to windows. Additional balcony may be provided where necessary to improve visibility. The point levers and signal levers should be so placed in the cabin that the signal man while working them may have a thoroughly good view of the yard and the cabin itself should be situated elevated and constructed to serve this purpose. The interlocking frame should be parallel to the track, along the length of the cabin and the lever man should have his back towards the track while pulling levers. This arrangement often gives the lever man a much better view. The height of the cabin depends upon its location. The height to the floor level for all central cabins is round about 5200 mm (17') ARL. In case sighting over a foot over bridge is required then the height should be increased so that floor level is not more than 914 mm (3') below the top of the over bridge. Cabins at the ends of stations should be about 3362 mm(11'0') ARL high except in large yards, where heavy goods shunting is involved for better visibility of points the height may be increased to about 4267 mm (14')ARL. All heights should preferably be increased in steps of 914 mm (3').

(ii) Where bigger size cabins are required, the future extension should be assessed and the cabin as well as the frame should be built and obtained to cater for future. The size of cabin is arrived at by first calculating the number of levers required to work the gear and then adding 12 to 15% of working levers extra as spares and 10 levers for future extension. For block cabin an extra length of 2135 mm (7'-0") may be required at the end away from the staircase. The sketches given show the general arrangement of interlocking frame, staircase,

door and windows of a block and a non block cabin. The question of standardizing the cabin building on Indian Railways is not yet finalized, and therefore, the sketches given in this respect relate to those used in one of the Railways (See below figures).



(iii) Along the front of the cabin near the ground, an opening must be left to enable the rods and wires to be let out, this opening should extend practically the whole length of the lever frame and should commence about 250 mm (10") below the rail of the adjacent track and extend to above rail level. To support the wall of the cabin at this opening, a steel joint lintel built into the cabin and may be supported at interval with cast iron support if the span happens to be too long. The supporters must be such that they do not obstruct a rodding run being taken out of the cabin. Extra opening not required should be blocked up. Necessary doors and windows must be provided in the ground floor to give as much of light as possible for examination of connections and interlocking apparatus.

(iv) Arrangements are also made for supporting the interlocking frame. In the case of orthodox single wire cabins, RS Joists or channel irons are placed, parallel to the length of the cabin. The ends of the joists or channels are supported either on bed stone or CC Block previously embedded in the two side walls of the cabin. The exact position of these joists or channel irons with respect to the cabin floor and walls of the cabin depend on the type of interlocking frame used. Some railways like the interlocking frame to be placed as close to the wall as possible so that more moving space is available in the cabin for the cabin staff. This arrangement may not be convenient from the maintenance point of view since there will not be much space left between the cabin wall and the leading down rods and vertical wire runs. This may cause inconvenience to staff while working on inside lead out. Some prefer to install interlocking frames more towards the centre of the cabin with a view to keep reasonably sufficient room for the maintenance staff to work and at the same time without causing much inconvenience to the cabin staff.

(e)CABIN DIAGRAMS, NUMBER PLATE, LEVER COLLARS AND CABIN EQUIPMENTS

(i) **Cabin diagram** is a diagram of the Yard showing in it the normal positions of all the points and signals controlled by the cabin. This diagram is made out from the interlocking plan and is generally drawn out in bold black lines and printed against a white background so that it can be easily seen from a reasonable distance. The signals and points are shown in their normal position; the various controls on signals are also mentioned. The positions of points and signals are marked out in the diagram with their relevant lever numbers. The diagram is generally framed in a glass fronted frame and is mounted at a suitable height easily seen by the concerned staff.

(ii) **Number plate:** Each lever in an interlocking frame is given a number. The numbering is done in serial order, the lever on the extreme left being given the number one (1) these numbers are painted on plates which are fixed on to their respective levers. Each number plate apart from exhibiting the lever number also shows its function and the number of other levers, in the order of operation must proceeds to release it. Sometimes those releases numbers are painted separately on board fixed above the lever frame which extends from one end to the other.

(iii) **Lever Collars:** A lever collar is a device which, when applied, is a reminder that a lever in an interlocking frame must not be operated. The lever collar when applied prevents the unlatching of the lever catch block when inadvertently the catch handle is pressed. The designs of the lever collars have been standardised as per DrgNoS972 and S973A . Lever collar manufactured to DrgNoS-972 is meant for use on standard ground frame levers, D/W Clutch and Direct levers, Rack and Pinion levers and standard catch handle locking levers. Lever collars manufactured to DrgNoS973 are only used with Direct Lever locking type levers manufactured to Drg.No.SA 530. In description over the lever collar has been changed from "Stop and Think" to "Line Blocked".

(iv) **Cabin Equipment:** All cabins must be equipped with

- A cabin diagram showing the location and normal position of all points, facing point locks signals and level crossings with their respective cabin lever numbers.
- A lever pull chart preferably in a glazed frame where ever the concerned release levers are not indicated on lever number plate. This lever pull chart needed not be given where the numbers of lever required to be pulled earlier is painted on the number plate.
- an instruction chart for the cabin in the regional languages.
- a clock where timing of trains or working of signals have to be recorded.
- Lever collars, point clamps, fog signals and a wash basin where necessary.
- Light as necessary so arranged as not to be mistaken for or interfere with the sighting of the running signals.

- Name plates when located beyond the station platforms. When located on the station platform name plates may be fixed to the front wall of the cabin. They may consist of the station name and the cabin letter or number for the former case.

- Suitable staging with ladder if necessary for attending to the interlocking frames, coupling devices, etc., It may be made of angle iron, old tie bars and 2" X 10" planks (50 X 250 mm).

- Suitable covered ways may be provided over the transmission on the cabin basement to enable the Maintainer to move freely from one side to the other and also attend the inside lead out without any hindrance.

- In some Railways, it is the practice that the initial equipment of the cabin such as tables, chairs, stools, racks for registers, etc., are supplied by the Signal Department, furnishers are supplied to polish the lever handles, brass bells are sometimes provided to announce trains to the Yard Shunting Staff whenever line clear is granted or train entering section signal is received etc., The brass bell also helps in drawing the attention of gateman to close or open the gates. The brackets for fixing the kerosene lit lamps at cabins are also provided by the signal department.

- Telephone as necessary.

Annexure - B

Main parts of the direct locking type interlocking frame (SA 530).		
Sl. No	**Name of the part**	**Drawing No.**
1	Lever	S 548/M
2	Catch Handle	SA 550C/M
3	Catch Handle Rod	S 551/M
4	Number plate	S 553/A or B/M
5	Catch Handle Box	S 552 /M
6	Quadrant Support T Bar	S 532/M
7	Quadrant Left Hand	S 534/M
8	Quadrant Right Hand	S 535/M
9	Quadrant Intermediate	S 536/M
10	Standard	S 531/M
11	Bracket for 1 channel locking box	S 541/M
12	Bracket for 4 channel locking box	S 540/M
13	Front Tail (point Lever)	S 546/M
14	Front Tail (Signal Lever)	S 545/M
15	Back Tail	S 547/M
16	Lever shoe	S 544/M
17	Shoe Cover	S 542/M
18	Bearing Cap	S 543/M
19	Shaft Cap	S 537/M
20	Shaft Collar	S 538/M
21	Shaft	S 539/M
22	Locking Plunger	S 566/A
23	Locking box 4 channel 5 levers	SA 571/M
24	Locking box 4 channel 7 levers	SA 572/M
25	Locking box 1 channel 5 levers	SA 553/M
26	Locking box 1channel 7 levers	SA 556/M
27	Back weight	S 582
28	Locks	S 660A to 671G
29	Interlocking bar (16mm X 12 mm)	---
30	Right end	S 576
31	Left end	---

Annexure - C

Main parts of the catch handle interlocking frame (SA 1101).		
Sl. No.	**Name of the part**	**Drawing No.**
1	Number plate	S 553 A/M or 553 B/M
2	Catch handle pin	S 967/M
3	Catch handle stop	S 968
4	Catch Handle	S 969
5	Catch Handle Knuckle	S 970
6	Standard	S 1106
7	Quadrant L.H	S 1107
8	Quadrant RH	S 1108
9	Quadrant Intermediate	S 1109
10	Quadrant support	S 1111
11	Bearing Cap	S 1112
12	End Shaft Cap	S 1113
13	Plunger Guide	S 1114
14	Shaft	S 1115
15	Lever Shoe Cover	S 1116
16	Lever Shoe R.H.	S 1117
17	Lever Shoe L .H	S 1118
18	Lever shoe Intermediate	S 1119
19	Lever	S 1120
20	Catch handle rod	S 1121
21	Catch rod lug	S 1122
22	Link pin	S 1124
23	Link pin	S 1125
24	Catch handle spring	S 1126
25	Catch handle BOX	S 1127
26	Link – A	S 1128
27	Link - B	S 1129
28	Locking Box 6 channel	S 1130 A & B
29	Locking Box 8 channel	S 1131 A & B
30	Locking Box10channel	S 1132 A & B
31	Locks	S 1150
32	Interlocking bar 16 x 12mm	---
33	Extension arrangement	SA 1104

ANNEXURE - D

Ground Frames: SA 921 to 926. Main parts of the Ground Frames								
Sl. No.	**Description**	**Drawing No.**	**SA921A**	**921B**	**923**	**924**	**925**	**926**
1	Number plate	S 553A/M	6	2	3	4	5	-
2	Standard	S 927/M	2	2	2	2	2	-
3	Tie rod	S 92B or 929A or 929J	-	-	-	-	-	-
4	Tie rod S929B	S 929B or 929E or 928N or 928G	-	-	-	-	-	-
5	Tie rod S929C	S 929C or 28C	-	-	-	2	-	-
6	Tie rod S929J	S 929J or 928D	2	-	2	-	-	-
7	Tie rod S928F	S 928F	-	-	-	-	-	-
8	Tie rod S929F	S 929F	-	-	-	-	-	1
9	Shaft S931A/M	S 931A/M	-	-	-	-	-	1
10	Shaft S931A/M	S 931A/M	-	-	-	1	-	-
11	Shaft S931C/M	S 931C/M	-	-	-	-	-	-
12	Shaft S931D/M	S 931D/M	1	-	-	-	-	-
13	Shaft S931F/M	S 931F/M	-	-	-	-	-	-
14	Quadrant Support	S 932A/M	-	-	-	-	-	2
15	‘ ‘	S 932A/M	-	-	-	-	2	-
16	‘ ‘	S 932A/M	-	-	-	2	-	-
17	‘ ‘	S 932A/M	2	-	2	-	-	-
18	‘ ‘	S 932A/M	5	2	-		-	-
19	‘ ‘	S 932A/M	1	5	-	2	3	4
20	‘ ‘LH S935/M	S 932A/M	1	1	1	1	1	1
21	RH S935/M		2	1	1	1	1	1
22	RH	S 932A/M	4	2	2	2	2	2
23	Lever Shoe		6	4	1	5	2	3
24	Lever Shoe Intermediate	S 937/M	6	6	2	3	4	5
25	Catch Box Pin	S 938	6	6	2	3	4	5
26	Plunger pin	S 939/M	6	2	3	4	5	-
27	Lever	S 9400/M	6	6	2	3	4	5
28	Catch Rod	S 941/M	6	6	2	3	4	5
29	Catch Box	S 942/M	-	-	-	3	-	1
30	Locking Box 4 Channels	SA 943/A	-	-	-	-	1	-
31			1	1	-	-	-	-
32	Locking Box 2 channels	SA 949A/M	-	-	1	-	-	-
33			-	1	1	-	1	-
34	Key lock extension	SA 971 or	-	-	-	-	-	1
35	-Do-	SA 954 or	-	--	-	1	-	-
36	-Do-	SA 955	-	-	1	8	10	-
37	Catch Handle pin	SA 967/M	-	4	6	3	4	5
38	Catch Handle stop	S 968M	6	6	2	4	5	-
39	Catch Handle	S 969/M	6	2	3	4	5	-
40	Catch Handle knuckle	S 970/M	6	2	3	2	2	2
41	Shaft Cap S		2	2	2	2	2	2
42	Tube MS 25mm bore grade light IS 1239)		2 Nos.	2 Nos.	2 Nos.	2 Nos.		

Annexure - E

ROD JOINTS

Type of Joints			
Sl.no	**Drawing No.**	**JOINT NAME**	**Type / Size**
1	S 2164	Eye Joint 20 mm (3/4") rod,	24 mm hole
2	SA 2417	Eye Joint 20 mm (3/4") rod,	20 mm hole
3	SA 60650/M	Eye Joint 33 mm (1 1/4") rod,	24 mm hole
4	SA 6051/M	Joint Flush 33 mm (1 1/4") **** This type solid joints are most commonly used***	Butt end
5	SA 6053/M	Joint Flush 33 mm (1 1/4")	Coupling End
6	SA 3616/M	Joint Long 33 mm (1 1/4")	Butt End
7	SA 3627/M	Joint Long 33 mm (1 1/4")	Coupling End
8	SA 2162/M	Joint Screw 20 mm (3/4")	Butt End
9	SA 3622/M	Joint Screw 33 mm (1 1/4")	Butt End
10	SA 3623/M	Joint Screw 33 mm (1 1/4")	Coupling End
11	SA 2160	Joint Screw Solid 20 mm (3/4")	Butt end
12	SA 6050/M	Joint Screw Solid 33 mm (1 1/4")	Butt end
13	SA 6052/M	Joint Screw Solid 33 mm (1 1/4")	Coupling End
14	SA 3619/M	Joint Screw Wide 33 mm (1 1/4")	Butt end
15	SA 3620/M	Joint Screw Wide 33 mm (1 1/4")	Coupling End
16	SA 3628/M	Point adjusting screw	Butt End
17	SA 3629/M	Point Adjusting Screw	Coupling End
18	SA 3631/M	Lug Eye	Butt End
19	SA 3631/a/m	Lug Eye	Coupling End
20	SA 3608 A/M	Swan neck	Coupling End
21	SA 3613/M	Goose neck	Coupling End
22	S 3633 A/M	Point rod coupling end for Flash Butt welding	
23	S 3633/M	Point rod coupling end for Smithy Welding	

ANNEXURE - F

DETAILS OF UNIT DETECTOR 3 SLIDES LAYOUT SA 5791/M TO 5796/M							
Part No.	**Description**	**5791**	**5792**	**5793**	**5794**	**5795**	**5796**
SA 5797/M	Unit Detector (3 slides)	1	2	3	4	5	6
SA 3121/M	Lock Detector Slide (Camp)	1	1	-	-	-	-
SA 3122/M	-do-			1	1	-	-
SA 3123	-do-	-	-	-	-	1	1
SA 5813B/M	Point Slide Joint(1 way or 2 way)		2	-	-	-	-
SA 5813B/M	-do-	-	-	2	2	-	-
SA 5813C/M	Point Slide Joint (5way or 6 way)		-	-	-	2	2
SA 5817/M	shoe Joint (Butt End)	1	1	-	-	-	-
SA 5817B/M	-do-	-	-	1	1	-	-
SA 5817C	-do-	-	-	-	-	1	1
SA 5818/M	Angle Slide (1 or 2 way)	1	1	-	-	-	-
SA 5819/M	-do- (3 way or 4 way)	-	-	1	1	-	-
SA 5820/M	Angle Slide (5 or 6 way)	-	-	-	-	1	1
SA5821A/M	Shoe Joint Coupling End		1	1	2	-	-
SA 5821B/M	-do-	-	-	1		-	-
	Bolt M.S.Hexa. Head M						
	20X40 with Hexa nuts	4	4	8	8	12	12
	Bolt M.S.Hexa.Head M						
	20X65 with Hexa. nut	2	4	6	8	10	12
	Spring washer M 20B	4	6	8	10	12	

ANNEXURE - G

VARIOUS TYPES OF LENSES & ROUNDELS USED IN RAILWAY SIGNALLING		
Sl.no.	**Size & Other particulars**	**Uses**
1	213 mm dia., 100 mm Focus Inner stepped clean lens	Used in MACLS Unit as outer lens
2	140 dia., 13mm Focus Outer stepped coloured lens (Yellow, Red & Green)	Used in MACLS Unit as inner lens
3	213 mm dia., 100 mm Focus inner stepped spread light (with 8^0 , 16^0 & 32^0 spread) clear lens	Used with MACLS Unit as Outer lens in case of curved track
4	101 mm dia., 89 mm Focus inner stepped Lunar white lens	Used in position light shunt signals
5	5-3/8" dia., 3 ½ Focus inner stepped Lunar white lens	Used in Junction Route Indicators
6	245 mm dia. Roundel Convex – Red	Used in 'B' Type spectacle in LQ Sig.
7	245 mm dia. Roundel Convex – Green	Used in 'A' Type & 'B' Type spectacles in LQ Sig.
8	213 mm dia. Roundel convex – Red, Yellow & Green	Used in 'A' Type Spectacle in LQ Sig. (Red only) (ii) Used in UQ Spectacle (For all three aspect)
9	90 mm (3 ½ ") dia. Roundel Convex Red, Yellow &Green	Used in mechanical shunt signals
10	136 mm (5-3/8 ") dia. 89 mm Focal length inner stepped clear lens	Used in K-Oil lamps of Sema-phore signals
11	136 mm (5- 3/8") dia. 89 mm (3 ½ ") Focal length spread light, clear inner stepped lense (with 8^0 & 10^0 spread)	Used in K-Oil lamps of Sema phore signals in case of curvatures
12	5" (127 mm) dia. 89 mm Focus inner stepped clear lens	Used in K-Oil lamps of Semaphore signals
13	5" (127 mm) dia. 89 mm (3 ½ ") Focus inner stepped spread light clear lens (with 8^0 & 10^0 spread)	Used in K-Oil lamps of Semaphore signals in case of curvatures
14	100 mm dia. Inner stepped lens-Red & Green	Used in trap indicators
15	100 mm dia. Inner stepped lens – White & Green	Used in Point indicators

S. No.	DESCRIPTION	SIGNAL FITTINGS												
		'A' TYPE						'B' TYPE						
		Tubular SA2000/M IRS Drg. No.	Qty.	Lattice SA1231-1236M IRS Drg. No.	Qty.	3doll bracket SA5538/A/M IRS Drg. No.	Qty.	Tubular SA2005/M IRS Drg. No.	Qty.	Lattice SA241-46/M IRS Drg. No.	Qty.	3doll bracket SA5578/B/M IRS Drg. No.	Qty.	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1.	Signal post	S2190/M	1	SA1251	1	-	-	S2190/M	1	SA1251/M A or B	1	-	-	-
2.	Base 168mm dia	S2012/M	1	-	-	-	-	S2012/M	1	-	-	-	-	-
3.	Pinnacle	S2019/M	1	S1262/M	1	S2019/M	3	S2019/M	1	S2162/M	1	S2019/M	3	-
4.	Ladder	SA2024/M	1	SA2238/M	1	SA5594 A & B	1set	SA2024/M	1	SA2358/M	1	SA5594 A & B	1	-
5.	Ladder Foundation	S2033/M	1	S2033/M	1	S2033/M	1	S2033/M	1	S2033/M	1	S2033/M	1	-
6.	Doll Signal 3.6 M	-	-	-	-	SA5543/M	1	-	-	-	-	SA5543/M	1	-
7.	Doll Signal 2.6M	-	-	-	-	SA5542/M	2	-	-	-	-	SA5544/M	1	-
8.	Hook Bolt	-	-	-	-	SA5550/M	4	-	-	-	-	SA5550/M	4	-
9.	Purlin	-	-	-	-	SA5569/M	8	-	-	-	-	SA5569/M	8	-
10.	Angle Stay	-	-	-	-	SA5571/M	4	-	-	-	-	S5571/M	4	-
11.	Hand Rails	-	-	-	-	SA5575/M	1set	-	-	-	-	SA5575/M	1set	-
12.	Stay	-	-	-	-	S5584/A	1set	-	-	-	-	S5584/A	1set	-
13.	Stay	-	-	-	-	S5585/A	1set	-	-	-	-	S5585/A	1set	-

ANNEXURE-H.2

(1) (2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
14. Girder	-	-	-	-	S5540/M	1	-	-	-	-	S5540/M	1	-
15. Channel Post	-	-	-	-	S5541/M	1	-	-	-	-	S5541/M	1	-
16. Flange A	-	-	-	-	S5546/M	1	-	-	-	-	S5546/M	1	-
17. Flange B	-	-	-	-	S5547/M	1	-	-	-	-	S5547/M	1	-
18. Semaphore Spectacle	SA2070/M	1	SA2070/M	1	SA2070/M	3	SA2085/M	1	SA2085/M	1	SA2085/M	3	-
19. Semaphore Bracket	SA2073/M	1	SA1236/M	1	SA2073/M	3	-	-	SA1283/M	1	-	-	-
20. Semaphore Bearing	-	-	-	-	-	-	SA2089/M	1	-	-	SA2089/M	3	-
21. Back Light Screen	SA2077/M	1	SA2077/M	1	SA2077/M	3	SA2090/M	1	SA2090/M	1	SA2090/M	3	-
22. Signal Arm	S2694/M	1	SA2694/M	1	S2694/M	3	S2694/M	1	SA2694/M	1	SA2694/M	3	-
23. Stop	-	-	-	-	-	-	SA2094/M	1	-	-	SA2094/M	3	-
24. Shock Absorber 'A'	-	-	-	-	-	-	-	-	SA1285/M	1	-	-	-
25. Shock Absorber 'B'	-	-	-	-	-	-	-	-	-	-	SA1286/M	1	-
26. Lamp Bracket	SA5748/M	1	SA5748/M	1	SA5748/M	3	SA5749/M	1	SA5749/M	1	SA5749/M	3	-
27. Lamp Bracket Carr.A&B Lamp Bracket support	-	-	S1265 or S1266	1	-	-	-	-	S1295	1	-	-	-
28. Signal Lamp	SA5700	1	SA5700	1	SA5700	3	SA5700	1	SA5700	1	SA5700	3	-
29. Counter Weight Lever 1 way	SA2126/M	1	SA1267/M	3	SA2126	1	SA2135/M	1	SA1267/M	1	SA2135/M	3	-
30. Counter Weight Lever Support	-	-	-	-	-	-	SA1289/M	1	S1289/M	1	-	-	-

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
31.	Eye Joint 20mm	S1264/M	1	S2164/M	3	S2164/M	3	SA2164/M	1	S2164/M	1	S2164/M	3	-
32.	Screw Joint 20mm	SA2162/M	1	SA2162/M	1	SA2162/M	3	SA2161/M	1	SA2162/M	1	SA2162/M	3	-
33.	Bar M.S. 20dia(I S2062)	As reqd.						As reqd.						
34.	Wheel Clamp	SA2120/M	2	-	-	-	-	SA2120/M	2	-	-	-	-	-
35.	U Bolt 140 dia tube	SA120/M	2	-	-	SA120/M	4	-	-	-	-	-	-	-
36.	Horizontal rope wheel 1 way	SA3000/M	1	SA3000/M	1	SA3000/M	2	SA3000/M	1	SA3000/M	1	SA3000/M	2	-
37.	Horizontal rope wheel 2 way	-	-	-	-	SA30001/M	1	-	-	-	-	SA30001/M	1	-
38.	Horizontal rope wheel 3 way A&B	-	-	-	-	SA30002/M	2	-	-	-	-	SA30002/M	2	-
39.	Rod Guide	-	-	SA1278(for 2arm)		-	-	-	-	SA1292(for 2arm)		-	-	-
40.	Counter Weight Lever 2 way	-	-	SA1268		-	-	SA2136		SA1263		-	-	-
41.	Counter Weight Lever 3 way	SA2128		SA1269		-	-	SA1269		SA1269		-	-	-
42.	Wire Shackle 16mm	SA3081/M	1	-	-	-	-	SA3081/M	1	-	-	-	-	-
43.	Spring Washer M20 (IS3068)		4	-	-	-	-		8	-	-	-	-	-
44.	Bolts MS Sq. Head M20X70 with Hex. nut		4	-	-	-	-		8	-	-	-	-	-
45.	Bolts MS Hex. Head M12X45 with Hex. nut		2	-	-	-	-		2	-	-	-	-	-

ANNEXURE-H.4

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
46.	Bolts MS Hex.Head M12X38 with Hex. nut		2	-	-	-	-		2	-	-	-	-	-
47.	Bolts MS Hex. Head M20X60 Hex. nut	-	-		2		6	-	-		2	-	-	-
48.	Bolts MS M12X35 Hex. nut	-	-	-	-		10	-	-	-	-		10	-
49.	Bolts MS M12X40 Hex. nut	-	-	-	-		10	-	-	-	-		10	-
50.	Bolts MS M16X55 Hex. nut	-	-	-	-		9	-	-	-	-		9	-
51.	Bolts MS M16X40 Hex. nut	-	-	-	-		40	-	-	-	-		40	-
52.	Bolts MS M16X50 Hex. nut	-	-	-	-		2	-	-	-	-		2	-
53.	Bolts MS M16X50 Hex. nut	-	-	-	-		13	-	-	-	-		13	-
54.	Bolts MS M20X55 Hex. nut	-	-	-	-		8	-	-	.	8		8	-
55.	Bolts MS Hex.Head 20X70 with Hex. nuts	-	-		8	-	-	-	-		8	-	-	-
56.	Washer Machined MS12	-	-	-	-		14	-	-	-	-		60	-
57.	Washer Machined MS M20	-	-	-	-		60	-	-	-	-		60	-

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
58.	Washer Machined MS M20	-	-	-	-		12	-	-	-	-		12	-
59.	Spring Washer M16	-	-	-	-		4	-	-	-	-		4	-
60.	Screw 12/20 Hex.Head IS1363	-	-		2	-	-	-	-		2	-	-	-
61.	Anchor Bolts complete	SA116A/M	4	SA116A/M	4	-	-	SA116A/M	4	SA116A/M	4	-	-	-
62.	U Bolts	SA120	2	-	-	-	-	-	-	-	-	-	-	-
63.	U Bolts	SA124 A	2	-	-	-	-	-	-	-	-	-	-	-
64.	Anchor Bolts 7/8"X3'0"	-	-	SA1281	4	-	-	-	-	SA1232	4		FPS	-
65.	Teak Wood Piece 50X30X175	-	-	-	-		6	-	-	-	-		6 only	-
66.	Roundel Convex RED 924/8mm(9.5/8") Dia	-	-	2756/M	1	-	-	2756/M	1	2756/M	1	2756/M	3	-
67.	Roundel Convex (9.5/8") Dia GREEN	2757/M	1	2757/M	1	2757/M	3	2757/M	1	2757/M	1	2757/M	3	-
68.	Roundel Convex RED 217mm(8.3/8") Dia	2753/M	1	2753/M	1	2753/M	3	-	-	-	-	-	-	-
69.	Clamp 140 mm dia tube	-	-	-	-	-	-	SA2146/A	2	-	-	SA2146	6	-

Remarks:

Item No.4 SA5587/M-2]
SA5588/M-1] for dolls
" 6&7 with complete fittings
" 25 SA1286 used on lattice fitting 'B' type for signal 2 arms.
" 41 used for signals 2 arm only.

ANNEXURE-H.5

IMPORTANT DATA OF INDIAN RAILWAYS STANDARD INTERLOCKING FRAMES

S.No.	Description	Direct locking type SA530		Catch handle locking type SA1101		Ground frame SA922 to 926		Remarks
		Metric units	FPS units	Metric units	FPS units	Metric units	FPS units	
1.	Length of the lever	2275 mm	7' 8"	1980 mm	6' 6"	1455 mm	4' 9 1/4"	
2.	Pitch of the lever	125 mm	5"	100 mm	4"	100 mm	4"	
3.	Angular throw of the lever		27°		33°		52°	
4.	Lever tails stroke on (1) Front tail for signals	250 mm	9 1/4" 10 5/8"	250 mm	10"			In SA1101 type frame there are no separate tails. The tail is a part of the lever body. In ground frames no tails are used. Holes are drilled on the body of the lever.
		300 mm	1' 0" 1' 3/8" 1' 2 3/4"	300 mm	12"			
	(2) Front tail for points	150 mm	5' 7/8"	125 mm	4' 5/8"	150 mm	6"	
		200 mm	8"	150 mm 200 mm	6" 8"	200 mm	8"	
	(3)Back tail	-	-	-	-	-	-	
5.	Mechanical advantages for 200 mm (8") stroke	5.3	5.4	5.6	5.6	6.2	6.2	
6.	Stroke of the tappet(plunger)	346 mm	13 7/8"	65 mm	2 15/32"	277 mm	10 7/8"	
7.	Pitch of the channel in the locking box	110 mm	4 3/8"	55 mm	2 1/16"	63.3 mm	2 1/2"	
8.	Width of the channel	70 mm	2 7/8"	40 mm	1 17/32"	55 mm	2 1/8"	
9.	Section of the tappet(plunger)	16X45.90 45.65	2"X5/8"	40.90X10 40.65	1.3/4X3/8"	40.90X10 40.65	1.3X4X3/8"	
10.	Section of interlocking bar	16X12 mm	3/4"X3/8"	16X12	5/8"X1/2"	16X12 mm	5/8"X1/2"	
11.	Max. No. of interlocking bars in each channel	Bottom	3		2		2	
		Top	3		2		3	
12.	Max. No. of channels	(4+1) or (4+4)		No limit		2 channels & 4 channels		
13.	Size of locking boxes	1 channel for 5 levers 1 channel for 7 levers 4 channels for 5 levers 4 channels for 7 levers		6 channels for 8 levers 6 channels for 10 levers 8 channels for 8 levers 8 channels for 10 levers 10 channels for 8 levers 10 channels for 10 levers				
14.	Bay	5 or 7		8 or 10		1,2,3,4,5,6		

ANNEXURE-H.6

REVIEW QUESTIONS

Subjective questions:

1. Write difference between SA 530 and SA1101?
2. Write advantages of SA1101 over SA530?
3. Write different types of cranks?
4. What are the different types of lead out?
5. Describe the inside lead out?
6. What are the types of rods used in Railways?
7. Write the material required for guide roller assembly?
8. What are the different types of rod joints?
9. What are the rules to be observed for running rodding runs?
10. Why compensator necessary in rodding transmissions?
11. What is normal crank and reverse crank?
12. Write rules for compensator?
13. Write the principles of Compensator?
14. Calculate the compensator position in the given lay out?
15. What is loose heel and fixed heel?
16. What type of switches are used in Indian Railways?
17. Write the advantages of over ridding switches?
18. What are the turn outs used in our Railways?
19. Write essential requirements before interlocking of a point?
20. What is lock bar and why it is provided?
21. Procedure for installation of lock bar?
22. Write procedure for adjustment of a point?
23. What is a detector and what is the function of a detector?
24. Procedure for the installation of a unit wire detector?
25. What are the types of signal posts and what types IR's used?
26. Write difference between Spectical "A" and "B"?

27. Write the functions of counter weight balance lever?
28. Write procedure for maintenance of signals?
29. What are the types of wires used in transmission?
30. Write different types of Pulleys?
31. What are the rules to be followed for running of a Wire Transmission?
32. Write classification of L.C.Gates and what factors decide its classification?
33. How many types of L.C.Gates are there?
34. Write types of swing type gates and its working?
35. Write disadvantages of swing type gates?
36. Briefly explain the Lifting *Barrier* parts and explain the functions?
37. Write advantages of Lifting Barrier gates?
38. What are the points to be checked while L.C.Gate inspection?
39. What is e-type lock and what are the types and where they are used?
40. Write the types of H.P.Locks and its working
41. Write what are the factors for choice of a cabin site?
42. What is cabin equipment?

Objective:

1. Fill up the blanks with appropriate words/figures:-

i) The leading stretcher bar have to be provided not more then _____ clearance from the bottom the Stock Rail. (3 mm)

ii) The through of switch rail is _____ in BG. (115 mm)

iii) Point should be provided with _____ pillars. (level)

iv) The Leading Stretcher Bar (BG) is fixed at _____ from the Toe of Switch Rail.(15”)

v) Following Stretcher Bar (BG)) is fixed at _____ from the Toe of Switch Rail.(33”)

vi) Cabin located in station yard should be at a distance _____ Standard from the center line of nearest track. (2135 mm)

vii) The length of Lock Bar is _____.(12810 mm)

viii) Total lift of Lock Bar is_____ when lever is operated from N to R position. (44 mm)

ix) Lock bar clearance should not exceed _____ from the top of the stock rail. (6 mm)

x) There should be _____ of lock bar clip and _____ of Lock bar stop in a lock bar. (10,3).

xi) Pitch of lever in SA530 is _____ and in SA1101 is _____. (125 mm, 100 mm)

xii) Pitch of the Channel in SA530 is _____& in SA1101 is _____.(110 mm, 55 mm).

Q.2. Write true (T) or False (F):-

i) The size of Red & Green roundels are same in B-Type Spectacle. (T)

ii) Dead Space is 63 mm in A -Type Spectacle (T)

iii) Down road connected from the back side in B-Type Spectacle. (F)

iv) Back light screen is fixed on the Spindle. (T)

v) Mounting of Spectacle is on Round Stud Pin (T)

vi) Bay in SA530 lever frame is 8 or 10 (F)

vii) Signal Crank is fixed on Signal Base. (T)

viii) Accommodating Cranks are of three different height. (T)

xi) Adjustable crank is used in rod run for diversion upto 20 degree (F)

x) Detector is used to compensate the variation of length of rod due to temperature (F)