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S 14

INTERLOCKING WITH METAL - METAL RELAYS

Indian Railways Institute of
Signal Engineering and Telecommunications

SECUNDERABAD - 500 017

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CHAPTER – 1: INTRODUCTION

1.1 Relay control of railway signalling gears made the following things possible:-

1. Remote control of functions over long distances
2. Shifting of interlocking between control levers to relays paving the way for replacement of levers with switches or buttons mounted on compact panels.
3. Fast, efficient and easy operation of gears, and
4. Less maintenance as compared to that of lever frames.

Systems in which interlocking of functions is achieved through relays are called Relay Interlocking Systems.

These are classified as:-

1. PANEL INTERLOCKING and
2. ROUTE RELAY INTERLOCKING.

They are so called because in the earlier British practice of these systems, their names suggested the functions between which interlocking was provided.

In the P.I. systems, each gear like a point, signal or slot controlled from the panel is individually interlocked with all other conflicting gears.

In RRI, operation of route setting relays indirectly enforces locking on all functions inimical to the set route as this route setting involves automatic operation of the required points.

In the new IRS specification for Relay Interlocking systems, a change in their names is sought to be introduced. P.I. is called as 'Non-route setting type Relay Interlocking System' and RRI as 'Route setting type Relay Interlocking System'. This is because the present practices of P.I. and R.R.I. have the same kind of interlocking provisions. However, the conventional names, straight and simple as they are, continue to be used on our railways, all along. The description of these chapters also follows the same practice.

One of the two practices of these systems prevailing on our railways, called the continental practice is introduced by M/s Siemen's of Germany. Their first installation which is of route setting type (RRI) came up in 1958 at Churchgate, Bombay on Western Railway. Subsequently, even as more installations of this type are provided in large yards, small yards, needed less costly provisions. Hence, non-route setting type (P.I.) systems are adopted in later days for these yards.

Both the British and Siemen's practices of Relay Interlocking Systems fulfil the requirements laid down in the IRS. Specification No.S.36/87 Amendment No.2. Also, their requirements are specified in Chapter No. XX of IRSE Manual (old version).

Entrance - Exit principle (NX) in which two controls, one at the entry point of route and the other near to its exit have to be operated simultaneously, is adopted in Siemen's practice.

1.2 Siemen's practice has certain unique features. The important ones are described below:-

1. Modular assembly type construction of control panels with small sections called "DOMINO STRIPS" fixed on a frame of suitable size.

This considerably reduces the panel size and also makes its modification easy to suit changes in the yard from time to time.

Control buttons need only feather touch operation and they are geographically located on the panel in similar positions to those of their connected gears in the yard. This makes the job of operator fast and less tiresome to improve his efficiency.

2. Emergency Route section release facility on the panel for quicker traffic management with the help of signalling staff in times of track circuit failures.

3. Usage of metal to metal contact relays for vital controls with a mandatory check for their failure to drop after each energisation and inclusion of proof for this check in control circuits. The main advantages of these relays over the conventional carbon to metal contact relays are their quicker operation and low coil current rating . Also their small size suits the concept of modular relay units called groups for each function control.

4. Group unit construction of relays which facilitates uniform gear control independent of the peculiarities of local layouts. This improves safety in their operation as the group wiring is factory tested under ideal conditions. Also the wiring is well protected in its enclosed casing. Due to this, the external wiring needed for interconnection and inclusion of other controls is greatly minimised resulting in the saving of installation and commissioning time.

5. Provision of main and intermediate distribution frames for wiring connections between various relay units, relays and operating panel as well as relays and external cables. All wires are terminated on 'Tag Blocks' fixed on these frames with facility of their easy identification during testing and modifications.

6. Indications on relay groups which facilitate quicker fault finding as they appear according to the relay operation sequence in progress.

7. Fuses with indication tags in bottle type holders occupy less space and their failures can be easily detected.

8. Centralisation of track relays in the cabin enables close monitoring of train movement in the yard by the maintenance staff while attending to a route release failure.

9. Interlocking and other vital conditions are proved in more than one stages of operation. This prevents the energisation of final control affecting the gear unless the required conditions are retained till the end of operation. This is essential especially with the use of interlocked relays for control.

10. Signal control is of NX type in which the operator has to operate signal button at the entry of the route along with the Route button near its exit simultaneously. This forces the operator to face the panel and make a conscious choice of buttons.

1.3 POWER SUPPLY EQUIPMENT consists of:-

a) Supply mains including one regular and one or two standby supply sources with 1-ph or 3-ph power transformers of suitable capacity and current rating. These may include a D.G.set.

b) Distribution Transformers for signal lighting, track circuit and indication supplies. One regular and one standby units of these are connected through 'programme switches' for selection.

c) One on line and one standby transformer-rectifier units connected to load through programme switches and contactor units of 110V D.C. for point machines ; 60V D.C. for cabin internal relays; and 60V DC for external circuits.

Power cables are laid to take outputs of all these units to a ‘switch and monitor’ panel provided in the relay room.

Power panel has ‘press and lock’ switches for various load feeders, an assembly of voltmeters, ammeters, frequency meter, and an array of indication lamps that monitor the supply availability for various local circuits.

The selected supply outputs are brought on elmox terminals fixed inside the panel at its back.

From this panel, power wiring for cabin internal supplies is taken onto the relay racks in a ring mains arrangement.

Wiring for external supplies in location boxes is done between the power panel and external cable termination racks. These supplies are taken on outdoor cables to the various location boxes in the yard, preferably on a ring main supply arrangement.

The arrangements and connections for the various supplies in non-route setting type and route setting type installations are dealt with in detail in their respective chapters.

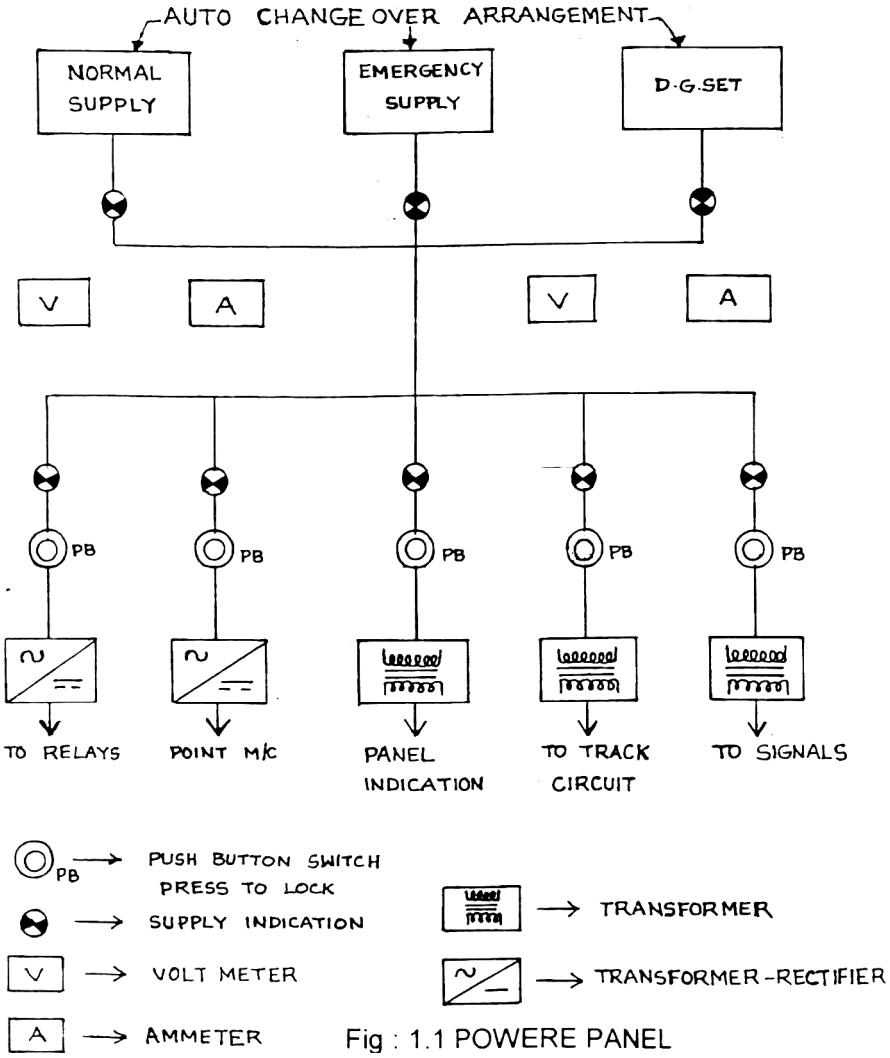


Fig : 1.1 POWERE PANEL

1.3.1 Power supply for track circuits and its checking circuits:

In the automatic route release circuit, the sequential occupation and clearance of the track circuits in route are proved. This condition may arise due to momentary power failure and fluctuation causes bobbing of track circuit. In order to ensure that the dropping and picking of track relays and their repeaters are due to actual occupation and clearance of the train and not due to momentary power failure, power supply for track circuits availability proving relay has to be proved in UYR1 and UYR2 circuit. This is achieved by the relay "ZR".

This relay normally remains energized and drops when the power supply for the track circuit fails. On resumption of the power supply "ZR" does not energised immediately but after a time delay so that all TPRS energies before ZR energies.

By this arrangement of allowing TPR's to pick up much before ZR relay, the condition for UYR1 and UYR2 – TPR's down ZR up will not occur by default in case of momentary power failure. Thus automatic route release during such failure is prevented.

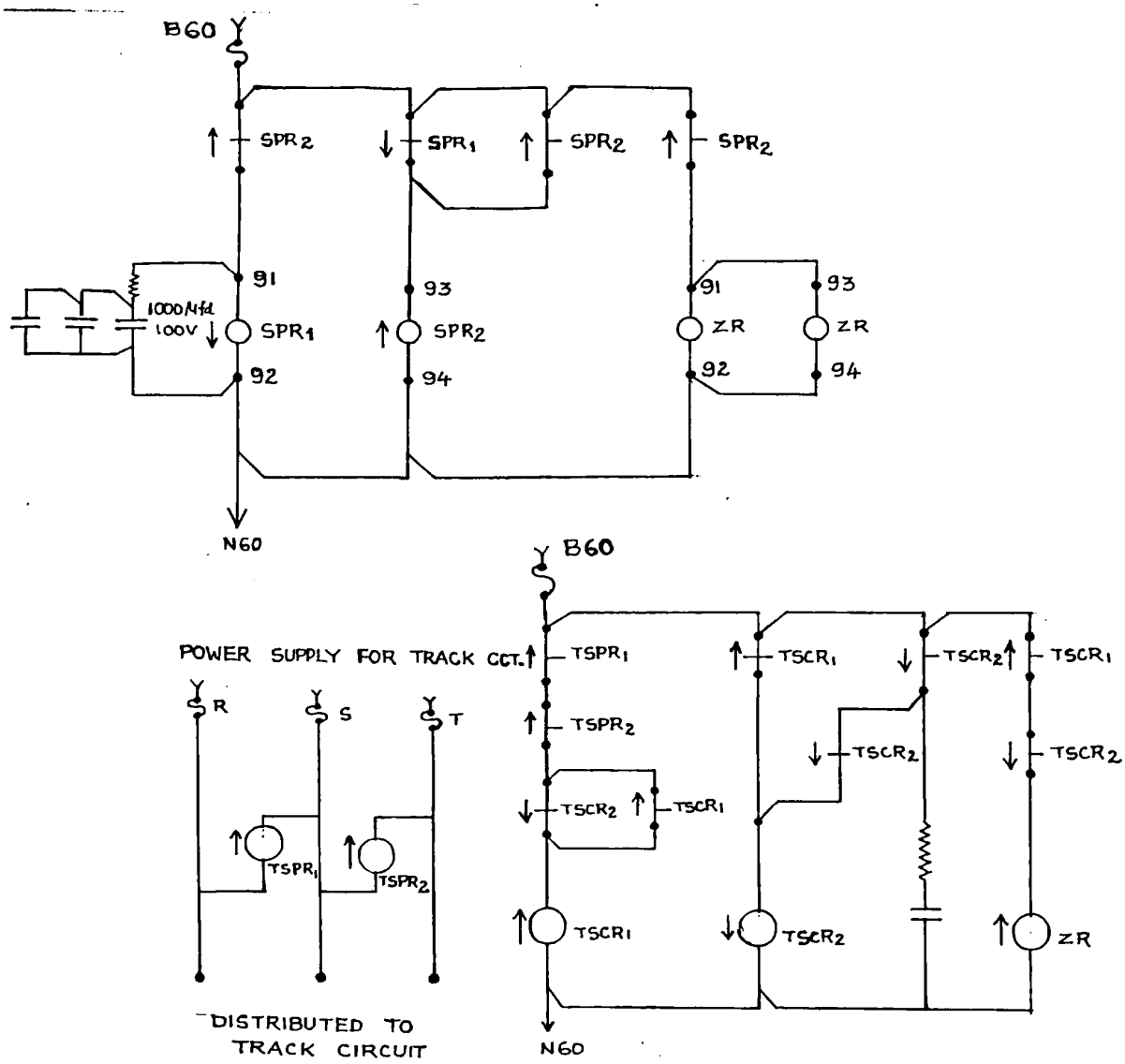


Fig : 1.2 A & B

CHAPTER - 2 : CONTROL PANEL

2.1 This is made up of rectangular panel sections called 'DOMINO STRIPS' having sizes either of 63mm X 38mm (2 1/2" x 1 1/2") or 54mm X 34mm (2 1/8" X 1 3/8"). Each panel section has a base and a top plate.

The alluminium cast base has fifteen compartments with removable fibre separators between them. Each compartment has an individual contact at its bottom centre and a common contact plate in the middle connecting all compartments. This plate is connected to the sixteenth terminal at the bottom of the strip. This common terminal carries the neutral connection of supply for indication lamps.

A pencil type 24V 1.2W indication lamp, where provided, occupies one compartment Red and White indication lamps are available. In some panels LEDs are used for indication purposes on panel.

A button fixed on the top plate above has a steel bridge. Its vertical limbs extend below into any two adjacent base compartments and rest close to the contacts at the bottom. These contacts are bridged when the button above is pressed. The button is of self restoring type opening the contact normally.

The top plate of the strip actually contains two aluminium and one steel plate one above the other. They are clipped together on all four sides, the top one being painted with slate grey above. The top plate according to its location may carry track, point or signal demarcation with slits cut to size and shape. Transparent white or green films placed between the lower two plates, as required, give the needed colours to the indications through these slits. Buttons may be fixed on the top plate in a suitable location as required. The top plates situated in the middle of the panel can be removed from their bases with the help of a magnet. The plates can be changed or modified as per alterations effected in the yard layout anytime.

The numbering of base components when viewed from the top and of contact terminals when the domino strip is released from the frame and turned over upside down for accessing is given below :-

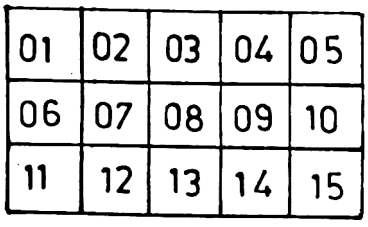


Fig : 2.1

Top View when the base is fixed to the frame

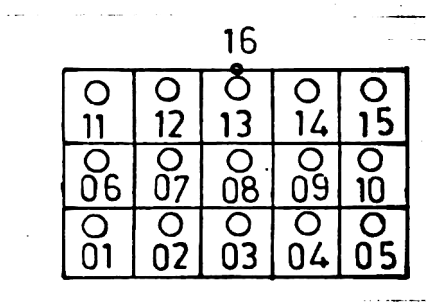


Fig : 2.2

View of terminals when the base is removed and turned upside down.

The location numbering of panel sections when their bases are screwed to the frame is as below : -

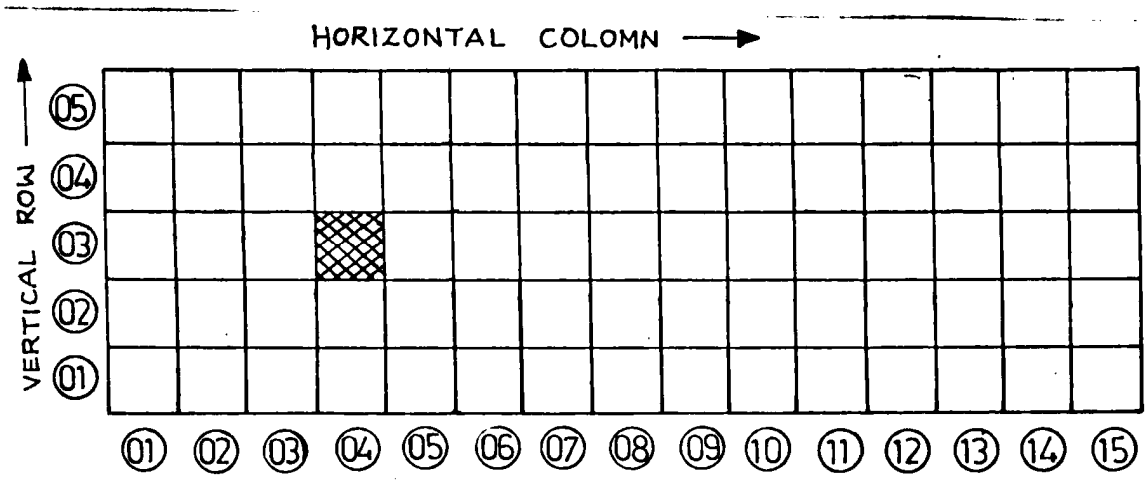


Fig :2.3

The location of any panel section is identified by its column number followed by its row number. For example, the shaded section in the panel above bears the number of (04.03). The contact terminal number 08 of this section is identified by the number (08.04.03).

The panel sections are generally assembled in multiples of five both horizontally and vertically as per need.

The dull finished grey colour of the panel surface eliminates undesirable reflections. The panel is mounted horizontally in an inclined plane for the convenience of operation.

Sometimes a separate illumination diagram made up of the same sections is mounted upright above the operating panel. If desired, the operating panel may have a simple line diagram of the yard with all demarcations excluding their illuminations.

Warning buzzers are fixed inside the panel. All the panel strip wiring is terminated on tag blocks mounted inside the panel.

2.2 PANEL CONTROLS & OPERATIONS

All Signalling functions having manual control will be operated by pressing two buttons simultaneously and releasing them within ten/fifteen seconds i.e. In the case of route setting, buttons shall be kept pressed till the last pair of points in the route start operating. Whereas main signals clear after the buttons are released, for a shunt signal buttons shall be released after the signal has come off. In other operations, buttons can be released immediately after pressing. Buttons required for a vital operation can only be accessed with both hands. This ensures conscious operation by the operator. There are individual control buttons for each gear located near to their panel demarcation and common buttons are located at the top of the panel.

These are identified as below:-

S.No	Button	Description	Colour	Location
1.	GN	(Main) Signal Button	Red	Close to Signal demarcation concerned on track.
2.	Sh-GN	Shunt signal button	Yellow	-do-
3.	UN	Route Button	Grey	Centre of the berthing or last control track circuit
4.	WN	Point Button (used only for point operation)	Blue	Close to the point demarcation.
5.	WN	Point Button (used for point operation and also for route section release)	Blue with white dot on top.	-do-
6.	LXN	Level crossing control release button.	Green or Grey	Close to the level crossing demarcation.
7.	KLYN	(Point) Key lock Release Button.	-do-	Close to the slotted point demarcation.
8.	COGGN	Calling on Signal control Button (common)	Red	Top of the panel.
9.	EGGN	Common Button to replace a cleared Signal at 'ON'	-do-	-do-
10.	YYN	Common Slot Release Button	Green or Grey	-do-
11.	YRN	Common Slot Return Acknowledgement button.	-do-	-do-
12.	WWN	Common Point Button for (regular operation)	Blue	-do-
13.	EWN	Common point button for (emergency operation)	-do-	-do-
14.	CH-YN	Crank Handle Release Button (Separate for each group)	Blue or Green	-do-
15.	CH-YRN	Crank Handle Slot Return Acknowledgement button (Separate for each group)	-do-	-do-
16.	AGGN	Common Button to introduce Auto working of a Main Signal.	Red	-do-

17.	AGGRN	Common Button to cancel Auto working of a Main Signal	Red	-do-
18.	EUYN	Common Emergency Route Section Release button	Blue with white dot on top.	-do-
19.	EUUYN	Common Emergency Full Route Release Button.	Grey	-do-
20.	OYN	Common Overlap Release Button	White or Grey	-do-
21	GXYN or SXYN	Signal lamp Failure Alarm acknowledge Release button	Red.	-do-
22.	WXYN or PXYN	Point detection Failure Alarm Acknowledge Button.	Blue	-do-
23.	DAY	Signal lamp voltage Control button for day time lighting	White or Grey	-do-
24.	NIGHT	Signal lamp voltage Control button for night time lighting.	-do-	-do-
25.	1.2.3.4	Panel lamp voltage Control buttons for four stages of light intensity	-do-	Note: In panels with LED indication in place of lamps, only two buttons, 1.2 are provided for 'Bright' & 'Dim' indication.

Buttons EWN and EUYN are normally obstructed for operation by a sealed disc. Before operation, seal has to be broken, seal wire has to be removed and the disc turned to free the button by the operator. In case of EUYN button a key control also provided in addition to the seal. After each operation, the operator has to get resealing done on the disc by the signalling staff.

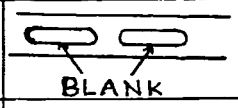
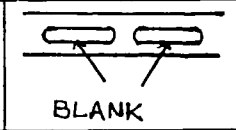
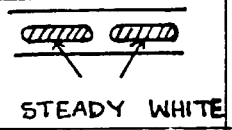
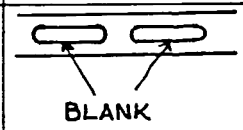
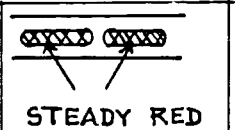
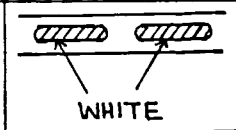
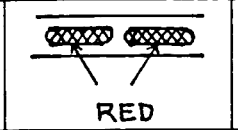
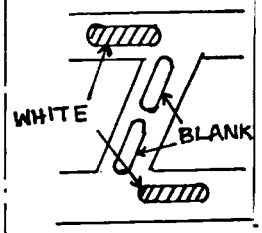
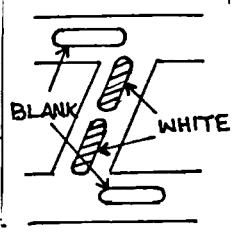
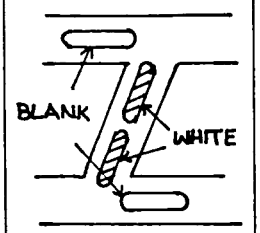
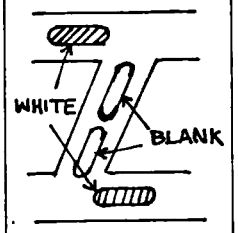
2.3 To record each emergency operation Counters of emergency operations are provided close to the concerned buttons at the top of the panel as below:-

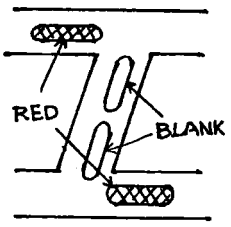
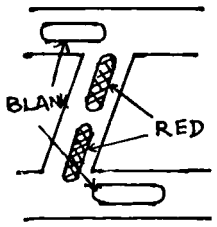
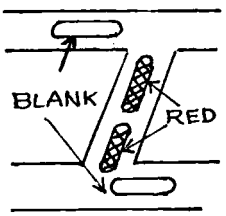
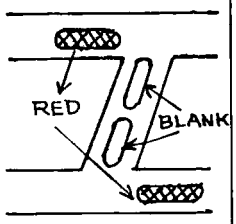
S.No.	**Counter**	**Description**	**Whether common or individual**
1.	EWZ	Emergency Point operation Counter	Common
2.	EUYZ	Emergency Route Section Release Counter	Common.
3.	EUUYZ	Emergency Full Route Release Counter	Common
4.	OYZ	Overlap Release Counter	Common

5.	COGGZ	'Calling on' Signal Operation Counter	Common.
6.	CH1Z/ CH2Z/ CH3Z/etc	Crank handle Release Operation Counter	Individual for each group.

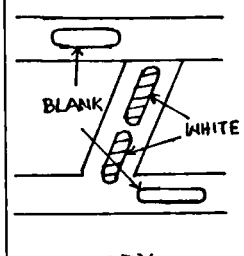
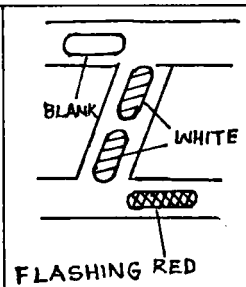
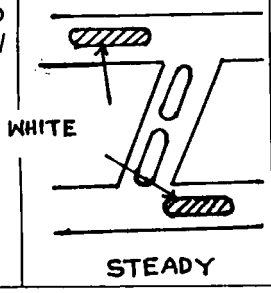
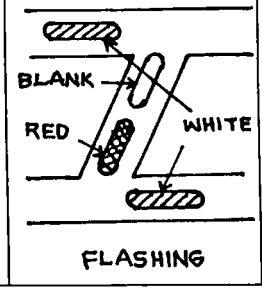
Some panels do not have Overlap Release Button (OYN). In its place, EUUYN was utilised instead of OYN.

2.4 The various panel operations and changes on panel indication consequent upon operation or change of gear conditions are detailed below:-

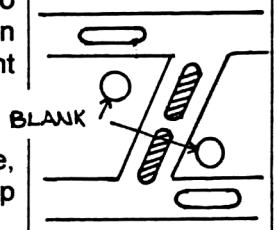
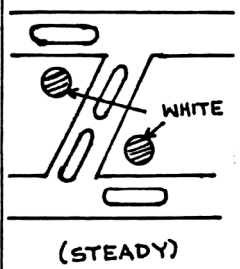
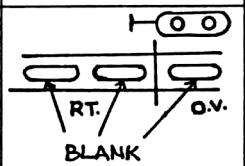
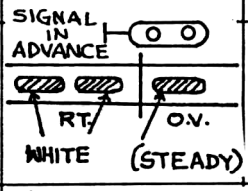
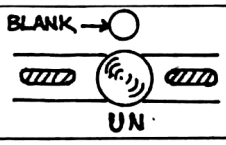
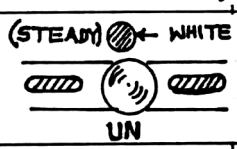
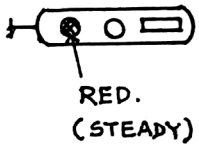
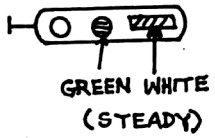
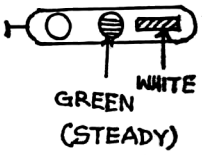
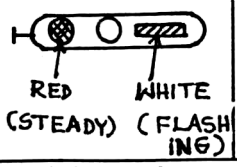
S.No	Gear operation or change of condition	Panel illuminations		Description
		Before operation or change	After operation or change	
1.	Track Circuit clear and Route not set		–	No illumination on strips.
2.	Track circuit clear and Route or Overlap is locked over it.			Steady white illumination on strips.
3.	Track circuit failed or occupied without route locking on it.			Indications turn to red from blank (steady)
4.	Track circuit failed or occupied after route locking over it.			Indications turn to red from white (steady)
5.	<u>REGULAR POINT OPERATION</u> (i) Press WWN with the concerned WN and release, to operate points from *normal* to *reverse*			Normal steady indication disappears. Reverse indication flashes during operation. Becomes steady after operation (white)
	(ii)Press WWN with the concerned WN and release, to operate points from *reverse* to *normal*.			Reverse steady indication disappears. Normal indication flashes during operation. Becomes steady after operation (white)

6.	EMERGENCY POINT OPERATION After ensuring non-occupation of point track circuits break the seal on disc beneath EWN, & turn it to free EWN.			
	(i) Press EWN with the concerned WN and release to operate points from *normal* to *reverse*.			Normal steady red indication disappears. Reverse indication flashes during operation becomes steady after operation (red).
	(ii) Press EWN with the concerned WN and release to operate points from *reverse* to *normal*.			Reverse steady red indication disappears. Normal indication flashes during operation. Becomes steady after operation (red)

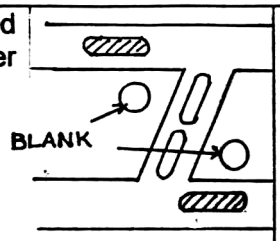
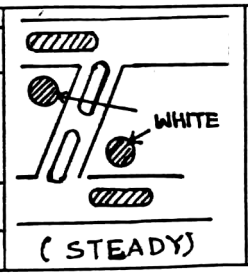
7. When points go out of correspondance with control:-

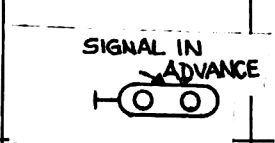
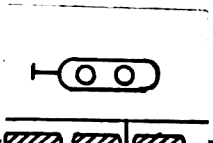
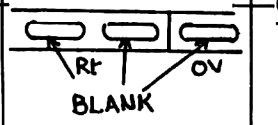
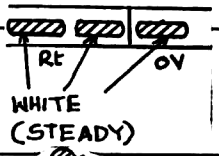
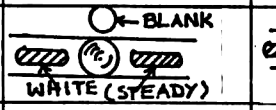
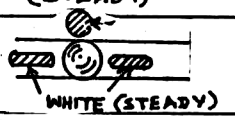
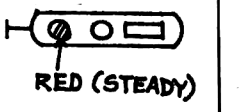
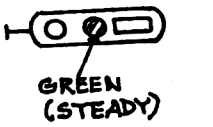
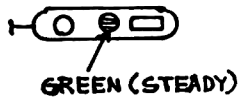
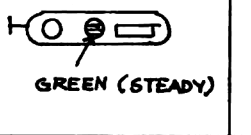
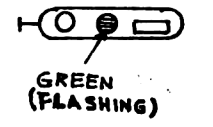
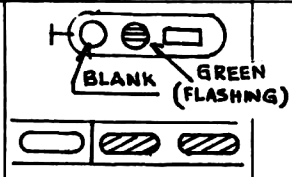
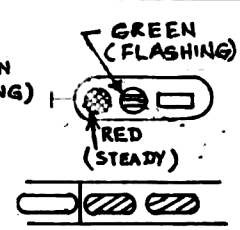
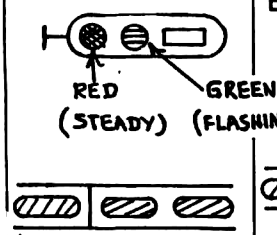
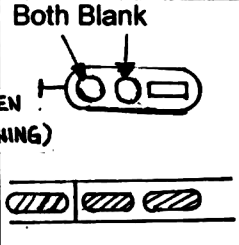
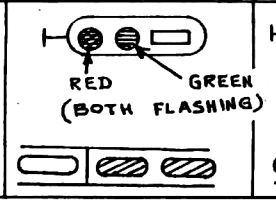
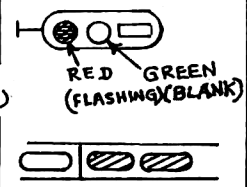
(i)	Points changed to *normal* with *control* remaining *in reverse*			*Reverse white indications* as per control flash, and *normal red* indication (on only one strip) as per point position flashes.
(ii)	Points changed to *reverse* with *control* remaining in *normal*.			Normal *white indications* as per control flash, and *reverse red* indication (on only one strip) as per point position flashes.

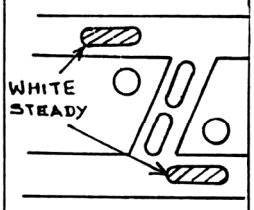
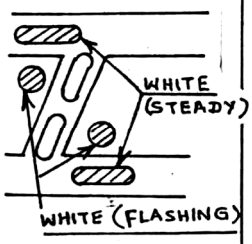
8. Main signal clearance operation for diversion movement.

(i)	Press the concerned GN and UN together and release (a) Route and overlap are set. (In RRI, points in route and overlap are set automatically as required. In P.I. they are already set to the required position by individual point operation.) (b) Points in route, isolation and overlap get locked.			On points locked in route, isolation or overlap, *steady white* spot indication appears as shown.
(ii)	Route including Overlap gets locked			Route and overlap tracks are illuminated *white (steady)*
(iii)	Signal locks Route before clearing			*Steady white* light appears above route button.
(iv)	Signal displays H.G. with Route indicator.			RG indication disappears and steady *white* Route indication along with *green* HG indication appears on signal demarcation.
(v)	If *more than two* lamps are fused on Route Indicator			White route indication flashes and signal displays red aspect indication.

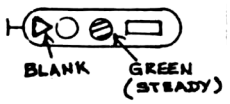
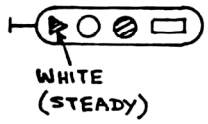
9. Main signal clearance operation for straight road movement.

(i)	Press the concerned GN and UN together and release. (a) Route and overlap are set. (In RRI, points in route, isolation and overlap are set			On points locked in route, isolation and overlap, *steady white* spot

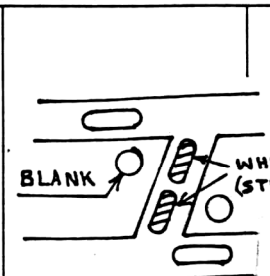
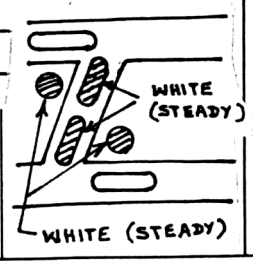
	automatically now as required. In P.I. they are already set.) (b) Points in route, isolation and overlap get locked.			indication appear as shown.
(ii)	Route including overlap gets locked.			Route and overlap tracks are illuminated *white (steady)*.
(iii)	Signal locks route before clearing			*Steady white* light appears above route button.
(iv)	Signal displays HG aspect.			Green HG indication appears on signal demarcation.
(v)	(a)Signal in advance is cleared for run through movement (b) Signal displays DG aspect.			Same indication remains on signal demarcation even as signal aspect changes from HG to DG.
(vi)	If DG lamp of Signal gets fused now, signal displays HG aspect since cascading control is available.			Green indication starts flashing
(vii)	If HG lamp of signal is also fused now, signal displays RG through cascading control.			Simultaneously flashing green and steady red indication are displayed. Route locked indication continues to be displayed.
(viii)	If RG lamp of signal is also fused now, signal remains blank.			Both red; green indications Blank with control relays picked up route locked indication continues to be displayed.
(ix)	Press GN and EGGN signal control relays drop.			Red flashing indication appears. It becomes steady only when RG lamp is lit. Route

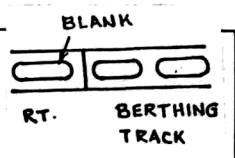
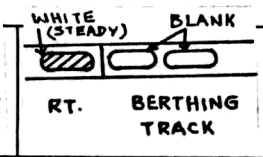
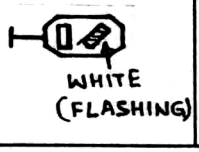
				locked indication continues to be displayed.
(x)	(In RRI, points not already lying in the required position, shall be operated in automatic route setting.) If in this process, any point operation is initiated by route setting but the point operation control fails.			Point locking spot indication flash point indication in the last operated position continues to be displayed.

11. Introduction of auto working on semi automatic signals & reintroduction of it manual control (only for st. Road movements)

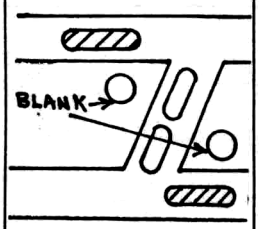
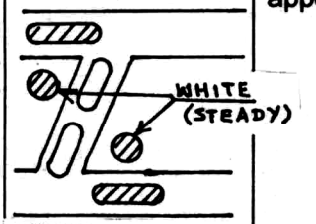
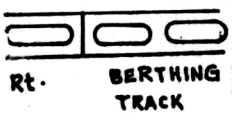
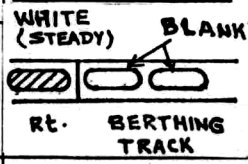
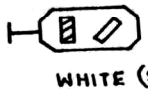
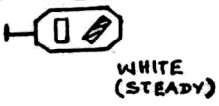
(i)	Press GN and AGGN together and release after the signal is taken 'OFF' 'A' marker on signal post is lighted.			White (steady) 'A' marker indication on Signal demarcation is lit.
(ii)	If 'A' marker lamp on signal post is fused, signal continues to work as automatic signal.			'A' marker indication starts flashing. It becomes steady only when lamp is replaced.
(iii)	Press GN and AGGRN together and release. Signal becomes manual controlled 'A' marker on signal post is extinguished.			'A' marker indication disappears.

12. Shunt signal clearance for diversion movement:-

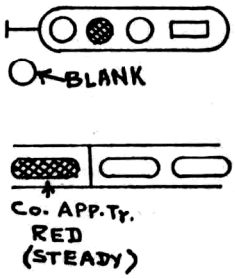
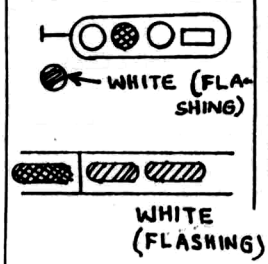
(I)	Press the concerned Sh.GN and UN together and release Route excluding overlap is set. In RRI points get operated automatically before locking if they are not already in reverse position). Points in route get locked.			On points locked in route steady *white* spot indications appear.

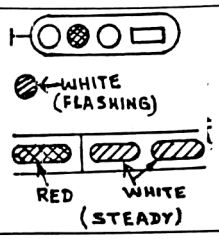
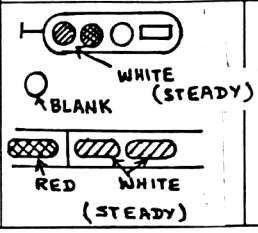
(ii)	Route gets locked (no overlap)			Route track circuits excluding the bathing track are illuminated.
(iii)	Signal displays 'OFF' aspect			'ON' aspect indication disappears and 'OFF' indication appears.
(iv)	If 'OFF' aspect lamp of shunt signal is fused 'OFF' aspect on signal becomes blank.			White illumination of 'OFF' aspect starts flashing. It becomes steady only after the lamp is replaced.

13. Shunt signal clearance for straight road movement:-

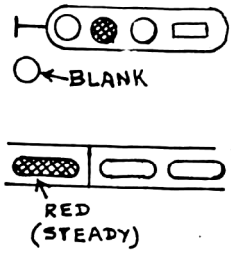
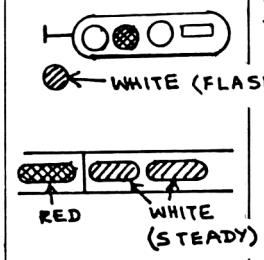
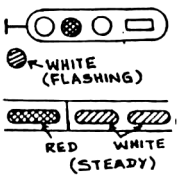
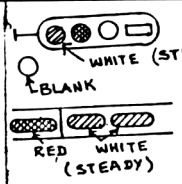
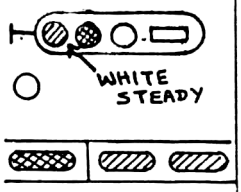
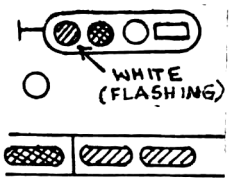
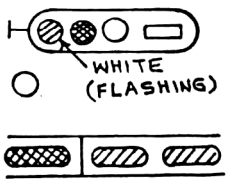
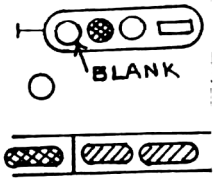
(i)	Press the concerned Sh GN and UN together and release. Route is set (no overlap) (In RRI points get operated automatically before getting locked if they are not in normal already). Points in route get locked.			On points locked in route steady white spot indications appear.
(ii)	Route gets locked (no overlap)			Route track circuits excluding the berthing track are illuminated
(iii)	Signal displays 'OFF' aspect.			'ON' aspect indication disappears and 'OFF' indication appears.

14. Calling on signal clearance for diversion movement.

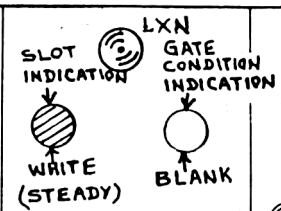
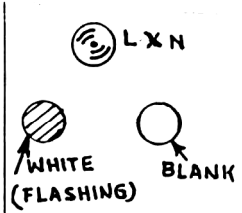
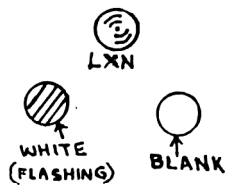
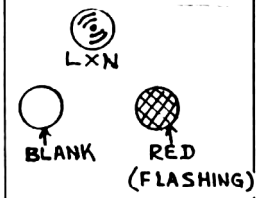
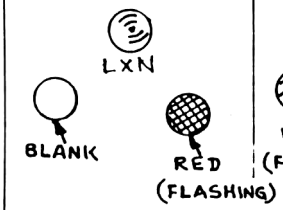
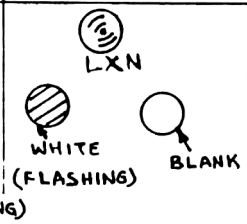
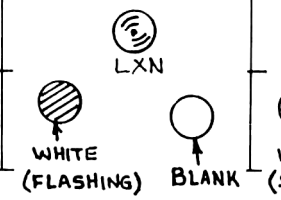
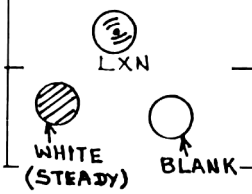
	After the train has occupied the calling 'ON' signal approach track circuit, Press COGGN along with the related MN. signal GN. Release only COGGN, keeping GN pressed press UN now and release both.			Route locked white indication appears on Track circuits in route except berthing track and white approach timer indication starts flashing.

(i)	Route gets set and locked. CO signal approach timer starts operation.			
(ii)	After 2 minutes, timer operation is completed and 'calling on' signal assumes 'OFF' aspect.			Approach times indication disappears and calling on signal 'off' indication appears.

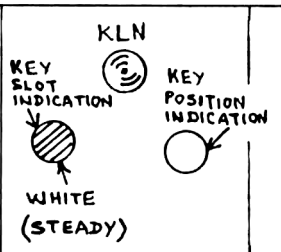
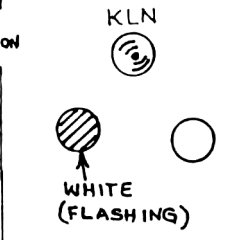
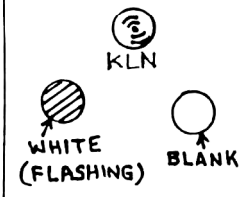
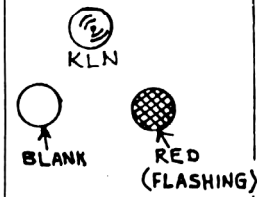
15. Calling on signal operation for straight road movement.

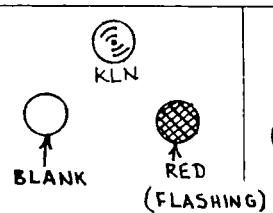
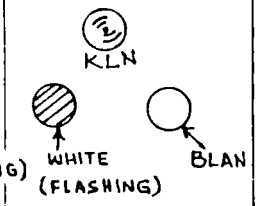
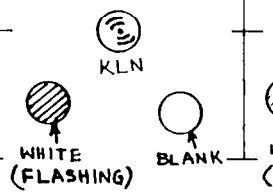
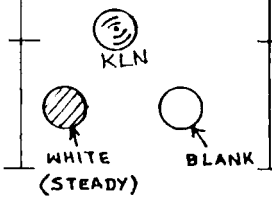
(i)	After the train has occupied the CO signal approach track circuit, Press COGGN along with the related MN SIG.GN. Release only COGGN, keeping GN pressed, Press UN now and release both. Route gets set and locked. CO signal approach timer starts operation.			Route locked white indication appears on track circuit in route except berthing track and white approach timer indication starts flashing.
(ii)	After 2 minutes timer operation is completed, and 'calling on' signal assumes 'OFF' aspect.			Approach timer indication disappears and CO signal 'OFF' indication appears.
(iii)	If CO signal lamp is fused, CO signal becomes blank.			CO signal white indication starts flashing. It becomes steady if CO Sig. lamp is replaced.
(iv)	Press (relevant Mn. Sig. Button) along with EGGN, C.O signal control relay drops.			C.O Signal white flashing indication disappears. Route locked indication continues to be displayed.

16. Release of level crossing gate slot & its return.

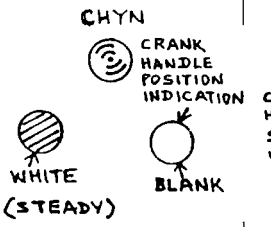
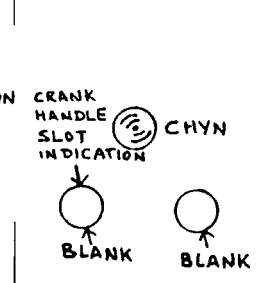
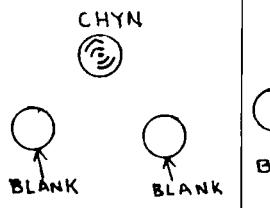
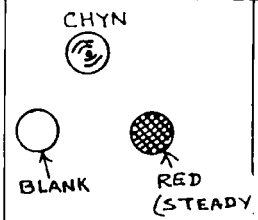
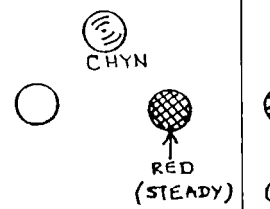
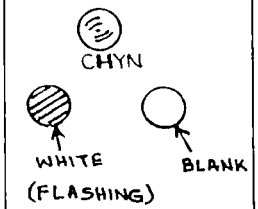
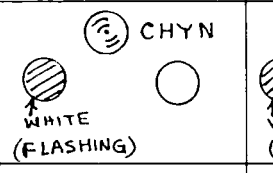
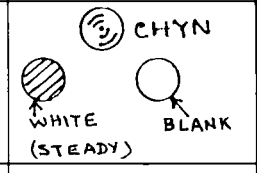
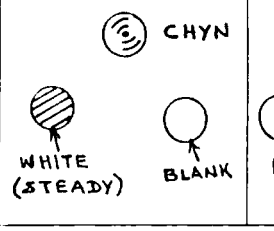
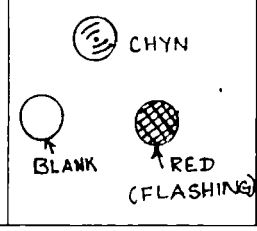
(i)	Press LXN and YYN together and release when no route or overlap involved is set. Gate slot is released and attention of gate keeper is drawn at the gate hut.			Gate slot white indication on panel flashes.
(ii)	Gateman takes out the gate slot key in the key lock relay.			Gate slot white indication is extinguished. Gate open condition Red indication starts flashing.
(iii)	Gatemen replaces the key after closing the gate			Gate open condition red indication disappears indicating gate closed condition. Gate slot white indication starts flashing on panel.
(iv)	Press LXN along with YRN gate slot gets withdrawn			Gate slot white indication becomes steady.

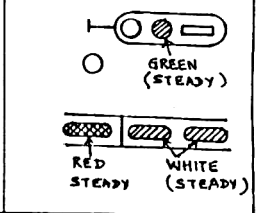
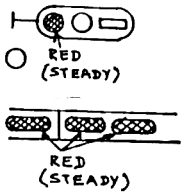
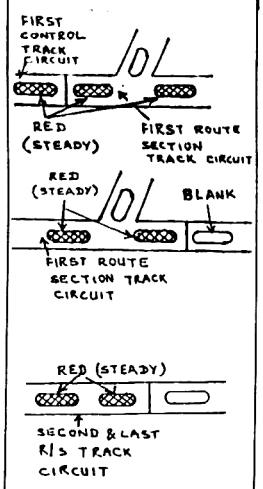
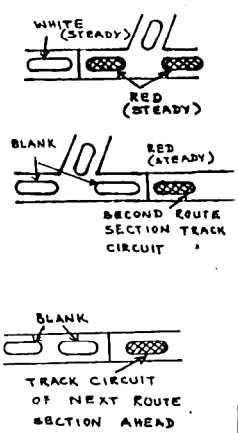
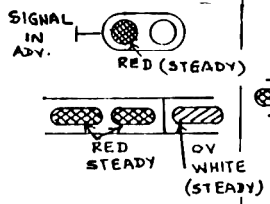
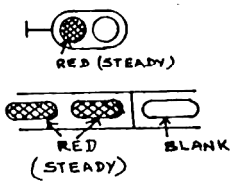
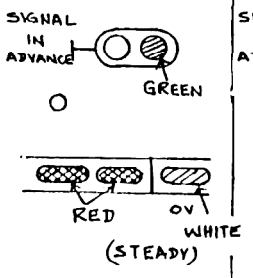
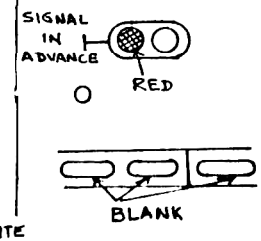
17. Release of slot on point key lock & its return:-

(i)	Press KLN button along with YYN button and release, when no route or overlap involved is set. Key lock control is released and attention of person at site is drawn.			Key slot white indication on panel flashes.
(ii)	Key is taken out from relay at site			Key control indication is extinguished . Key position indication becomes flashing red, indicating key taken out condition.

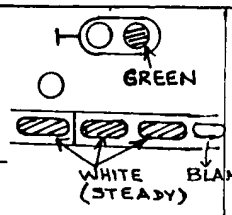
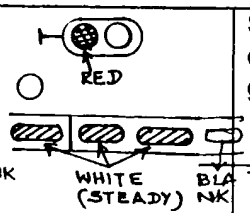
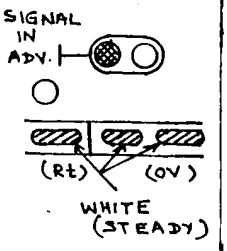
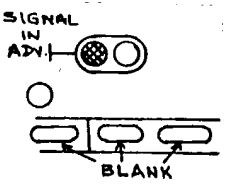
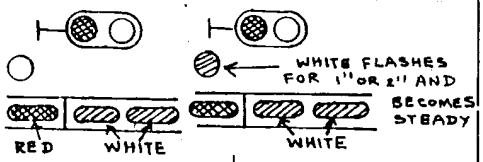
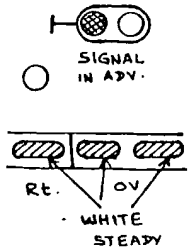
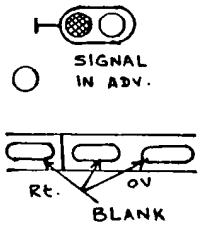
(iii)	Key is replaced in the key lock relay after relocking points.			Key position red indication disappears indicating that point key is replaced. Key slot indication starts flashing on the panel.
(iv)	Press KLN along with YRN and key lock control gets withdrawn.			Key slot white indication becomes steady.

18. Release of point group crank handle control & its return.

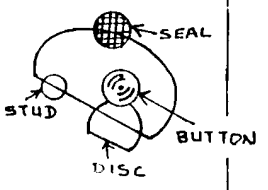
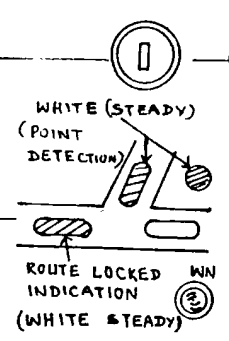
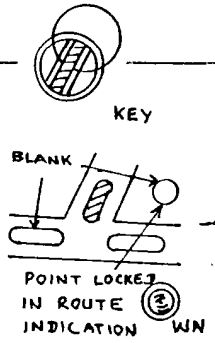
(i)	When no route or overlap is set involving the points of which the crank handle is to be released. Ask for co-operation from site which will be given by pressing CH. P/button at the location.			Crank handle slot indication disappears.
(ii)	On seeing the Red indication flashes when co-operation is received from site, press CHYN of concerned group along with YYN and release.			On the CH position steady red indication appears when crank handle slot is released.
(iii)	After CH is released from the machine and the key is re-inserted in the relay to pick it up, it gets locked.			Crank handle position red indication disappears. Crank handle slot white indication starts flashing.
(iv)	Press CHYN along with YRN and release. Crank handle slot gets withdrawn.			Crank handle slot white indication becomes steady.
(v)	If without release of crank handle slot from the panel, crank handle key lock checking circuit (CHKLCR) fails, when point			Crank handle slot indication disappears as soon as key lock checking circuit failed. Crank handle position

	operation is attempted, its detection fails and can be restored only after key lock checking fault is removed.			red indication starts flashing.
19.	**Automatic route release with passage of train over it:-**			
(i)	Train enters the route. As the first control track circuit is occupied, signal goes to 'ON'.			First control track circuit displays red. Indication on signal demarcation changes to red (steady).
(ii)	As the train occupies and clears track circuits one after another, route sections get released in succession behind the train.			As the train progresses, track circuits display occupied (Red) indications one after another. Those track circuits cleared by the train display white indications when finally, the route section gets cleared, illumination of route section track circuits completely disappears.
(iii)	**If the train is not running through:** overlap gets released *two minutes after* the occupation of berthing track circuit and release of last route section.			Berthing track displays steady red indication. Overlap track white indication disappears after two minutes.
(iv)	**If Route Section in the Overlap portion is already set for clearing signal in advance and allowing run through:** Overlap gets released with the passage of train over it *immediately*.			Overlap set indication which is a part of route locked indication for signal in advance disappears after the passage of train over it.

20. Manual route release in emergency.

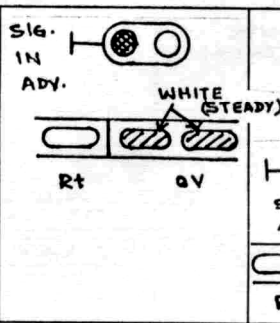
(i)	Press GN and EGGN together and release to replace signal at 'ON'			Signal indication changes from green to red.
(a) (ii)	**If approach track is clear.** Press GN and EUUYN together. Release EUUYN only, keeping GN pressed. Press UN now and release both. Route and overlap get released immediately.			Track circuit illumination of route and overlap as well as route locked and signal locks route indication disappear . EUUYZ counted progress by one number.
(b) (ii)	**If approach track is occupied.** Press GN and EUUYN together and release. EUUYN only keeping GN pressed, press UN.			White approach lock release timer indication flashes for two minutes after operation and then becomes steady.
(iii)	**After Timer indication becomes steady :** Press GN and EUUYN together. Release EUUYN only, keeping GN pressed. Press UN now and release both. Route and overlap get released.			Track circuit illumination of route and overlap as well as route locked and signal locks route indication disappeared.

21. Individual route section release in emergency:-

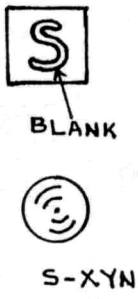
(i)	Break open the seal on disc blocking the EUYN operation and turn it to free EUYN. (This operation is done with co-operation from authorised S&T staff on request)			
(ii)	Authorised S & T Staff has to insert the EUYN Key on panel and turn.			

(iii)	Press the nominated WN for route section release concerned and EUYN simultaneously and release. The particular route section gets released.			Route locked indication on concerned track circuit and point locked indication disappear. Point position indication in the last operated condition remains EUYZ counter progresses by one number.

22. Manual overlap release in abnormal conditions:-

(a)	**If OYN is provided on the panel:** Press OYN along with the concerned UN and release.			Unless the last route section in the route is released. Overlap releasing is not possible. Overlap white illumination disappears soon after the operation.

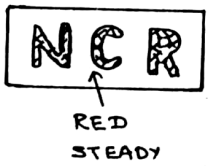
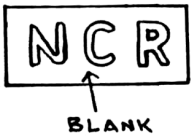
23. Signal lamp fused warning:-

	A stencilled S Red indication appears at the top of panel and also buzzer sounds. After noting the location of failure, press S-XYN /GXYN button Buzzer stops. Visual indication remains till the signal lamp is replaced.			Red 'S' indication disappears after the fused signal lamp is replaced.

24. Point detection failure warning:-

	A stencilled P Red indication appears at the top of panel and also a buzzer sounds. After noting the location of failure, press P XYN / WXYN button. Buzzer stops. Visual indication remains till the point detection is restored.			Red 'P' indication disappears after the point detection is restored.

25. Indication of Button stuck in pressed condition or button relay/ button repeater relay stuck in picked up condition:-

	Consequently some button checking relay remains dropped and common button checking relay also drops. Concerned button checking relay and common button checking relay can pick up only. When fault is removed.			'NNCR' indication is displayed till the fault is removed. Buzzer also does not stop. Till the fault is removed. No manual operation is possible on panel in this condition.

CHAPTER – 3 : RELAY GROUPS AND ITS ARRANGEMENT

3.1 The following types of relays are used in these systems of Siemens practice.

S.No	Type of Relay	Specification	Purpose.
1.	Non-ACI K50 Neutral control relay.	RSSK-30/0011	for all controls except point motor feed. Switching, in non RE areas and internal circuits of RE areas.
2.	ACI K50 neutral control relay	RSSK-30/0078	for external circuit of RE areas.
3.	K50 type RECR, DECRs, /HECR UECRs of main signals & OFF & ON-ECRS of shunt signals.	RSSK-30/0013 RSSK-30/0014 RSSK-30/0015	for checking different signal lamps.
4.	K50 Interlocked relays	Rssk-30/0012	for internal controls in cabins.
5.	Point contactor relay	K 915-1	for point motor feed switching.
6.	Motorised clock work timer relay.	Rssp - 31/0071	Time control of locking releases and calling on signal clearance.
7.	Mercury flasher relay	Type RB 109	for generating, flashing indication supply.
8.	Drs 50 type DC track relay	RSSK-30/0071	for DC track circuits in Non-RE and AC RE areas.
9.	2 Phase induction motor type AC track relays.	RSSK-30/0081	for track circuit in DC RE & AC.RE areas.

3.2 K-50 relays are available only in group units of different sizes. Depending upon the unit size, these groups are broadly classified as:

(1) Mini groups &
(2) Maxi groups.

Maxi groups are further classified as (1) Minor Groups & (2) Major group.

The capacities of various groups are as follows:-

S.No.	Class	Capacity
1.	Mini Group	2 Neutral control relays, 1 interlocked relay or 1 ECR with power conversion unit.
2.	Minor Group	15 Neutral Relays (with one interlocked relay replacing two neutral relays, one contactor relay replacing four neutral relays, or one resistor or condensor fixed in place of one neutral relay in some units.
3.	Major Group (used only in RRI).	Upto 30 neutral relays (with replacements by other relays as in a minor group).

3.3 The various signalling gears are controlled in these systems by relay groups as shown below:-

S.No	Gears Controlled	Class of Group & Drg.No.	Designation & Usage	Number of Various Components									
				Single Coil Neutral	Double Coil Neutral	Interlocked Relays	Contactors	Resistances	Condensors	Rectifiers	Terminials	Indications	Transformer
1	One 2-Asp Main Signal	Minor RsSp 3525/2	Signal Group in PI, RRI or lever Control	10	-	-	-	2	3	2	100	2 On(R) & Off(G)	-
2	One 3-Asp Main Signal	Minor RsSp 3525/46	Signal Gourp in PI, RRI or lever control	13	-	-	-	2	3	3	100	2 On & Off	-
3	Two Shunt Signals	Minor RsSp 3525/67	Signal Group in PR, RRI or lever control	13	-	-	-	2	2	4	100	4 ON (R,R) & OFF (Y,Y)	-
4	Two Route Sections	Minor RsSp 31/00021	Universal Route Group in PI, RRI	5	-	3	-	-	-	-	100	2 Rt set & Pt locked and Checked	-
5	Two Siemen's Point Machine (Successive Controls)	Minor RsSp 31/0001	Drs II Point Group for PI	3	4	2	1	11	1	1	100	1 Pt Det (R)	-

S.No	Gears Controlled	Class of Group & Drg.No.	Designation & Usage	Number of Various Components									
				Single Coil Neutral	Double Coil Neutral	Interlocked Relays	Contactors	Resistances	Condensors	Rectifiers	Terminials	Indications	Transformer
6	One or Two successively controlled Siemens Point Machines with DC Motor	Major RsPs 3515/19	Drs Point Group for RRI	7	6	5	1	11	1	1	180	3 Pt Det 1 Pt Lock (R) 1 Track Fail (R)	-
7	One or Two successively controlled Simens Point Machines with AC 3 – Phase Motor	Major RsPs 31/0015	Universal Point Group for RRI	7	6	5	1	11	1	1	180	-do-	3
8	One or Two successively controlled Siemens Point Machines with AC 3 – Phase Motor	Minor RsSk 31/0003	3 – O Point Group for PI	3	4	2	1	11	1	1	100	1	1
9	One or Two successively controlled Point Machines of other than Siemens make with DC 3 – Phase Motor	Minor RsSk 3515/22 (to be used with Main Points Group)	Drs Point switching Group for PI, RRI or lever control	4	1	3	1	-	-	-	-	100	1
10	Succesive operation control of eight point groups	Minor RsSk 3515/3	Point Chain Group for RRI	8	-	-	-	-	-	-	-	-	-

3.4 K-50 Relays

On the basis of thickness of residual pin / separating pin, relays are classified as:

1) A type : residual pin thickness is 0.35mm
   (a) Non A/C Immunised neutral relays
   (b) Interlocked relays

2) B type : residual pin thickness is 0.15mm
   (a) A/C Immunised neutral relays
   (b) special or double coil relays
   (c) UECR

3) C type : residual pin thickness is0.45mm
   (a) RECR
   (b) DECR

4) a) Maximum Contacts available = 8 Nos.

   b) Standard Contact Configuration:

   i) Neutral/Int.rel. = 6F/2B, 5F/3B, 4F/4B.
   ii) ON/OFF ECR = 3F/3B.
   iii) UECR = 5F/1B.
   iv) WJR (P/group) = 2F/2B.

   c) Current carrying capacity: -
   (i) Switching=2 Amp
   (ii) Continuest= 5 Amp

   i) Switching = 2 Amps.
   ii) Continuest = 5 Amps .

   d) All independent, series double make break.

   e) Contact resist = 0.05 Ohm.

5) Code pins are provided to prevent the plugging of wrong relay in a base.

6) Guide pins are provided to prevent plugging of relay in a wrong direction i.e., inverting the position of relay.

7) The armature operation is assisted by proving action and hence more positive.

8) Size of the relay is small. It occupies less space and operation is very fast.

9) Contact resistance of metal-to-metal relay is less so that more contact can be proved in one circuit.

MINI GROUP

Front view

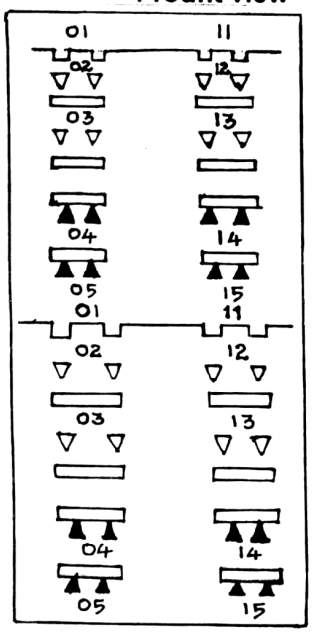


Fig : 3.1

Rear view

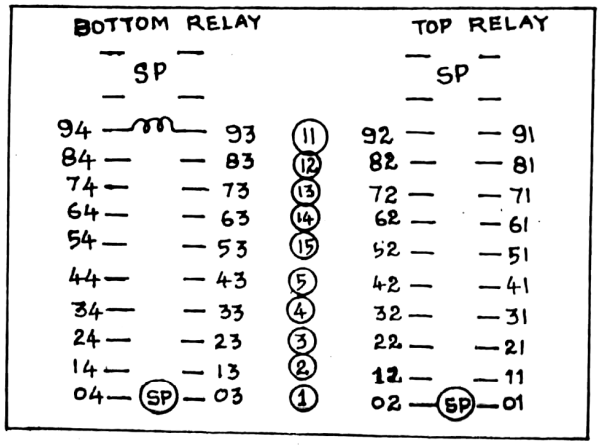


Fig : 3.2

02 – 12 Always front contact
05 - 15 Always back contact.
03 - 13
Inter changeable contact
04 - 14

Contact Nos.	Termination details	
	Top Relay	Bottom Relay
01	01 - 02	03 - 04
02	11 - 12	13 - 14
03	21 - 22	23 - 24
04	31 – 32	33 - 34
05	41 - 42	43 - 44
15	51 - 52	53 - 54
14	61 - 62	63 - 64
13	71 - 72	73 - 74
12	81 - 82	83 - 84
11	91 92	93 94

Fig : 3.3

3.5 Minor group:

1. Main Signal Group : 3 Aspect,
   2 Aspect.

2. Shunt Signal Group : It caters two shunt signals.

1. 3 ASPECT MAIN SIGNAL GROUP

FRONT VIEW

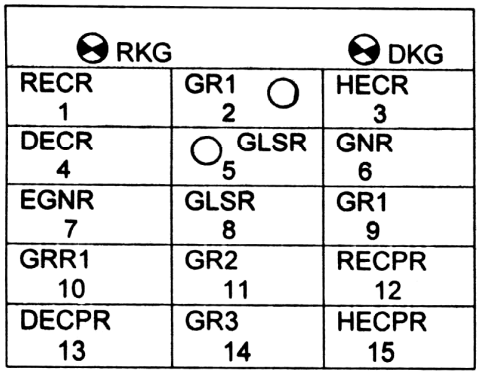


Fig : 3.4

REAR VIEW

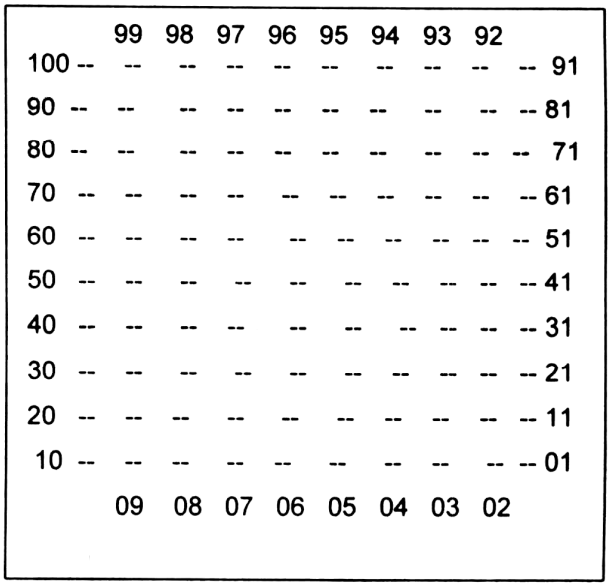


Fig : 3.5

1. **Signal Button Relay (GNR)** : This is signal button relay energised when concerned signal button 'GN' is pressed. Provided the emergency signal button (ERN) is not simultaneously pressed.

2. **Emergency Signal Push-button Relay (EGNR)** : This relay operates when the signal button 'GN' and common emergency button 'ERN' are pressed simultaneously for throwing a clear signal to ON position.

3. **Red-aspect Lamp Checking Relay [RE(MN)CR]** : This relay indicates or proves burning of ON aspect. Relay drop immediately when any one of the filament fuses as the operating current is about 275mA. Hence this relay cannot be used for OFF aspects.

4. **Yellow / green Lamp Checking Relay (H / DECR)** : Same as RECR. But, this relay drops only when both the filaments of signal lamp is fused.

5. **Repeater of Lamp Checking Relay (RECPR / HECPR / DECPR).**

6. **Signal Lock Stick Relay (GLSR)** : This relay is used to provide one train one signal feature and is equivalent to the conventional "SR". In main signal group this relay remains normally in a de-energised condition and picks-up when the route is initiated and drops before GR2 picks up for clearing the signal. SH GLSR is normally in energized condition.

GLSR is made slow to release by provision of 250 Mfd condenser in series with a 100 Ohm resistance across the relay coil.

7. **Signal Control Relay (GR1, GR2, GR3)** : These are the relays which controls the signal aspect. GR1, GR2 together perform the function of conventional HR and GR3 that of DR. In case of 4-Aspect signal, an additional relay GR4 has to be provided externally.

   GR1 made slow to release by connecting a 500Mfd and 100 Ohm in series with relay coil. Relay is made slow to release to prevent the signal going to danger in case of power fluctuation or momentarily bobbing of track circuit for bobbing.

8. **GPR1 & Repeater of ER1 Relay** : In addition, it provides supply to route indicator lamps.

2-Aspect Signal Group

⊗ RKE		⊗ DKE
RE(Mn) CR	○ GR1	HECR
	GLSR ○	GNR
EGNR	GLSR	GR1
GPR1	GR2	RE(Mn)CPR
		HECPR

Fig : 3.6

Shunt Signal Group

⊗RKE	⊗DKE	⊗RKE	⊗DKE
RECR	HECR		GLSR
GNR	EGNR		GR1
GR2	○ GR1		GR2
GNR	○ GR1		GR1
RECR	HECR		GLSR

Fig : 3.7

3.6 Minor Route Group:

UNIVERSAL ROUTE GROUP

Front View

⊗RKG		⊗ HKE
AU(R)S 1	2	BU(R)S 3
AU(N)S 4	5	BU(N)S 6
7	'A'DUCR 8	'B'DUCR 9
U(R)LR 10	11	UDKR 12
U(N)LR 13	UYR1 14	UYR2 15

Fig : 3.8

Rear View

	99	98	97	96	95	94	93	92	
100	--	--	--	--	--	--	--	--	91
90	--	--	--	--	--	--	--	--	81
80	--	--	--	--	--	--	--	--	71
70	--	--	--	--	--	--	--	--	61
60	--	--	--	--	--	--	--	--	51
50	--	--	--	--	--	--	--	--	41
40	--	--	--	--	--	--	--	--	31
30	--	--	--	--	--	--	--	--	21
20	--	--	--	--	--	--	--	--	11
10	--	--	--	--	--	--	--	--	01
	09	08	07	06	05	04	03	02	

Fig : 3.9

1. Route Setting Relays [U(R)S/U(N)S]: There are two sets of route setting relays in each universal route group and cater for two route sections. It is an interlocked relay, when the upper/top coil is latched, it indicates that the route section is set and when the lower armature (bottom relay) latched it indicates that the route section is not set.

   In RRI 'A' route section setting relay AU(R)S latched, it controls the setting of points in the sub-route for straight route and 'B' route section setting relay ['B' U(R)S] controls the setting of point in the diverging route.

   In P.I., U(R)S picks up only after ensuring that the points for the route section are set and locked in the required position. This relay locks the point group electrically.

2. Route Clear Indication Relay (UDKR): This is a neutral and common route clear indication relay for all the route sections of a sub-route picks up when a route section is set and all the track circuits in the set Route Section are clear. This relay helps in sequential proving of sub-route track circuits for automatic route release by the passage of .

3. Route Clear Checking Relay (ADUCR/BDUCR): These are neutral relays and ensure that the points in the concerned route sections and isolation are correctly set and locked. One separate relay is provided for each route section.

4. Sub-route Locking Relay [U(R)LR/U(N)LR]: This is an interlocked relay used for locking the sub-route when it is engaged in a signalled move. This is common relay for all the route sections in a sub-route. The latching of upper relay locks the sub-route and latching of bottom relay indicates that the sub-route is free.

   Picking up of this relay [U(R)LR] ensures that –
   a) the concerned route section setting relay U(R)S is latched;
   b) route section is clear of a train
   c) relevant DUCR is up;(relevant route section is checked)
   d) concerned buttons are released.

5. Route Release Relays (UYR1 & UYR2) : These are neutral relays and operate and stick when a train passes over the sub-route proving that the track circuits are actuated in a predetermined sequence. These relays in conjunction with UDKR release the route section after the passage of the train, thus permitting the sectional route release.

3.7 Minor group DRS-II Panel Point Group:

Front View

RKE		
Z1WR1 1	Z1NWR 2	Z1RNR 3
W(R)R 4	(R) WLR 5	WKR2 6
W(N)R 7	(N)WLR 8	WKR1 9
10	11	WKR3 12
WR		
13	14	WJR 15

Fig :3.10

Rear View

	99	98	97	96	95	94	93	92	
100	--	--	--	--	--	--	--	--	-- 91
90	--	--	--	--	--	--	--	--	-- 81
80	--	--	--	--	--	--	--	--	-- 71
70	--	--	--	--	--	--	--	--	-- 61
60	--	--	--	--	--	--	--	--	-- 51
50	--	--	--	--	--	--	--	--	-- 41
40	--	--	--	--	--	--	--	--	-- 31
30	--	--	--	--	--	--	--	--	-- 21
20	--	--	--	--	--	--	--	--	-- 11
10	--	--	--	--	--	--	--	--	-- 01
	09	08	07	06	05	04	03	02	

Fig :11

29

1. Point Group Initiating the Point Control Relays (Z1WR1): This is the first relay to pick-up in a point group for point operation. It has two windings. This relay is to initiate the point-switching group where the points are operating by other than Siemen's Point Machine.

2. Point Control Relay [W(R)R/W(N)R]: This is an interlocked relay. Super imposed detection facility is made possible by using this relay.

   i) When W(N)R latched point detection circuit is closed.
   ii) When W(R)R latched point operation circuit is closed.

3. Normal Point Initiating Relay (Z1NWR): This is a double coil relay. This relay switched on normal point controlling relay [(N)WLR]. Once energized, it drops only when the point buttons are released and (N)WLR is energized.

4. Reverse Point Initiating Relay (Z1RWR): This is a double coil relay. This relay switched on reverse point controlling relay [(R)WLR]. Once energized, it drops only when the point buttons are released and point controlling relay [(R)WLR] is energized.

5. Point Controlling Relays [(R)WLR/(N)WLR]: This is an interlocked relay used for controlling point operation circuit. When -

   i) (N)WLR :- It closes normal point operation circuit.
   ii) (R)WLR :- It closes reverse point operation circuit.

   This relay do not have heavy duty contacts.

6. Point Detection Relay No.1 (WKR1): This relay detects the correct setting and locking of point in either position. This relay energies only when the point is set and locked in correspondence with point group. Independently it cannot indicate the position of the point.

   W(N)R + (N)WLR + WKR1 = NWKR↑

   W(N)R + (R)WLR + WKR1 = RWKR↑

7. Point Detection Relay No.2 (WKR2): This is also called as "Cross Protection Relay". It operates during sequence of relay operation in point group and switches on point time delay relay. Once this relay picks up and drops only when the point is set and locked It also energies when the point and point group is out of correspondence and when there is a cable fault. It protects the point by causing WKR1 to drop to provide flashing indication.

8. Point Detection Relay No.3 (WKR3): It is double coil relay. It is also called as a "End Position Proving Relay". This relay operates:

   i) When the point and point group is in correspondence on completion of operation through point operation supply (IC 110VD). When once energized at the end of Point Operation, stick through its 2nd coil till such time W(N)R is latched.

   ii) It operates during sequence of relay operation in point group when the point operation form in normal to reverse is initiated to disconnect the point detection supply of WKR1.

9. Point Time Element Relay (WJR): This is a neutral relay. To make it slow to release a 2500 Mfd condenser in a series with 39 Ohms resistance connected across the relay coil. Once this relay is energized, will be held for 10 Seconds. This relay controls the point contactor relay for a maximum period of 10 Seconds or this relay drops as soon as the WKR3 picked up. This feature prevents the overloading of point machine in case of obstacles or failure. It operates during sequence of relay operation in point group when the

point operation from Reverse to Normal is initiated to disconnect the point detection supply of WKR1.

10. Point Contactor Relay (WR): This is a contactor Relay having Heavy duty contacts, compels the point operation circuits and its front contacts are designed to carry heavy current of 10A. Motor feed is switched on through this relay front contacts.

    Current carrying capacity of a heavy duty front contact = 10 Amps.

Coil Resistance is 60 Ohms only. Once the relay is energised. It will hold through its own front contact in series with 600 ohm resistance to reduce the holding current.

Coil Resistance of the Relays used in Point Group:

1.	Z1WR1 1st Coil	=	1340 Ω
	2nd Coil	=	1590 Ω
2.	Z1NWR 1st Coil	=	1340 Ω
	2nd Coil	=	1590 Ω
3.	Z1RWR 1st Coil	=	1340 Ω
	2nd Coil	=	1590 Ω
4.	WKR3 1st Coil	=	1340 Ω
	2nd Coil	=	1590 Ω
5.	W(R/N)R	=	615 Ω
6.	(R/N)WLR	=	615 Ω
7.	WKR1	=	1840 Ω
8.	WKR2	=	52.3 Ω
9.	WJR	=	1840 Ω
10.	WR	=	60 Ω

3.8 Point Major Group (R.R.I.):

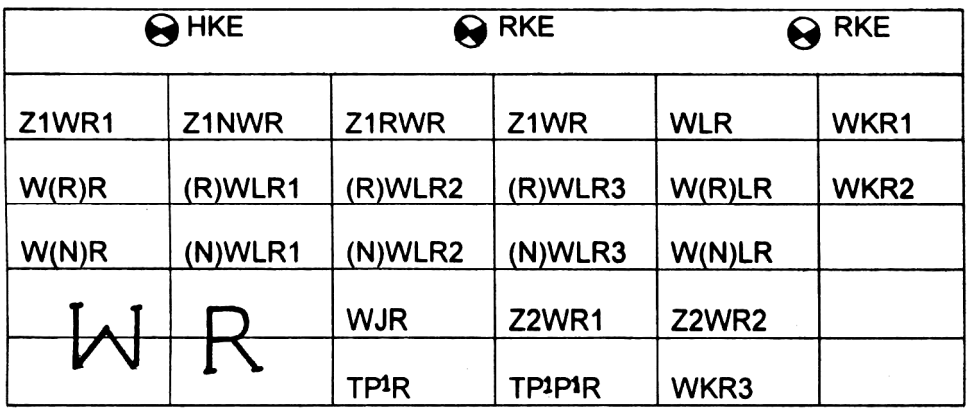


Fig : 3.12

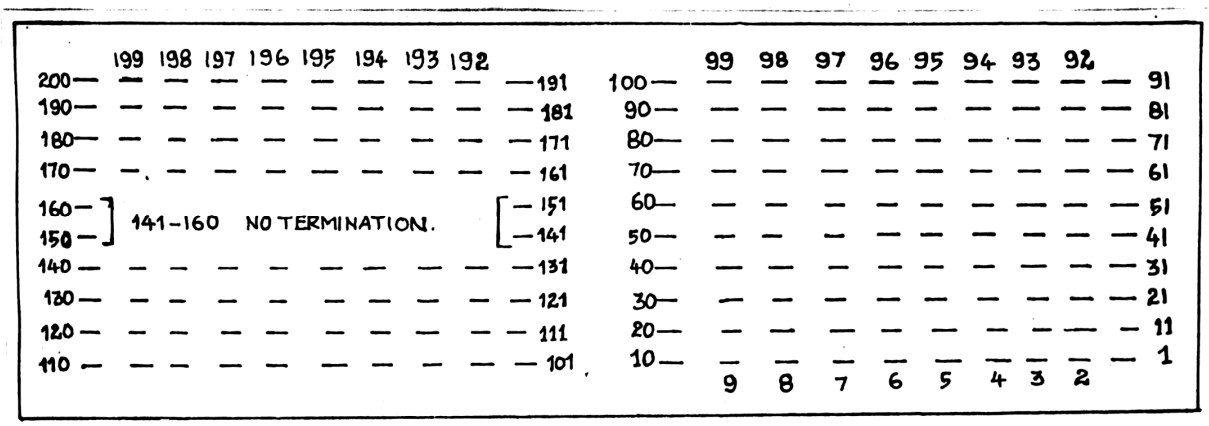


Fig : 3.13

1. Point Initiating Relay (Z1WR): This is the first relay in the point group to respond to route initiation. This does not respond for individual point operation.

2. Points Lock Relay (WLR): This is a double coil relay. This relay has to function namely –

   i) It checks that the point group is initiated due to route setting only and not due to accidental lifting of relays U(R)'s OR OVZ2U(R) R
   ii) It checks the track locking condition.
   iii) It switches on the point chain group and helps in sequential operation of points.

3. (R/N) WLR1,2,3 : Three number of relays are used for obtaining the required number of contacts. The function of these relays are same as in the case of minor point group.

4. TP1R,TP1P2R : Track Repeater Relays, Point Zone Track Repeater Relays.

5. Panel Indication Controlling Relay (Z2WR1) : This relay picks up when the point is operated during route setting to give an indication on point tracks in the route or overlap set on the main line.

6. Panel Indication Controlling Relay (Z2WR2) : This relay picks up when the point is operated during route setting to give an indications on point track in the overlap set to sand hump side.

   These relays, however do not operate for isolation points.

Relays Coil Resistance:

1. Z1WR	1st Coil	=	1340
	2nd Coil	=	1590
2. LR	1st Coil	=	1340
	2nd Coil	=	1590
3. Z2WR1		=	1260
4. Z2WR2		=	1260
5. TP1R		=	1840
6. TP1P2R		=	1260

Rest all relays function is same as in the case of Minor Point Group.

7. Point Group Locking Relay [W(R/N)LR]: It is an Interlocked relay. When a point falls in the Route/Overlap/Isolation, W(R)LR picks up and locks the point group electrically and indicates by lighting the middle light indication on the point group. W(N)LR latch indicate that the point is free.

3.9 Point Switching Group:

This group is provided at the point location for controlling of point machine other than Siemen's type. This group functions in conjunction with the main point group located at the central relay room. The arrangement of relays in this group is as under:

Front View

W(R)R 1	W(R)PR 2	(R)WR 3
W(N)R 4	W(N)R 5	(N)WR 6
Z1WR 7	N/R WR 8	WKR2 9
10 W	11 R	WKR1 12
13	14	WKR3 15

Fig : 3.14

Rear View

	99	98	97	96	95	94	93	92		
100	--	--	--	--	--	--	--	--	--	91
90	--	--	--	--	--	--	--	--	--	81
80	--	--	--	--	--	--	--	--	--	71
70	--	--	--	--	--	--	--	--	--	61
60	--	--	--	--	--	--	--	--	--	51
50	--	--	--	--	--	--	--	--	--	41
40	--	--	--	--	--	--	--	--	--	31
30	--	--	--	--	--	--	--	--	--	21
20	--	--	--	--	--	--	--	--	--	11
10	--	--	--	--	--	--	--	--	--	01
	09	08	07	06	05	04	03	02		

Fig : 3.15

1. Point Switching Group Initiating Relay (Z1WR): When the Z1WR1 relay operates in the main point group, it switches on the point switching group by closing the Z1WR relay coil circuit. This relay opens the circuit of WKR1 of both main point group and point switching group.

2. Points Relay [W(R)R/W(N)R & W(R)PR/W(N)PR]: These relays helps in switching over point control circuit and point detection circuits.

3. Points Operation Controlling Relay (N/R WR): It is a repeater relay of WJR and WR relay of main point group. This is a neutral relay.

4. Point Operating Relay [(R/N)WR]: This is an interlocked relay. When (R)WR picks up controls reverse operation of point; and (N)WR picks up controls normal operation of point.

5. Point Detector Relay No.1&2 (WKR1 & WKR2) : Same function as main point group.

6. Point Detector Relay No.3 (WKR3) : This relay operates at the end of each operation and indicate that the completion of point operation. It causes WKR2 & WR drops and W(N)R and W(N)PR operates.

6. Point Contactor Relay (WR): It controls the feed to point machine and is heavy duty front contact.

3.10 Point Chain Group:

FRONT VIEW REAR VIEW

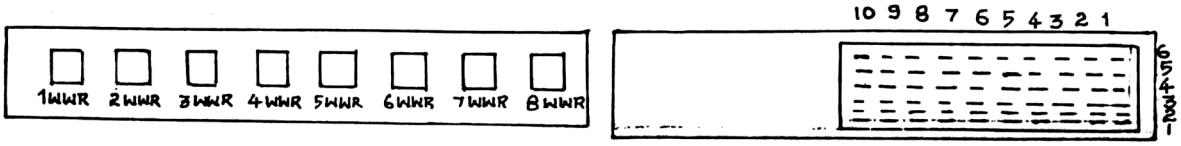


Fig : 3.16

This relay group is used only in Route Relay Interlocking (Relay Interlocking Route Setting Type) and placed on top of the rack just above the major point groups. One chain group is provided with eight numbers of neutral relays. The circuit is designed in such a way that which picks up one after the other and also drops one after the other. The pick up contact of 1st relay (1WWR) is used for one major group to energize Z1WR relay during automatic operation of point. Thus the picking up of Z1WR in each Point group is ensured. One after another during route setting, so that the operation of point relays group/starting (switching) of point machine is staggered.

One chain group can cater eight numbers of major point groups.

Sequence of Relay Operation of Point Chain Group:

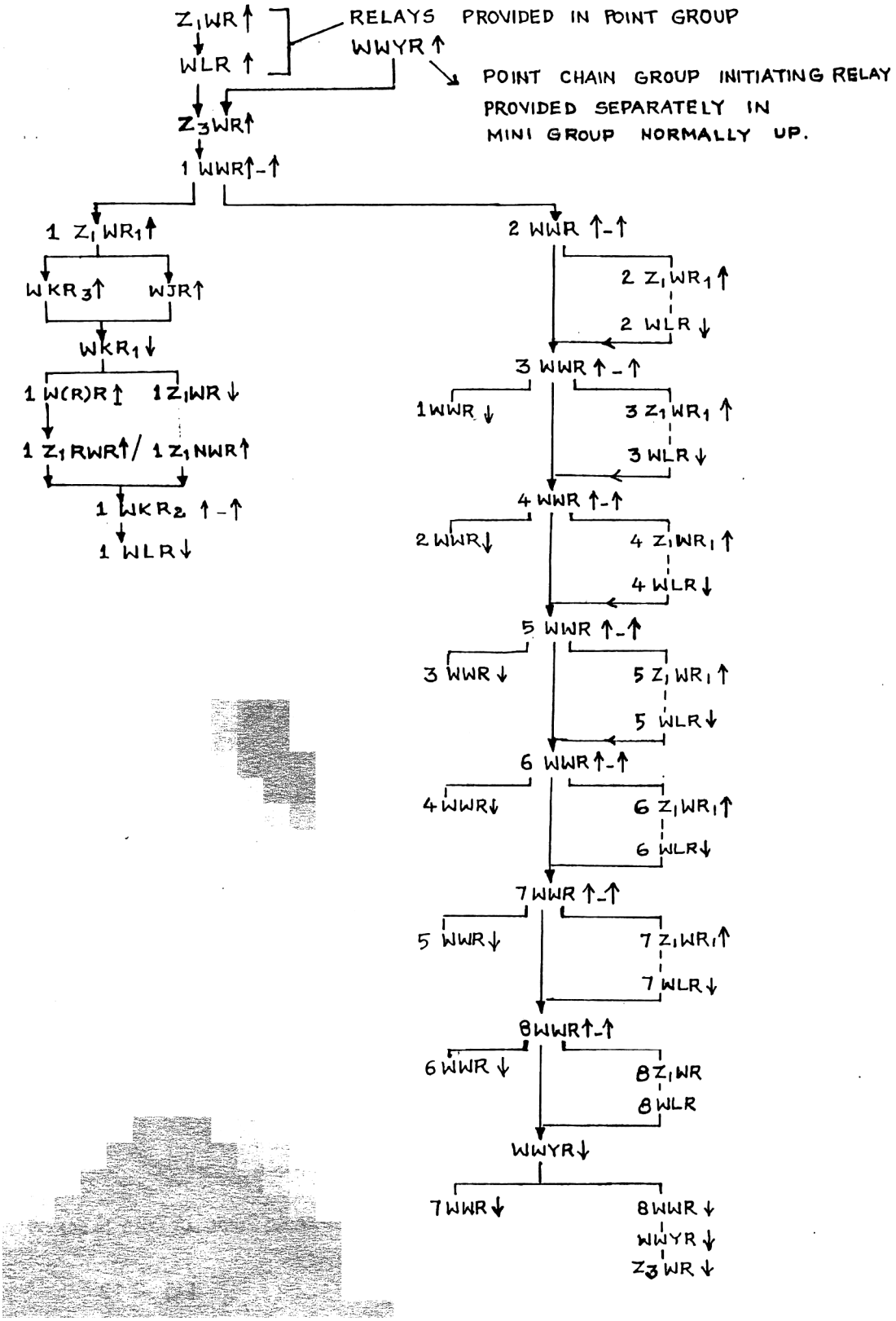


Fig : 3.17

3.10 Relay room arrangement and installation:

The relay racks are erected on pedestal, which are anchored to anchor bolts. Proper side and back supports by means of single irons from the adjoining walls are provided. Ladders are fixed at the side and top of the rack to run the cables and wiring. The distance from the parallel wall to the first row of relay rack should be 1.5M and also from the sidewall it shall not be less than 1.5M. The distance between intermediate rows of racks should not be less than 1.00 Metres so as to enable free movement for maintenance staff in between two rows of racks.

In small installations, the tag blocks are provided in rear of relay rack. Copper wires do the connection between the relay groups and tag blocks.

In case of major yards, the tag blocks are fixed on a separate row of racks called as intermediate distribution frames, numbered according to the relay rack numbering. Using 60 cores and 40 cores in door cable makes connection between the relay group and tag blocks. Inter wiring between one group to another group and to the external connections such as panel, external cables termination is done at the tag blocks by using 0.6.mm.dia jumper wires. More than two wires shall not be terminated on tag block pins. 0.6 mm. dia. wires are used for all circuits and 1.00mm. dia. wires are used for point control and signal lamp circuits.

The arrangement as a whole gives a neat appearance and renders alteration to wirings, localisation of faults, etc. extremely easy with minimum disturbance to the working installation. All the connections to terminal boards, IDF, relay groups are done by soldering. The solder joints have proved to be satisfactory in practice.

One relay rack can accommodate -

a) 8 Nos. of major group and one chain group.
b) 16 Nos. of minor groups and "G" type fuse blocks on top.
c) 64 Nos. of mini-group and "G" type fuse blocks on top.

Mini-group in a Row

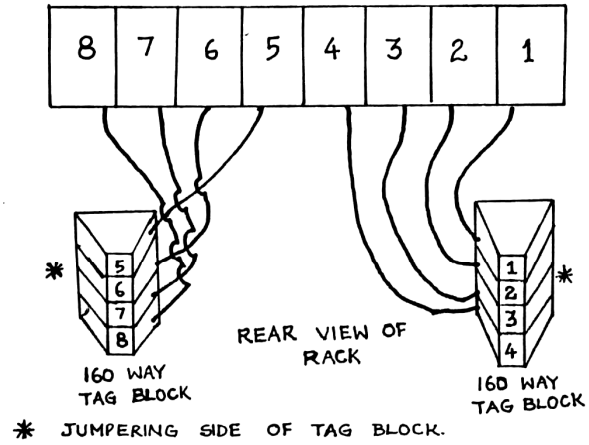


Fig : 3.18

Minor group in a Row

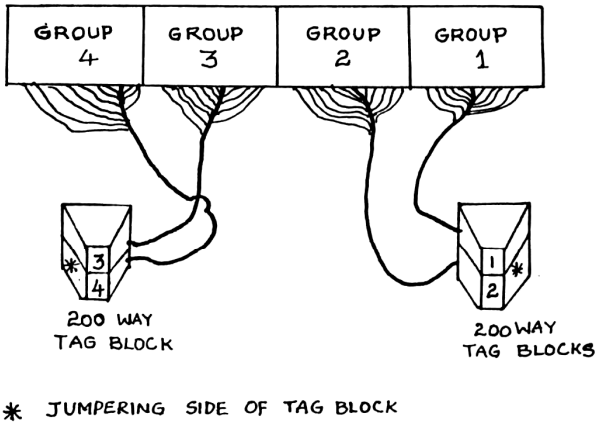
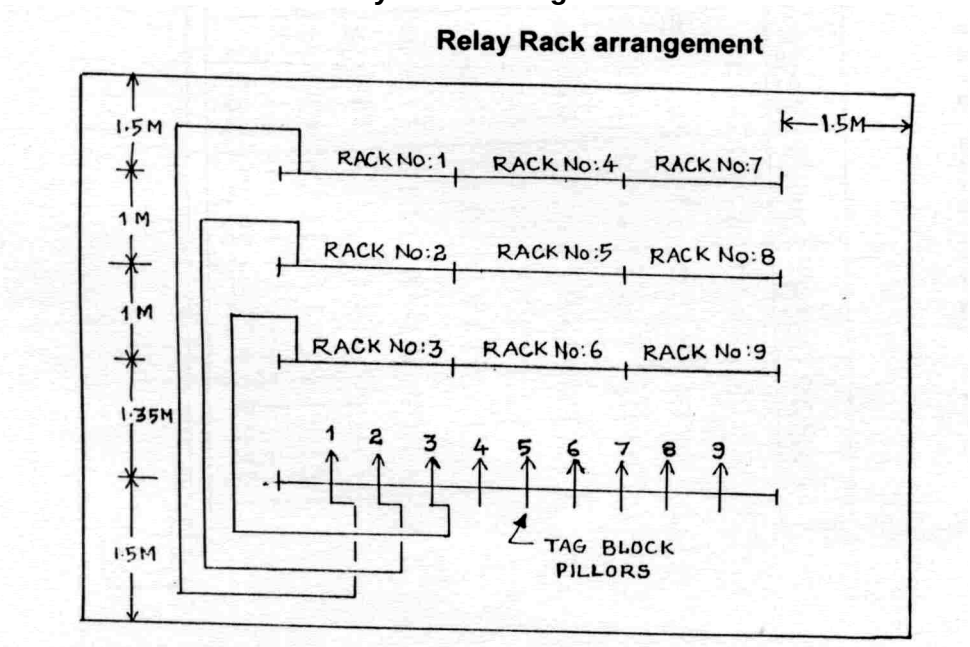


Fig : 3.19

Two types of tag blocks are available one with 200 terminals and the other one is 160 terminals. One tag block of 200 terminal can accommodate one number of major group or two numbers of minor groups or five numbers of mini-groups. One tag block of 160 terminal is sufficient for four mini-groups.

Relay Rack arrangement



- each tag block piller contains 10 Nos. of 200-way tag blocks.

Fig : 3.20

The numbering of a 200-way tag block termination is shown in the diagram block.

This is generally used for terminating the wiring of one major group or two minor groups or five mini-groups. The counting is done from the rear towards the front as shown.

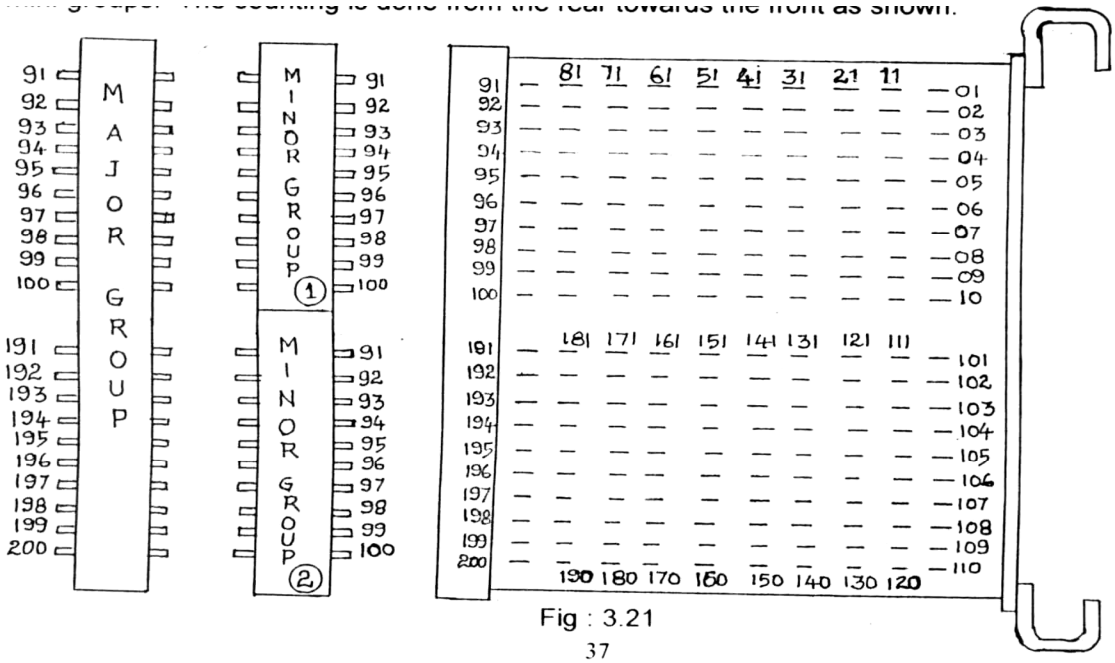


Fig : 3.21

37

The numbering of a 160-way tag block which is generally used to terminate the wiring of four mini-groups is shown bellow.

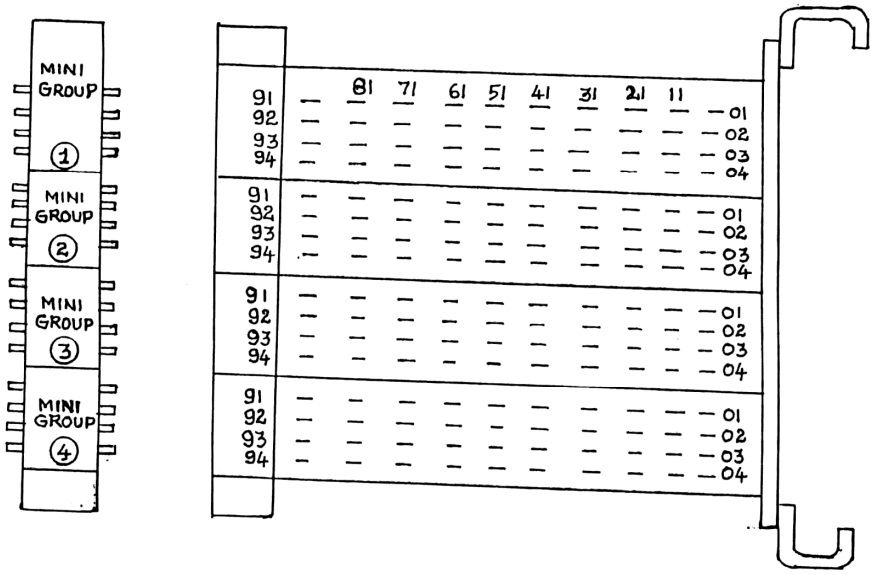


Fig : 3.22

CHAPTER - 4 : ROUTE SECTION PLAN

4.1 The route section plan shows the entrance and exit buttons with their designation at their geographical location. The buttons are represented by a small circles in the plan.

In Relay Interlocking (Siemen's) System, interlocking between various signalling functions are not provided as in the case of other systems. For this purpose the major yard is divided in to zones to signal routes and signal route to sub-routes and sub-routes to route section or overlap. The route sections and overlaps are the basic units for achieving the interlocking.

The entire layout is divided into a signal route and further into a sub-route to facilitate the sectional route release.

Each sub-route includes one or more point in it. Sometimes, sub-routes without point can also exist for achieving special condition of interlocking. Sub-routes are numbered as per the number of any one of the points which exist in it. If there is no point, such sub-route will be numbered as per the signals controlled by it.

Sub-route which includes one or more points are so formed by combining route sections so that only one movement is possible over that sub-route at a time. This is ensured by using a common sub-route locking relay U(R)LR. For a crossover point, in which parallel movements are possible, there will be two sub-routes. Each sub-route is further divided into route sections. Each route section usually giving certain specified setting of points. The straight movement over a sub-route requiring points in normal position is called "A" route section and the diverging route requiring points in reverse is called B or C or D route section. A sub-route can have one route section or more number of route sections.

The following example illustrate the principles involved in demarcation of route sections and formation of sub-route:

Case No.1:

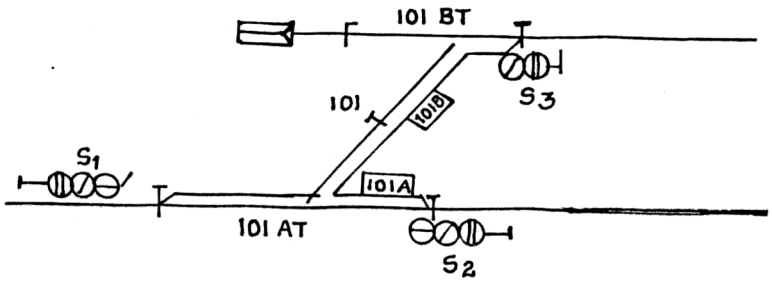


Fig : 4.1

Point No.101 is having only sub-route as only one movement is possible at a time. When the main line end is used for a movement, say clearing the starter Signal No.2, the other end cannot be used for any other movement except it can be used for setting the overlap.

Point No.101 is having two number of route sections i.e., 101A which control the point in normal position and 101B which controls the point in reverse position.

No. of Point	No. of Sub-route	No. of Route Section	Point Controls
101	101 A/B	101A	101N/101N
		101B	101R/101R

Case No.2:

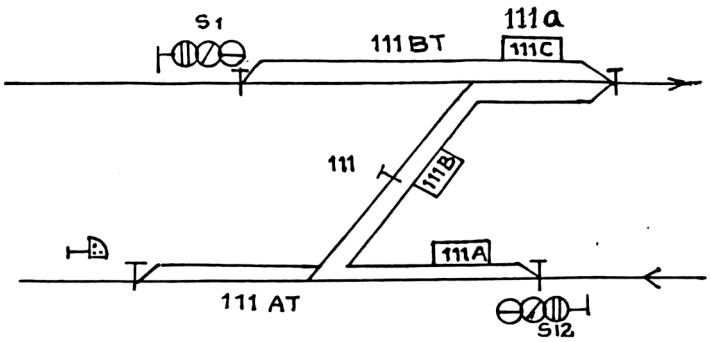


Fig : 4.2

No. of Point	No. of Sub-route	No. of Route Section	Point Controls
111	111 A/B	111A	111N/111N
		111B	111R/111R
	111 a	111a	111N/111N

There are two sub-routes for the crossover shown Route section 111A and 111a can be set simultaneously with points in normal for parallel movements.

In this 111 A/B is one sub route having two route section and 11/a is second Sub route having only one route section.

In some installation, the crossover point above is given dual number, 111/112. This is for the purpose of assigning separate number for the two sub-routes on the crossover distinctly.

Case No.3:

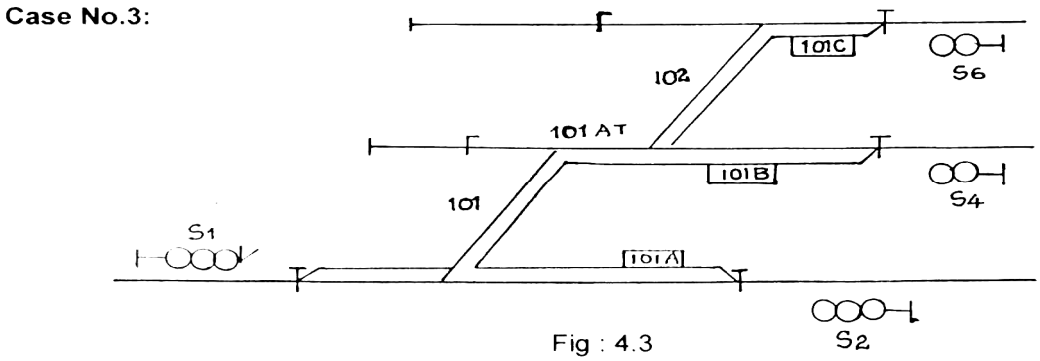


Fig : 4.3

No. of Point	No. of Sub-route	No. of Route Section	Point Controls
101 102	101 A/B/C	101A	101N/101N, 102 N/102N
		101B	101R/101R & 102N/102N
		101C	101N/101N & 102R/102R

Point No.101 and Point No.102 is having only one sub-route as only one movement is possible at a time. This sub-route is having three route sections since three possible movements are there. In this, no sectional route release facility is not available for providing the sectional route release arrangement these points should be splitted and should be provided with two number of sub-route and each sub-route will have two number of route sections.

Case No.4:

a)

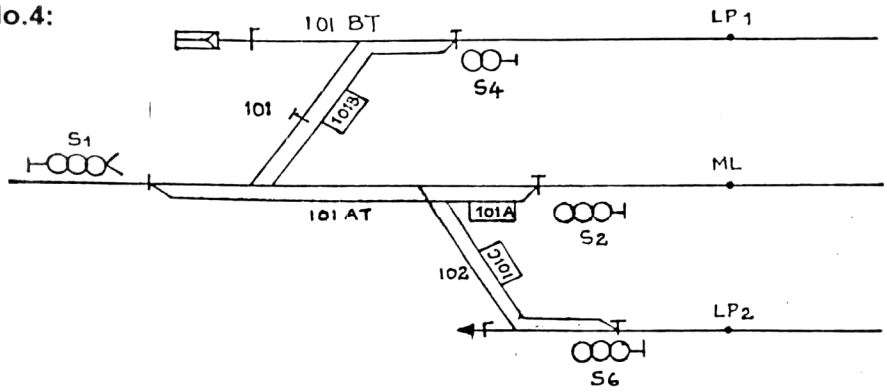


Fig : 4.4 a

No. of Point	No. of Sub-route	No. of Route Section	Point Controls
101 102	101 A/B/C	101A	101N/101N & 102N/102N
		101B	101R/101R & 102 N/102N
		101C	101N/101N & 102R/102R

Remark: Sectional Route release facility is not available.

b)

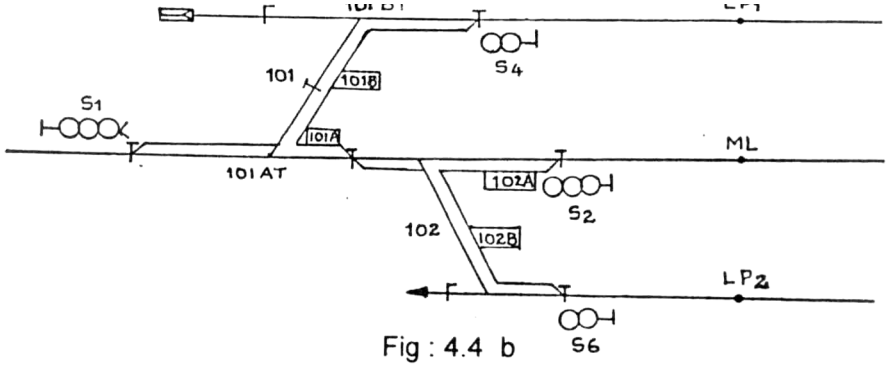


Fig : 4.4 b

No. of Point	No. of Sub-route	No. of Route Section	Point Controls
101	101 A/B	101A	101N/101N
		101B	101R/101R
102	102 A/B	102A	102N/102N
		102B	102R/102R

Note: SRR is available.

Case No.5:

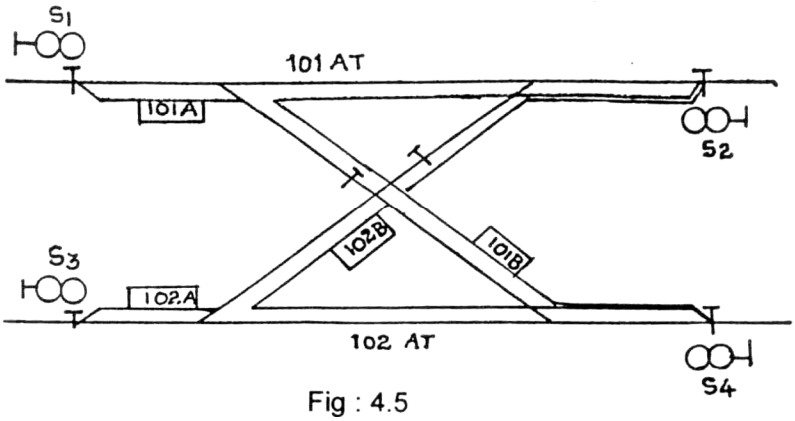


Fig : 4.5

No. of Point	No. of Sub-route	No. of Route Section	Point Controls
101 & 102	101 A/B	101A	101N/101N & 102N/102N
		101B	101R/101R
	102 A/B	102A	101N/101N, 102N/102N
		102B	102R/102R

In the above layout with two points 101/101 and 102/102, there are two sub-routes, i.e., 101 A/B and 102 A/B. Since there is possibility of parallel movement, keeping Point 101N and 102N. Each sub-route is provided with two route sections since two possible movements are there.

Case No.6: ⟶ Diamond Double Slip: ⟶

SUB ROUTE FOR A DOUBLE SLIP LAYOUT

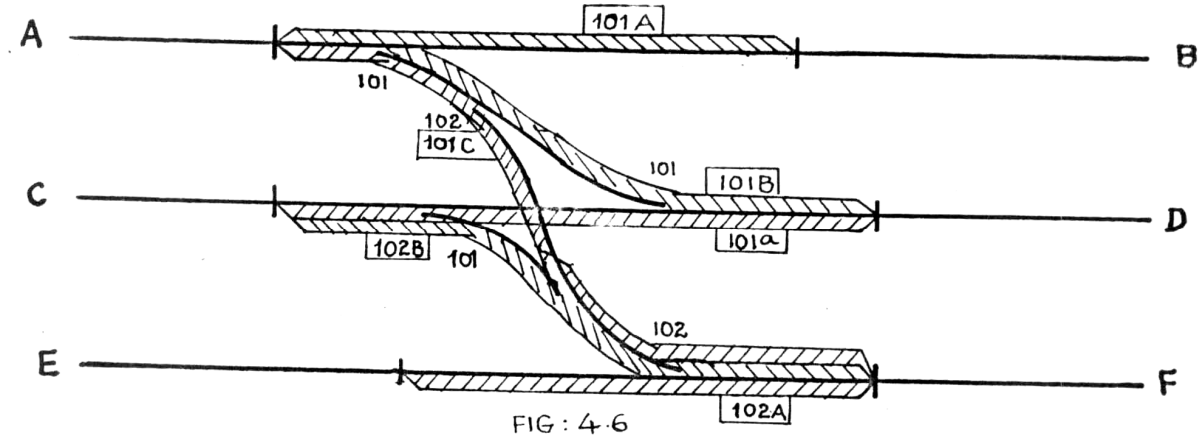


FIG : 4.6

Movement	Route Section	Point Position	Remarks
A – B **A - D** **A - F**	**101 A** **101 B** **101 C**	**101 N** **101 R, 102 N** **101 R, 102 R**	**First Sub Route**
C - D	**101 a**	**101 N, 102 N**	**2nd Sub Route**
F - E **F - C**	**102 A** **102 B**	**102 N** **102 R, 101 N**	**3rd Sub Route**

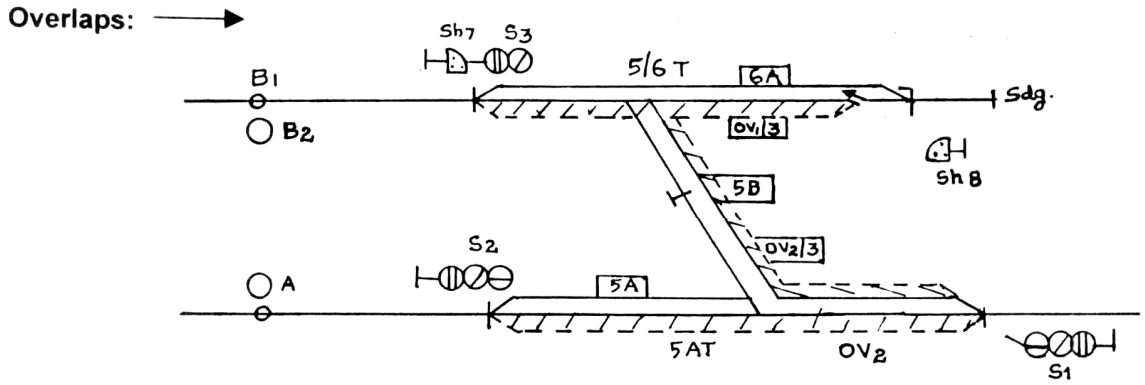


Fig : 4.7

Signal Overlaps are marked in the route section plan. This helps to identify the interlocking required for an overlap with other overlap and route sections.

Overlaps are numbered as per the signal numbers beyond which they fall. These are required to be set along with the route for main signal in rear. Many places more than one overlap are available to choose from. In the above layout signal No.2 has only one overlap where as signal No.3 has two overlaps. Each overlap is provided with one Interlocked relay called OVZ2U(R/N)R. Latching of Reverse coil indicates that the relevant overlap is set and this relay will lock the overlap points. This relay will ensure normal position only after the specified time delay, after the train has entered the berthing track.

Where there is a choice of overlap, a separate overlap setting relay is provided for each overlap. For selecting the required overlap a separate route buttons are provided as shown in the layout. In case of non-route setting type of relay interlocking, separate overlap button is not required since points in the overlap also to be set individually to the required position.

In route section plan preferably route sections are marked in bold lining with different colours and overlaps are marked in dotted/shading lines. This facilitates their easy identification in big yards with many route and signals.

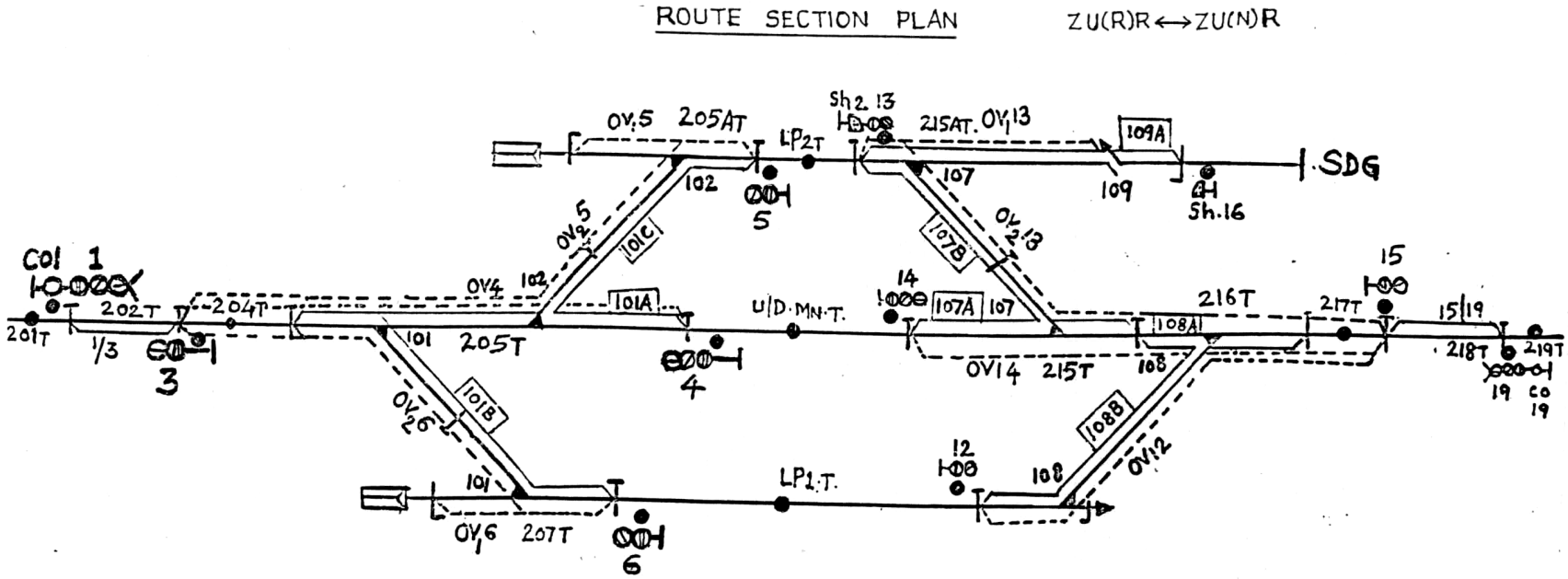

ROUTE SECTION PLAN
ZU(R)R ↔ ZU(N)R
Col 1
201T
202T
1/3
3
204T
OV4
102
OV2 5
101C
205AT
OV1 5
LP2T
5
Sh2. 13
215AT.
OV1 13
107
107B
OV2 13
109A
109
Sh.16
SDG
101A
U/D MN-T.
4
14
107A
107
216T
108A
OV14 215T
108
15
217T
15/19
218T
219T
19 CO 19
101
205T
101B
OV2 6
OV1 6 207T
6
LP1-T.
12
108
108B
OV1 2

Fig : 4.8

CHAPTER – 5 : PRINCIPLES OF OPERATION FOR VARIOUS GEARS

5.1 The functions operated from the panel are

1. Points
2. Routes
3. Signals and
4. Slots.

Operation of the first three functions takes place in four stages, viz

1. INITIATION
2. CONTROL
3. CHECKING and
4. LOCKING .

In the 'INITIATION' stage, interlocking and other safe conditions are verified and confirmed before changing the position of controlled gear.

In the 'CONTROL' stage, initiation is proved and operating feed is connected to the gear after checking the integrity of relays involved in the process.

In the 'CHECKING & LOCKING' stages, the changed condition of gear is ascertained and this condition is locked, i.e., retained undisturbed until after the movement of train or fulfilment of the necessary safe conditions in emergencies.

5.2 Operation Of Points

5.2.1 Regular Operation:

In the *INITIATION* stage, it is proved that the point is free from route locking as well as track locking and that the necessary panel operation is done.

In P.I., this panel operation is always individual for each point.

In R.R.I., either individual operation of points or route setting for a signal collectively.

(1) initiates point control by

(i) checking point locking conditions.
(ii) removing point detection; and
(iii) switching point machine circuit from detection to operation feed.

2. The *CONTROL* stage following initiation ensures *cross protection* and *overload protection* to the machine before starting the motor operation.

In RRI, this also requires setting *successive control* of all concerned points of the route and overlap in motion soon after the simultaneous beginning of their initiation. This ensures that only two point machines can start moving at a time. It is necessary to limit the load on point feed rectifier and ensure its full output voltage during operation.

The culmination of this stage is in the machine changing the position of points. This happens if only proof of safe conditions established during initiation is not disturbed throughout this stage.

3. The third and last stage of point operation consists at first of its *POSITION DETECTION*. In this, the point machine circuit is switched over to cut off operating feed and connect detection supply. Then, through the machine detection contacts, correspondence between points and control is established by means of a detection relay.

LOCKING of this detected condition of points takes place only when a route is set involving this point in RRI. The point becomes free to be operated again after the set route is normalised.

5.2.2 Operation In Emergency:

Failure of point track circuit creates an emergency when track locking on point prevents their operation. In that case, a recorded and cautions panel operation is done after physical verification of track conditions to save heavy detentions. An emergency common points button (EWN) is pressed along with the individual point button (WN). This initiates point operation by-passing track locking conditions (but no signal clearance other than calling ON Signal is possible over the points in this connection)

The rest of point operation is as per the regular procedure.

5.3 Signal And Route Operation

5.3.1 *Signal Initiation* and Route *Initiation* take place at a time as signal button and route button are pressed together and released. In these initiations, it is proved that the previous route setting in the location is normalised, be it of the same route or a conflicting route or overlap.

Availability of all the route sections to be set is checked for the purpose of making a traffic movement in a particular direction only. Once the direction is established, it is not possible to initiate any other signal on the same route *in opposite direction*.

Also, interlocking between a main signal and conflicting shunt signals is achieved at this stage by means of a '*shunt signal selection relay*'. Overlap is also set for main signals and calling on signals of S/L sections.

2. Route initiation is followed by *Route Setting* which takes place section wise.

Setting of a route section makes points lying within it, its isolation points and slots inoperative until the route setting is normalised again. This is called 'Route locking of points and slots'.

In RRI, setting of a route section includes operation of the concerned points, if they are not already lying in the required position, before locking them.

3. *Route Checking* involves proving of correct point detection along with route setting and free condition of route section track circuits. The route section does not get normalised unless this locking is released after the passage of train or a cancellation operation in emergency. This takes place only after signal & route buttons are released.

4. The set and checked route section is *locked* by the operation of a common locking relay of the sub-route. The route section does not get normalised unless this locking is released after the passage of train or a cancellation operation in emergency.

5. The following conditions are proved in the *Main Signal Control*:

(i) Signal in advance is not blank.
(ii) Overlap is set.
(iii) Points in the overlap are correctly detected

(iv) Overlap track circuits are not occupied.
(v) Route track circuits are not occupied.
(vi) Route sections are checked and locked.
(vii) Controls are normalised after the previous signal clearance and train movement or cancellation thereafter (one train only on one signal clearance)

6. Signal control is followed by *Signal Locking*. In this process, a signal engages or locks a route setting before its clearance. This enforces signal to signal interlocking in the yard directly in addition to the directional and other route lockings in the initiation stage.

After this, the signal finally gets cleared.

5.3.2 Shunt Signal Control:

For *shunt signal*, all the main signal control conditions except setting of overlap, point detection in overlap and non-occupation of last track circuit are proved. In this case, the interlocking provided in the initiation stage is considered sufficient due to the cautions speed permitted by the signal. No second stage locking on the route setting nor direct signal locking is proved. Also, shunt signal gets cleared before the buttons are released after operation.

5.3.3 Calling On Signal Control:

For *calling on signal* control, operation is done only after the occupation of C.O. approach track circuit. No signal initiation takes place for this. Route initiation and setting take place as in the case of main signal concerned. After the necessary time delay, proving the route point detection, and also overlap point detection in case of single line working, the calling on signal gets cleared. Signal locking is not considered necessary.

5.4 NORMALISATION OF ROUTE

5.4.1 With Train Passage:

Regular normalisation of a set route takes place after train movement over it automatically. In this process, signal assuming 'ON' aspect with route occupation releases indication locking on all the route sections. Approach and back lockings get free for each route section individually one after the other when track occupation and clearance take place progressively. And this culminates in the release of route locking, route normalisation and release of locking on concerned points. This process is referred to as *Automatic Route Release*.

The process ends with overlap release in case of main signals 2 minutes after the last route section is released for a halting, train. Overlap gets released along with route section ahead for a run through train with its passage.

5.4.2 In Emergencies:

In emergencies, the various locking releases of route are effected by specified operation on the panel.

5.4.3 Manual Route Release:

EGGN is pressed with the concerned GN to release indication locking on all sections of the route set. Then, a process known as '*manual route release'* is initiated by the operator by means of three buttons, viz, EUUYN, GN & UN. This operation releases locking and normalises all the route sections as well as the overlap if set at the same time. The locking becomes free soon after the panel operation for route release, in case track circuits in approach of signal are not occupied, nor failed. If they are not clear, the release takes place when the three button

operation is repeated after a safe time lapse of 120 seconds, as read from a stabilised panel indication which started flashing after the first three button operation.

The route and overlap release leads to the release of signal locking and point lockings.

5.4.4 Emergency Route Section Release:

In case of track circuit failure in any section of the route set, the route section concerned cannot get released either in the process of automatic route release or manual route release. This situation calls for a joint action of the panel operator along with some responsible official of signalling department to normalise this route section and avoid heavy traffic detentions.

After getting a specific written request from the operator, S & T key is inserted and turned on the panel. Then the operator breaks the seal, turns the disc to free EUYN and presses it alongwith the specific route section point button, WN. With this, the route section gets unlocked and normalised. Consequently its points get free from route locking and the signal locking relay concerned also gets normalised.

5.4.5 Emergency Overlap Release:

In case, a signal overlap has to be released in emergency, the pressing of 'OYN' along with the 'UN' concerned behind the signal, releases the overlap instantly provided the last section of the route concerned is already normal. If OYN is not provided on the panel, EUYN is used instead of OYN for this purpose

5.5 Release Of Crank Handle & Return:

With the concerned route sections and overlaps normal, the panel operator advises the man at site to cooperate for crank handle release. At site, a push button on the Crank Handle Key lock relay Box is pressed.

Then, the *white indication* near CHYN on the panel extinguished & Red indication flashes. The operator now presses CHYN alongwith the common Slot Release Button, YYN.

At site, with the button still pressed, a *steady red indication* appears on the box. The key can now be taken out from the Key Lock Relay to operate the point machines concerned. When the key is extracted, the *steady red indication* on the box & control panel continues to be displayed.

When the key is re-inserted on the Key lock Relay after use and turned, the relay drops. The *red indication* at site disappears.

On the panel also, the *steady red* indication disappears and *flashing white* indication reappears. Seeing this, the panel operator has to press CHYN along with common Slot Return Button, YRN. This normalises the slot and the concerned white indication on the panel becomes steady.

5.6 Release Of Lever Crossing Gate Slot & Return:

When route sections and overlaps involving the gate are normal, the panel operator presses LXN along with YYN. The *steady white* indication near LXN on the panel starts flashing.

A *steady red* indication appears on the level crossing Key lock Relay box at site. When the push button on the box is pressed, the key lock relay picks up and releases the key. When the key is extracted, the *steady red* indication on the box remains.

The *flashing white* indication near LXN on the panel disappears and a *flashing red* indication appears. After the gate is closed, when the key is reinserted in the Key lock Relay and turned, the relay drops.

The *flashing red* indication at LXN on the panel disappears, and the *flashing white* indication reappears.

On seeing this, when the panel operator presses LXN alongwith YRN, the slot gets withdrawn and the *white indication* becomes steady.

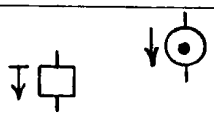
At site, the *red indication* on the box now disappears.

Release Of Point Key Lock Slot & Return:

The operation on the panel and at site are similar in this case and the indications displayed are also the same to those of gate slot explained above. The button operated for point slot release is KLN instead of LXN alongwith the common buttons YYN and YRN.

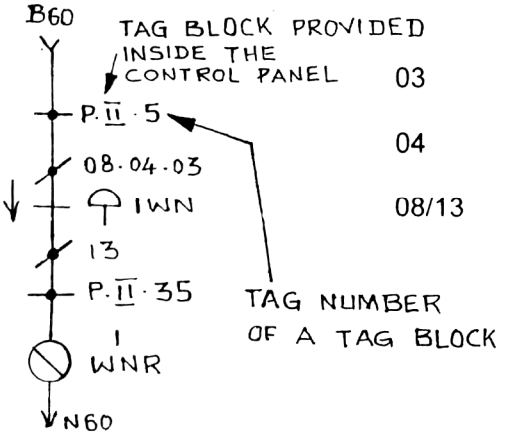
CHAPTER – 6 : SYMBOLS AND NOMENCLATURE

In Siemens's Relay Interlocking System the circuitry is generally drawn in German Symbols with British Nomenclature. Some of them are mentioned below:

Sl.No	Symbol	Description/Nomenclature
1.		Neutral Relay.
2.		Point Contactor Relay. Interlocked Relay Reverse Coil (Top Coil) normally in de-energized condition.
3.		Interlocked Relay Button Coil normally energized.
4.		Track Relay.
5.		Track Repeater Relay.
6.		Block Relay Automatic Territory.
7.		Time element relay or helper relay to TER.
8.		Normal position of the neutral relay is picked up.
9.		Normal position of the neutral relay is down.
10.		Normal Coil of the interlocked relay normally up.
11.		Reverse Coil of the interlocked relay normally down.
12.		Contact closed.

13.		Contact interrupted or open contact.
14.		Closed contact of a normally energized neutral relay i.e., "Front Contact".
15.		Closed contact of a normally de-energized neutral relay i.e., "Back Contact".
16.		Interrupted/open contact of a normally energized neutral relay i.e., "Back Contact".
17.		Open contact of a normally de-energized neutral relay i.e., "Front Contact".
18.		Diagonal line inside the relay circle from left top to right bottom indicates that the relay is used in point circuit.
19.		Horizontal line inside the relay coil indicates that the relay is used for route circuit.
20.		Diagonal line from right top to left bottom indicates that the relay is used for signal controls circuit.
21.		Panel key contact.
22.		Push button pressed contact.

(I)



03 : Domino vertical row numbers.

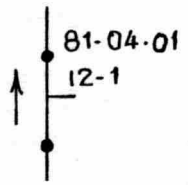
04 : Domino horizontal column numbers.

08/13 : Compartment number of a domino.

: Symbol of a push button.

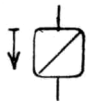
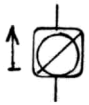
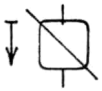
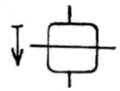
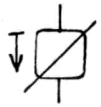
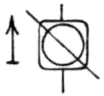
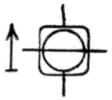
Fig : 6.1

(II)



03 : Rack number on which the relay is provided.
04 : Position of the relay in a relay rack.
81/82 : Contact termination on amphenol terminal & tag block.
1 : In the mini-groups top relay, relay no.1 and the bottom relay is relay no.2.
12 : Contact number of the relay.

Fig : 6.2

Relays Connected in point Circuit		Relays Connected in Route Circuit		Relays Connected in Signal Circuit	
Symbol	**Nomenclature**	**Symbol**	**Nomenclature**	**Symbol**	**Nomenclature**
		NEUTRAL RELAYS			
	Point Control Circuit		Route Control Circuit		Signal Control Relay
	Point Detection Relay		Route Checking Relay		Lamp Proving Relay
	Point locking Relay		Route Locking Relay		Signal Locking Relay
		INTERLOCKED RELAYS			
	Reverse Coil Used for point control circuit for reverse operation		Reverse coil used for Route Control circuit		Reverse coil used for controlling Signal Control Circuit
	Normal Coil used for Point Control circuit for Normal operation		Normal coil used for Route Control circuit		Normal coil used for controlling Signal Control circuit
	Reverse coil used for locking the Point circuit		Reverse coil used for locking the Route circuit		Reverse coil used for locking the Signal control circuit
	Normal coil used for releasing the locked circuit		Normal coil used for releasing the locking over route circuit		Normal coil used for releasing the locking of Signal control circuit

CHAPTER – 7: EXTRACTS FROM SPECIFICATIONS FOR RELAY INTER LOCKING SYSTEM

For ready reference the extracts of IRS – S 36 – are given below

1. SCOPE
2. GENERAL REQUIREMENTS
3. CONTROLPANEL
4. INTERLOCKING & CIRCUIT REQUIREMEN
5. RELAYS
6. SIGNALS
7. POINTS
8. TRACK CIRCUITS
9. CABLES
10. WIRING & RELAY RACKS
11. FUSES, TERMINALS & TERMINAL LINKS
12. POWER SUPPLY ARRANGEMENTS
13. GENERAL

LIST OF OPTIONAL REQUIREMENTS.

INFORMATION TO BE SUPPLIED BY PURCHASER.

INFORMATION TO BE SUPPLIED BY TENDERER.

RELAY INTERLOCKING SYSTEMS

1. IRS-S-36/87
   Refers to IRS, IS & BRS Specifications for signalling materials, cables, relays, point machine and various IRS design drawings.

2. Covers mechanical and electrical requirements including ancillary equipment, (Design performance and safety aspects).

3. **RELAY INTERLOCKING:**

   a) Route setting type by entry/exit.
   b) Non-route setting type (route set by individual operation of points).

4. For installation in RE Area, equipment and circuitry to comply with requirements as per approved RE Practices.

5. Signalling Plan and Control Tables to be supplied by purchaser.

6. Suppliers to furnish detailed wiring diagram, control panel diagram, route control, chart, cable diagram, track bonding diagram, relay contact analysis, relay rack arrangement, terminal charts, fuse charts, power panel diagram, power supply scheme, etc.

7. **CONTROLPANEL:**

   - Areas covered by each track circuit to be clearly distinguished.
   - Normally switches, buttons, etc. to be provided on panel itself in geometrical order unless separate illuminated diagram and console containing operational arrangement are asked for.
   - Route setting on basis of entrance - exit principle entrance/exit both buttons or entrance switch (2 or 3 POs) and exit button.
   - Non-route setting type route to be set by operation of individual points; signals to be cleared by individual push button + common button or individual switch for each signal or common switch for conflicting signals or signals cleared by push button at entrance and push button at exit.
   - Point operation for route setting by individual button + common button or individual 2 or 3 POs switches.
   - Approach locking or route release locking to be provided as specific by purchaser.
   - Provision to be made for emergency operation of points during point 2 one-track circuit failure; emergency group point button be kept sealed and each operation to be recorded in an electric counter.
   - Facility to switch over from manual control to automatic working for routes specified by purchaser.
   - Slotting facilities available with end cabins, ground frames, LC's, C.Handles, siding points, etc.

- Slot to be controlled by two buttons or a switch similar to route setting principle, slot cancellation by group cancellation by entrance/exit button; slot cancellation after certified time delay and has to be counted in an electric counter.

- If required by purchaser, switches/buttons to be provided on panel for controlling supply voltage for panel indication (intensity of illumination).

- If required by purchaser, facility for adjusting operating voltage of signal lamps from panel.

- If needed by purchaser, control for selecting power supply from mains/DG set/AT_I/AT_2, on control panel.

- SM's lock up key to be provided, when taken out, all points to be inoperative and all signals except those cleared shall also be in operative- facility to put back any signal cleared to danger in case of emergency but no route can be altered.

- In major yards, indication panel giving status of various functions in yard, to be provided in relay room for benefit of maintenance staff, if required by purchaser,

8. **CONTROL PANEL INDICATIONS:**

- Point indication white (normal) and green (reverse) near point switch/button or by white strip light on the leg of point switch; if needed by purchaser, indication lights to flash till points are correctly set and locked. if point do not set with in predetermined time, warning bell to be given which can be stopped on acknowledgement but flashing indication to continue till defect is set right; point locked in route to be indicated by a small red or white light near the point or respective switch/button which gets extinguished when point is free; if needed by purchaser, point free indication also to be provided.

- Route indications (white lamps to show setting and locking of routes, to get extinguished when route is not set), if needed by purchaser one or more first track circuits in route to flash till route is correctly set and locked, when track is occupied colour of indication to change to red and to go back to white when track is free and to get extinguished when route is released.

SIGNAL INDICATIONS:

- Stop Signal-Red indications and permissive signal at 'ON' by an Yellow light on the signal symbol in the panel; corresponding 'OFF' aspects also to be indicated on the panel.

- Shunt signal on same post, no 'ON' indication needed. if on separate post, 'ON' aspect by white light strip or two miniature white lights in horizontal position; 'OFF' aspect by slanting white light strip or two miniature slanting white lights.

- ‘A’ or 'AG' marker indication to be provided below signal symbol.

- 'Calling ON' at 'OFF' to be indicated by a white light below corresponding running signal indication.

- If needed by purchaser, a white strip light to be provided over running signal symbol on the panel, when RI is taken 'OFF'.

- For each track circuit minimum of two red (and white) lights to be provided per track circuit; red lights to light up when track is occupied and extinguish when track circuit is free.
- Power supply voltage meter to be provided on panel, if required by purchaser.

- Indication to show availability of power supply from mains/DG/AT_1/AT_2 to be provided on panel.

OTHER INDICATIONS:

- Approach track circuit where provided to be indicated on a panel as per table of contract (approach locking), approach track circuit controlling "Calling on" to be indicated in a distinct manner.

- Advance approach warning to be provided, if required, flashing lights and audible bell, audible warning to stop on acknowledgement; warning indications to disappear when train on approach track circuit or when signals taken "Off'.

- Where required by purchaser individual or group audible and visual alarms to be given for failure of signal/route bulbs; audible alarm to be silenced by acknowledgement.

- Near CH control switch/button, white lamp for CH, free and red lamp for CH locked to be provided.

- White lamp for emergency route cancellation in approach lock condition, after lapse of time delay, to extinguish after cancellation of route.

- If two position push buttons provided, audible indication to indicate that push buttons are left pressed.

- Indications for slot, gate control, etc. as required by purchaser.

- Panel indication bulbs to operate by maximum 24V miniature bulbs or LED's as specified by purchaser.

- Return wires for indication lamps to be so provided as not to damage wires due to heating; any break in return wire not to give wrong indication or pick up a wrong relay.

9. INTERLOCKING AND CIRCUIT REQUIREMENTS:

- Wiring diagram Symbols as per BS-376 or American/German symbols as required by purchaser; circuit explanations in English.

- A2 size papers for all documents.

- Purchaser to approve table of control.

- If required, internal circuits to be electrically isolated from external circuits.

- Circuit design to be such that fluctuations in power supply or resumption of supply following failure, cannot take signal to a less restrictive aspect than intended.

- If proved that Signalling relays are used, sequential operation of relays to be proved.

- Battery for power supply for line circuits to be kept at farthest end from operated unit, where not practicable, separate cable to be used for outgoing power supply.

- Common return not to be provided for vital circuits.

- All external safety circuits in cables.

- In route setting system, signal to be cleared only after checking conflicting routes, points in route/isolation/overlap are operated/locked/detected, route/overlap/ isolation is locked, track circuits in route + overlap are clear, CH for all points in route/overlap/isolation are locked and control is not released, LC's in route + overlap are closed and locked against road traffic.

- Siding control is locked and cannot be released.

- In non-route setting type, points in route/overlap/isolation to be operated by individual operation of switches/push-buttons and signal to be cleared after fulfilling/checking various conditions as per route setting type.

- For calling on signals, T-Circuits in Route + Overlap need not be free and proving of points and LC Gates in overlap not needed in O-Line but isolation points to be set, locked and detected in required position.

- For shunt signals, berthing tracks need not be clear, points and LC Gates in overlap need not be proved.

- Conflicting routes to be interlocked through route interlocking circuits.

- If required, pre-setting of conflicting routes as nominated, shall be possible.

- Approach and back locking of signalled route to be effective when all points are finally set but before signal assumes 'OFF' aspect or before 'A' Marker is lit.

- Approach locking or time locking to be provided for all controlled signals and also for electric locks or hand-operated points.

- White indication for block control on LSS to be provided on control panel in absolute block system.

ROUTE RELEASE CIRCUITS:

Unless automatic route release by passage of train is asked for, route + overlap to be released when signal put to "ON" and corresponding route switch/button is operated to normalise the route.

- If route has number of route sections, route section should not release only by picking up track relay; next track circuit should also be dropped and picked up except where last track is a berthing track; if route is controlled by single track, route release after pre-determined time delay.

- Route release circuit to be effective only if two track circuits' drops and pick up in sequence.

- In route setting type, sectional route release to be provided where required, sub route already released can be used in other routes if permitted by interlocking.

- In non-route setting system, sectional route release not required unless specifically asked for; complete route to be released after signal put back to "ON" and corresponding route switch/button operated to normalise the route.

- Emergency route release after suitable time delay to be possible when approach track is occupied (or dead approach locked) if signal put back to danger and train has not passed the signal within delay period,

- Overlap points to be released only after lapse of 2 minutes after occupation and clearance of last point track circuits, on cancellation of route; overlap points also to be released simultaneously.

- If required by purchaser, facility for emergency route/sub-route cancellation in case of track circuit failure, to be provided; to be possible only by co-operation of ASM + Signal staff and operation to be counted.

SIGNAL CONTROL CIRCUITS:

- Where self-restoring type push buttons are used, signal to assume "OFF" only after push button is pressed and released.

- In case of failure of a signal lamp, lamp of lower aspect is to be lit automatically and in case of red lamp; it shall not be possible to clear signal in rear.

- Signal to display most restrictive aspect when signal ahead is blank.

- Fouling protection, approach locking/time locking, route locking, siding control key locking, CH locking, route holding and track locking to be incorporated in control circuits.

- When necessary, each aspect of a signal to be proved and aspect indication shall be provided as needed.

- LC Gate to be released only when signal is replaced to "ON" and route is released. Interlocking between points to be provided only to the minimum extent necessary. Point control circuit to be so designed that a cross connection or a short circuit cannot operate a point or give a false indication of the same.

- Correspondence of point control relays and point indication relays to be proved in signal circuits.

- X Overs to be normally operated by separate point machines and detection/locking to be connected in series.

- CH to be so interlocked with signals that it cannot be released unless signals have been put back to "ON" and concerned route is released.

- Where number of points is more, points can be grouped in different zones and CH of different groups should not be interchangeable.

- Siding control keys to be suitably interlocked with signals leading over that line.

10. CROSS PROTECTION:

- Unless specifically required, for purely internal circuits, double cutting or cross protection need not be provided.

- All equipments in external circuits shall be suitably protected from cross connections and immunised to operation by stray currents.

11. RELAYS:

- Time element relays electronic type confirming to IRS/BS/BRS Specification shall be used. When electronic timers are used, two numbers to be used and their contacts to be in series with each other.

- All plug-in relays and relay groups to be fitted with non-interchangeable interlocking device.

- Removal of relays/relay groups from relay racks during operation shall not cause any unsafe condition in the circuits.

- Max. possible number of relays to be housed in relay room itself.

- Wherever possible, all relays except track relays to have 10% of working contacts to be spare subject to a minimum of IF and IB; relay rack to have space to accommodate repeater relays in future as required by purchaser.

- Flasher relay to be preferably of mercury type, electronic flasher not be used for route setting operation or point operation; can be used for other circuit.

12. R.I

- Can be of direction type, multi-lamp type or stencil type.

13. POINTS:

- Point machine can be with plunger type locking, rotary locking or point clamp type locking.

- Means to cut-off motor feed after pre-determined time in case of obstruction in the point.

- Over load protection and cross protection to be provided.

- CH interlocking by dividing them into number of groups. CH with different wards and corresponding slots in point machine. CH may be provided near group of points to which they refer.

- AC traction area, point machines to be immunised.

14 . TRACK CIRCUITS:

- DC, 50Hz. AC, 83 1/3 Hz. AC or Axle Counter, AFTC, can be used.

- Adjacent track circuit should not wrongly energise a relay in case of failure of block joints.

- DC track circuit not be fed directly by transformer - Rectifier, Battery is a must; if battery is disconnected, Rectifier also to get disconnected.

- For centralising track relays, separate 2 core cable of adequate size to be used.

15. CABLES:

- Unscreened, screened, power cables, axle counter quad cables.

- In each main cable spares to the extent of 20% of total conductors used to be provided up to point zone and 10% spares beyond, no spares required if total number of conductors used is $\leq$ 3.

- Conductor size such that voltage drop on line is > 10%.

- Cable termination or jointing outdoor, same to be done in water tight junction boxes.

- 2 Cores of cable for telephone communication from relay to end to yard for maintenance purposes, if in different directions, one pair for each direction; in RE area, communication by telecom. Cable.

- ELD's (multi-channel) optional for detecting leakage to earth.

16. WIRING

- All wiring in cabin & locations to be terminated on terminal blocks/tag blocks.

- Single Core 1mm., multi-core each 1mm., multi-core each 0.6mm or flexible wire 16/0.2mm to be used for internal wiring.

- Relay rack to relay rack wiring by 1.6/1.5mm^2.

- For shelf & plug-in type relays, 16/0.2mm.

- Proved type relays, 0.6mm. single strand.

- Cable termination to tag blocks and indicators, 1 mm. Single strand.

- CB's, lever locks, etc., single strand 1. 5/1.6mm^2.

- Relay to relay wiring in same rack to be direct without tag blocks/terminals, as far as possible.

- Relay rack to have spare capacity to take 15% more.

17. FUSES:

Each group of circuits to be carefully protected by fuses.

- Fuses giving visual indication during blow-off, preferred.

18. POWER SUPPLY:

- To have 20% spare capacity.
- Voltage stabiliser to give 110V ±2%.
- Signal supply transformer to have 110- 120-130V tappings.
- Where 3 ø track circuits used, each phase voltage being available to be proved in route release circuit.
- No break power supply for AC circuits with automatic/manual switch over facility to stand by during voltage fluctuation or frequency variation by >+-3%.
- All DC circuits including point machines to have battery back up in both RE and Non-RE areas.
- Ring main system to be adopted for outdoor feeders.

19. GENERAL:

- Big yards, busy junction stations where large number of movement, take place, relay room to be A/c; optional in wayside stations.
- Relay rooms in areas prone to dust, fumes, extreme temperatures, etc. may be account.
- Route setting type installations, fire detector and alarm of approved design to be provided, all installations to be provided with fire fighting arrangements.
- Adequate spare relays and other equipments to be provided with each installation.
- Quartz clock on indication panel, if required.
- Proper earthing for relay racks, panel, power supply, switch board, transformers, inverters, etc.

OPTIONS : To be specified.

1. RRI or PI.
2. Control & indication separate or not.
3. Three position signal switch in PI.
4. Point switch two or three position.
5. Voltage control on panel indication.
6. Voltage control on signal supply.
7, SM's lock.
8. Provision of voltmeter.

9. Requirement of approach warning.
10. Lamp failure indication.
11. Sectional route release.
12. Double cutting in internal circuits.
13. Holding of overlap,
14. Provision of air conditioning.

INFORMATION TO BE SUPPLIED BY THE TENDERER:

1 . Type of panel lamp to be used.
2. Type of over load cut-off in point machine.
3. Specification of cables/wire.
4. List of spares.
5. Requirement of power supply.
6, Additional facilities, if any.

INFORMATION TO BE SUPPLIED BY THE PURCHASER:

1. RRI or PI.
2. RE or Non-RE.
3. Signalling plan and selection table.
4. Control Panel - Separate/Combined.
5. If RRI, push buttons/knob & button; if PI, common signal switch or not.
6. Point switch - 2 or 3 position.
7. Details of alternate overlaps/routes.
8. Semi-automatic working.
9. Details of various slots/controls.
10. Voltage control - Limits.
11. Details of change over arrangement in power supply.
12. Indication panel for maintainer,
13. Type of panel indication bulb.
14. Symbols to be used in circuits.
15. Requirement of external supply.
16. Pre-setting of route.
17. Details of sectional route release.
18. Details of aspect proving required.
19. Grouping of point crank handles.

20. Type of route indicator.
21. Point operation.
22. Type of track circuit.
23. Type of wire to be used.

CHAPTER – 8: SPECIAL FEATURES OF CIRCUIT DESIGN

Essential Feature/s of Siemens Circuitry :

1. The circuit flows from the top of the sheet to its bottom branching out sideways unlike the circuit in British practice which flows horizontally from left to right.

2. Signal and route initiation; Signal control and locking; and panel indication circuits follow the pattern of yard layout facilitating easy identification of route selection.

3. A process of chain control is adopted for vital functions with the operating conditions of one relay forming part of another relay circuit including its own operated condition. This results in saving of relay contacts even as ensuring that more than one relay have the same conditions proved.

4. At least two relays energised through independent selections are used in final control of vital gears. This is necessary as the relays used have only metal to metal contacts.

5. All important conditions affecting safety like interlocking are proved in two or three stages upto the final control of a gear.

6. During the reversal of an interlocked relay, its repeater is first reversed and this condition is proved so that all further controls are simultaneously progressed leading to the final operation.

7. In the circuit of an interlocked relays top or bottom coil, the front (N.O) contact of its counterpart is included as an economiser contact without fail.

8. Double coil relays are used if they are to be provided with stick circuits when some of their operating conditions change. This is necessary as one condition of an interlocked relay is proved in the pick up circuit and its other condition in the stick circuit Ex. Z_1WR_1 relay.

Circuit Explanation:

Principles of designing the circuit:

The following principles have been adopted in the designs of the circuits using metal-to-metal contact relays:

1. Any unsafe failure can only result in a “prohibition” and not in permission.

2. Each failure should draw the attention of the operator by withholding which could otherwise be given.

3. The correct completion of an action, which has been initiated, must be confirmed by an active indication.

4. Every indication, which might result in permission, must take the form of an action e.g. the current energizing a relay during the time of permission is effective in the case of a neutral relay and the pulse changing the position of an interlocked relay.

5. Dependent action should be switched in cascade via the indication i.e., the initiation of an action is identical with the indication of previous action.

6. Independent section may take place at the same time if the indications of their correct completion are switched in series.

7. Continuous indication must be interrupted during each working cycle to prove that the indicating device is capable of working and the information is the result of an action.

8. The final permission for a signal to be cleared must be obtained by the energisation resulting from two independent actions.

9. The proper functioning of track relay should be checked in the route release circuit. The application of the above principles are explained when the individual circuits are described.

CHAPTER – 9 : PLANNING EXECUTION AND COMMISSIONING OF A MAJOR ROUTE RELAY INTERLOCKING

9.1 Successful commissioning of a major RRI or for that matter, any project in the Railway, depends to a very great extent on detailed and proper planning. While this is true in the case of all works it is a must to commission as installation under traffic, safely with least repercussion to traffic.

Assuming that approved plans and circuits are available and materials have been procured, changeover from the mechanical working of a major yard to RRI involves the following stages:

9.2 Outdoor:

i) Conversion of the mechanically operated points to motor working.
ii) Erection of Colour Light Signals at the proper locations.
iii) Insertion of insulated joints for track circuits and charging the track circuits to the extent possible in advance and insulating the fittings of the mechanically operated points temporarily as required.
iv) Fixing circuit controller, adjustment of bands for inter-cabin control with adjacent cabins/stations as well as level crossing gates, if any, not directly worked from the RRI cabin.
v) Laying and terminating the cables and testing the continuity, right from the cable termination board to the gear at site.

9.3 Indoor:

i) Installation of the indoor relay equipments and wiring as per approved circuits.
ii) To work all the routes from the panel and carrying out functional test.
iii) Soldering of wires on the IDF.
iv) Carrying out contact break test as per approved circuits.
v) Checking number of wires on each terminal on the IDF and confirming that it tallies with the approved circuits and no extra wire exists.

9.4 Phase work and changeover from mechanical Signalling to RRI.

i) Drafting circular notice, planning the various phases carefully at convenient margins available between traffic.
ii) Planning and making interim arrangement to work the trains during the various stages.
iii) Testing the whole installation directly worked from the RRI control panel and handing over the same for traffic.

9.5 Communication:

Provision of a reliable communication system between the central cabin panel and other indoor and field unit locations.

9.6 Outdoor:

9.6.1 Conversion of the mechanically operated points to Electrical working:

The mechanically worked points to be converted will be having non-insulated fittings, mechanical facing point locks, detectors etc. Provision of electric point machine will require two long wooden sleepers with gauge plates extension. Since track circuiting is essential insulated gauge plate and insulated structures are also required. The work should be planned point by

point. Traffic blocks are requisitioned point by point. On removal of the mechanical fittings of the points, long wooden sleepers are inserted. Insulated gauge plates with extension and insulated structures are then fitted. Further the point machine is installed and the ground connections fitted and necessary adjustment carried out. The installation of point machine may require the shifting of the facing point lock/detectors suitably. After the installation and adjustment of the point machine by crank handle, the point fittings are removed and kept properly bundled and numbered and kept in proper safe custody. The old mechanical fittings are reconnected with suitable modifications, necessary adjustment carried out, tested and the point reconnected and handed over to traffic. This may preliminary work of installation of the point machine is carried out on all the points in the yard coming under the jurisdiction of the proposed RRI scheme.

Detailed planning is essential to carry out this work safely with minimum detention to traffic. For this purpose it is very much essential to draft out a phase plan after detailed discussion with the operating staff especially the local station staff who are conversant with the pattern of traffic at the station.

Suitable traffic blocks depending upon convenient margin available between the trains after a detailed study of the time table and the control chart have to be got sanctioned. Special duty staff for managing the traffic unavoidable during the block are to be posted. The procedure for passing a train over the affected point should be explained and discussed with these staff. Proper telephone communication between the cabin from where the concerned point and signal is worked and also the site of work should be ensured.

While the above procedure is the normal method which could be adopted to carry out the work, it may not be possible to adopt the same in a major busy yard involving suburban traffic. In the above method it is to be noted that the point machine fittings are removed after initial installation and adjustment and the mechanical working is restore. In this case the changeover from the mechanical working to the electrical working has therefore to be carried out at the time of actual commissioning of RRI and the minimum time required for each point end can never be less than an hour or two.

This may not be possible in the case of a major yard involving suburban train working. In such cases it is imperative that all the points are converted to electrical operation from the different cabins by respective levers in advance with the result the actual work involved at the time of commissioning of RRI will only be disconnection of the cable coming to the old cabin and making the connection to the new RRI cabin through. This can be managed within 10 to 15 minutes per point. This will however, require provision of electric lever lock on the concerned lever, wiring the circuits and detection of the point by providing signal reversers or signal motors in the case of semaphore signals. Otherwise conversion of the semaphore signal to colour light signal will also be required in advance. To prevent the point being operated under train, it can be achieved either by charging track circuit and providing track locking on the point lever or retaining lock bar only, worked by the lock lever. If the track circuit required for track locking of the point conforms with the track circuit required for the RRI, it may be advantageous to charge the track circuit in advance so that the part of the RRI work could be completed. If it is not so, it may be advantageous to retain the lock bar since thereby no locking alteration also will be involved. However, converting the mechanical point to electrical operation from the individual cabin is itself a major work requiring lot of materials and involves major cost. This has to be taken into account and sufficient provision made in the detailed estimate at the planning stage itself.

9.6.2 Erection of Colour Light Signal at the proper locations:

While erecting the new Colour Light Signal it has to be properly planned so that it does not come in the way of the visibility of the existing signals specially shunt signal. Since there will be a gap between the commissioning of the new Colour Light Signal and dismantling of the semaphore signal during which the train may have to observe Colour Light Signal commissioned the visibility of the Colour Light Signal has to be kept in view carefully. It should be possible to dismantle the mechanical signal without damage to the newly commissioned Colour Light Signal.

9.6.3 Insertion of insulated joints:

Since the layout in the yard where RRI is to be commissioned is not track circuited, unforeseen problems may crop up while charging the track circuits and may involve long time. Hence, it is very much essential that as many track circuits as possible are charged and adjusted in advance. This will require insertion of insulated joints and insulating the mechanical fittings of the point temporarily though it is not required for the mechanical working itself. Even where track circuits are required for the existing working prior to commissioning of the RRI, it may be preferable to charge track circuit and energise the relay at the final location in the RRI cabin and provide a repeater in the existing cabin for the temporary working, so that the work involved at the time of commissioning of RRI will only be the disconnection of the temporary track repeater relay from the existing cabin.

9.6.4 Fixing of lever locks and circuit controllers:

Fixing electric lever lock and circuit controller connecting to the lever, cutting and adjustment of bands etc. it will be necessary to provide additional lever locks and circuit controllers for inter-cabin slotting, gate controls etc. in connection with the RRI at connected cabins and ground frames which must be done in advance. Where the lever lock and circuit controllers do not interfere with the existing working, it can be left in the working conditions. In other cases the locking dog of the lever lock may have to be kept removed with all other fittings in intact so that the work involved at the time of commissioning of RRI will only be reinsertion of the lock-dog and its adjustment.

9.6.5 Laying and terminating the cables:

The cables have to be laid and terminated properly as per the cable plan and the insulation and continuity of the conductors from the cable termination board to the gear at site tested and kept ready in advance. Testing and confirming conductors of the points and various signal aspects is most important so that under no circumstances a wrong aspect will be exhibited by a signal even during the progress of the commissioning of RRI. A detailed planning in preparing cable plan will go a long way in the convenient working of the RRI installation. While earmarking the cable conductors for the various gears, it should be borne in mind to make it possible to disconnect a cable for purpose of testing affecting the minimum number of lines and gears as possible. In other words it should not be that any cable disconnected, will affect all the lines and paralise the traffic. The proper laying of the cable is also important for which the cable route has to be decided after proper survey of the yard taking into consideration, the drainage, cables of other departments specially high tension cable etc. The cable route has to be got approved by all the departments concerned. Cable should be laid sufficiently deep and protected by proper covering materials. The cable plan must show the distance of the alignment from the adjacent track center and/or permanent land mark. Each apparatus case must have the detailed location plan available in it before the commissioning is taken on hand.

9.7 Indoor:

9.7.1 Installation of the indoor equipment and wiring as per approved circuits:

The quantum of work involved has to be assessed properly and the number of staff to be deputed and the number of shifts to carry out the work has to be decided taking into consideration the time frame within which the work is required to be completed. The grouping of the relays in the racks has to be palnned in such a way that the length of the jumper wires will be as short as possible. It should also be grouped zonerwise for the conveniencwe of locating and identifying the relays either during testing or during rectification of faults. It is also important to have good appearance in the relay room and with this in view it is preferrable to install the major groups in the front row facing IDF. It may be advantageous to locate the LT power panel inside the relay room but, the various power equipments have got to be housed in another room as close to the relay room as possible. Duplicate power equipment with easy and suitable change over arrangement must necessarily be available.

Jumper sheets are to be prepared from the circuit diagram and handed over to the wireman to carryout the wiring. The jumper sheet gives details of the terminals on the IDF between which the particular wire is connected. Jumper sheets are prepared sheet wise and sheet number quoted in the jumper sheet which can be referred back at the time of carrying out the circuit alteration as required at a later stage and hence it is very much essential to preserve the jumper sheet atleast till the commissioning.

A colour code by earmarking fixed colours for a particular supply like BX-110, B-60, N-60, B-110, N-110, BX-24, NX-24 etc. are followed which will facilitate to locate any wrong connections at the time of commissioning. The wiremen should be strictly instructed not to have mix up of wires of different colour. It is also important not to have more than 2 wires in one terminal of the IDF.

9.7.2 To work all the routes from the panel and carrying out functional test:

On completion of the wiring of circuits the next stage in the commissioning of RRI is to check and confirm the correctness of the wiring as per the approved circuit and to confirm that the various gears controlled from the RRI panel correspond correctly to the operation of the control panel. For this it is essential to operate each and every route from the control panel, take off the relevant signal, simulate the condition of the passage of train over the signalled section after which the routes get cancelled automatically. The other 2 methods of the cancellation of the route ie. cancellation by the cabin ASM by 3 button operation and cancellation of individual sub-route by the S&T staff have also to be tried out to see that they respond correctly.

For these tests, it should be noted that the points at site cannot and will not be connected to the new RRI control panel since they will be and are required to be connected and worked from the existing mechanical cabin. Hence, it will be necessary to provide temporary connections on the point groups to simulate the operation of the point from normal to reverse and vice-versa and detection thereby when the relevant buttons are pressed from the control panel without the outside point gear being connected to the point group.

For the purpose of testing all the functions of the route relay interlocking, it is advantageous to employ a mock panel. On the mock panel all the signals controlled from the RRI panel are repeated. In addition, the track repeater relays are directly charged through individual switches to simulate condition of occupation or otherwise of the track circuits. Switches are also employed in the point indication circuit to facilitate the testing of point detection. Similarly switches are earmarked for various inter cabin controls, level corsssing gates etc. This will facilitate to simulate conditions of sequential operation of the track circuits during the passage of trains and the automatic cancellation of the route thereby. The signals repeated on the mock panel are directly connected from the corresponding terminal on the cable termination board

and when the lamps are lit the corresponding ECRs get energised and the corresponding indications are available on the control/indication panel. We are able to ascertain the correctness of the signal aspects by looking at the signal repeaters on the mock panel. After all the routes of the RRI are thus tested through mock panel, functional tests are carried out.

The following tests are carried out during the functional test of control panel:

a) Signals are taken off beginning from the first route by operating the relevant buttons on the control panel. The various route sections required to be set for a particular signal are checked by cancellation, one at a time and ensuring the signal goes to ON by cancellation of route. With each cancellation, the signal has to be cleared back and the cancellation of the subsequent routes tried. It is also to be ascertained that it is not possible to reinitiate the signal over a set route. This is done by retaining one of the routes required at a time, cancelling all other routes and trying the initiations of the signal.

b) The elimination of the conflicting route is tested by setting the conflicting route one at a time, and trying the initiation of the concerned signal. It is important that the signal does not initiate with the conflicting route set and does initiate when the conflicting route set is cancelled.

c) The detection of the point in the route and over-lap and isolation is ascertained by de-energising the indication relay of the point one at a time by operating corresponding switch of the mock panel and confirming that the signal goes to ON.

d) The proving of the concerned track circuits clear in the concerned route is checked and confirmed in the similar way from the mock panel. The same method is employed to check the effectiveness of the inter-cabin control, level crossing gates etc.

e) Approach locking of the signals is tested by taking off the signal and breaking the conditions of approach locking one at a time and confirming that the route does not get cancelled within 2 minutes time delay. It should also be ascertained that when the approach to the signal as per the control chart is not occupied, the route can be cancelled without time delay.

f) In RRI, the fact that one of the aspects of the signal ahead is lit for a signal to come to off position is to be established and this is to be checked and confirmed during the functional test. The aspect control for double yellow and green aspect have also to be checked and confirmed during the functional test.

g) Back lock testing on the RRI control panel is carried out by setting one route at a time, de-energising one track circuit from the foot of the signal upto the last point in the route at a time through mock panel and then trying 3 button cancellation of the route. If any one of the track circuits in the back lock territory of the signal is de-energised it should not be possible to cancel the route by 3 button operation. Consequently it should be tested and confirmed that the route gets cancelled by three button operation if no track circuit in the back lock territory is de-energised, every time. It is important to keep a watch on the counter of the route cancellation to ascertain that cancellation is correctly recorded.

h) Testing of track locking of the point is carried out by de-energising the track circuits of the points concerned, one at a time and trying the operation of the point by means of the point button and point group button. It should not possible to operate the point by the regular point group button and point button and at the same time it should be possible to operate the point by pressing the emergency point operation button and the individual point button. Every such operation by means of the emergency point button is recorded on the relevant counter the function of which should be checked and confirmed for every individual operation.

i) It is most important that not only the fuse of the circuit under test, but all the fuse are in position while carrying out the contact break test, as otherwise, a path of false feed which may be existing due to a flow in circuit may not reveal itself.

9.7.3 Soldering of IDF wires:

The wires are soldered to the terminals after these tests. Soldering of wires on IDF at an RRI installation has to be done very carefully since, otherwise, it may cause intermittant and complicated failures resulting in a detention to traffic. The soldering of the wires has to be planned taking into consideration the number of terminals to be soldered, the time frame within which the work has to be completed to keep up the target and the number of staff conversant with the work of soldering available. A correct assessment of the number of terminals such a conversant staff can solder during his duty hours without hurrying through is most important. Before the wires are soldered, it should be ensured that they are connected firmly to the terminals and the terminals must be cleaned thoroughly with a brush since accumulation of dust on the terminal will cause dry solder. Care should be taken to ensure that the insulation of the wires do not get burnt while soldering. It should be checked up thoroughly by a supervisor to ensure that no terminal is left unsoldered. A few percentage check at officer's level is also desirable.

9.7.4 Carrying out contact break test:

Break test should be carried out only after the soldering work is completed. This is a very important work which has to be necessarily completed before the installation can be ready for commissioning. This is to ensure that all the contacts of the various relays that are incorporated in the circuit of a particular function do necessarily exist in the wiring and also to confirm that there is no possibility of a false feed bye-passing the vital selection of the function under test. This test is carried out by breaking the conditions starting from the fuse to the function, one at a time and ensuring that the function fails on each such occasion. This is normally done by connecting a test lamp at the final terminal of the function which will get lit when all the conditions are correctly fulfilled. Then the contacts, one at a time are broken by inserting a thin film between the relay contacts and the contact pin carrier of the relay. When the film is thus inserted the relay should de-energise (or the lamp should extinguish) and when the film is removed thereby making the contacts, the relay should energise and/or the lamp should lit again. If there is a false feed bye-passing the vital selection, it can be noticed since by breaking the contact that are bye-passed, the relay will not de-energise since it will be kept energised by the false feed. The fault can then be localised and remedial action taken. Similarly, if there is an omission in the wiring, this will also come readily to light since breaking of such omitted contact will fail to de-energise the relay. Thus, the authenticity of the wiring as per the approved circuit is ascertained by the contact brake test. It should be ensured that the breaking of the contacts is carefully done taking care not to damage the relay contacts. Break test should necessarily be carried out at Gazetted level and sheet by sheet record of the test should be maintained.

9.7.5 Checking number of wires on the IDF:

While the contact break test will establish whether the wiring is as per approved circuits or not and whether all the contacts that are shown in the approved circuits do really exist in the wiring or not, any extra unwanted contact or wire in the circuit will not be revealed by a contact brake-test. This is because while carrying out the contact brake-test the S&T official will naturally break the contacts that are appearing in the approved circuits and he will be in dark about the unwanted contact that have inadvertently been inserted in the circuit. This can be detected by one and only method of checking the number of wires on the IDF terminals and tallying the same with the approved circuits. In the case of a junction between a number of terminals, any two terminals of the junction should have only one wire each and all other terminals should have two and not more than two wires. If it is not so, then the actual wiring has to be traced out and the extra wire has to be removed and the wiring rectified.

9.8 Phase work and change-over from mechanical Signalling to RRI.

9.8.1 A lot of preparatory work is required to be carried out in order to have a safe and efficient changeover from mechanical signalling to RRI. It may not be possible to complete the switchover on a single day or in one continuous block. Depending the traffic pattern and the yard layout a plan should be drawn out with regard to areas that will be transferred to the panel under each block. In the case of different cabins it will be preferable to plan the switch over cabin wise. If this is not possible, zone-wise or line-wise switch over can be thought of. The various phases have to be drafted out after thorough and detailed discussions with representatives of the Departments concerned. It will be very much beneficial to associate the field staff at the lower level including control office staff who are conversant with the yard and the pattern of traffic. The various phases have to be drafted out, taking into consideration, the minimum time required to carryout the work and the most suitable period during day and night depending upon the traffic at that station.

9.8.2 Commissioning of major RRI installation normally lead to a circumstance where part of the yard gets connected to the RRI control panel and the remaining portion continues to be worked from the existing mechanical cabins. During such interim stage, it has to be planned and ways and means found out to work the trains with minimum detention but without compromising safety. The procedure to be followed should be listed and the staff concerned should be drilled. Each staff should be provided with a copy of the instructions.

9.8.3 Sufficient special duty operating staff are to be detailed during commissioning of the RRI so that at a time of unforeseen emergencies, the train working does not suffer unduly for want of staff to work the trains in such circumstances. Operating staff must be posted at important signals of the area which is being transferred to the RRI cabin with proper telephone connections so that as and when required, private number can be exchanged between the RRI/existing cabin and the operating representatives at the foot of the signal and authority issued at the foot of the signal without much delay. It is very much essential to have sufficient stock of switch clamps and padlock and they must be kept properly oiled and in good working conditions.

9.8.4 Sufficient number of S&T Officers and staff have also to be detailed during the phase work. They should be divided in groups nominating a leader for each group. It is most important that S&T staff thoroughly conversant with the yard are kept for outdoor duties and staff conversant with the RRI circuitry and operations are kept for indoor work.

9.8.5 The activities to be done by each group of staff whether indoor or outdoor should be listed and recorded and each group leader should be supplied with a copy of the same, clearly identifying the activity his group is to perform.

Points, one at a time have to be connected to the control panel, worked directly from the control panel and lie of the points at site, the position of the controlling relay and the corresponding indication on the panel have to be tallied Likewise, the detect or contacts of all the ends of the points have to be broken one at a time to ensure correct detection of the same by the point controlling relay equipment.

9.8.6 The energisation of the track relays from its proper feed is to be ascertained by ensuring that track relay de-energise when any portion of the track circuit is shunted at site and energises back when the short is removed. The correct adjustment of the track circuit has to be ascertained by measuring the control voltage and also checking the train shunt resistance value.

9.8.7 The correctness of the signal aspect which is most crucial has to be ascertained by physical verification from the site. Each signal, route indicator, shunt, calling on and 'A' markers should therefore be visually checked from site after operating and clearing from the panel.

9.8.8 Though the special duty operating staff are required mainly during the progress of the phase work, it is essential for S&T staff conversant with the new RRI working to be available at the RRI cabin round the clock during the progress and completion of the entire work in order to observe and attend to the teething problems if any.

9.8.9 After the entire installation is connected to the new RRI control panel, all the routes must be thoroughly tested on the control panel, its satisfactory functioning ensured and then the same can be handed over for traffic.

9.9 Communication:

Successful commissioning of RRI depends to a very great extent on efficient communications. Standby means of communication must be catered for, since reliance of one mode of communication only may prove detrimental. The following are the vital modes of communication which must necessarily be available.

a) RRI intercom: usually this mode of communication is a part of the RRI installation itself. RRI intercom should be provided lavishly at as many locations as possible in the field. This not only helps during the commissioning of the system but also is a valuable aid for maintenance.

b) A magneto Group telephone circuit should also form part of the RRI system. This again should be provided at all locations and cable termination junction locations.

c) Not very costly talk back systems are now available commercially. It is advisable to cater for such a system for the installation as a permanent feature at a few selected locations catering for group of points and signals.

To meet the requirements of all the above communication systems which are to be retained as a permanent measure, a separate communication cable should be planned and laid when signalling cables are laid. Connecting any communication circuit through a signalling cable results in lot of induction problems.

d) Further, specifically for the exclusive use of phase working, reliable Walkie-talkie VHF equipments, with a master unit located at the panel location is to be provided. Each working group leader at site should be provided with a hand set. Sufficient number of additional hand sets are to be made available so that these are kept on charge to replace ones in use when batteries run down.

e) At selected locations Auto telephones connected to the main exchange shall be provided to facilitate direct communication with control office etc.

f) It is advantageous to install a PA system operated from the cabin and having loud speakers at selected location for conveying instructions to the field staff during phase working.

9.10 General:

i) Convenient shelter to protect them from the weather, has to be provided for the special duty operating staff with proper communications at convenient locations in the area of work. If the works are programme to be carried out at night also, then suitable lighting arrangement must also be made

ii) The phase working is likely to be continued uninterrupted for a number of hours during which the staff will not get any time break for tea, food etc. Therefore it is important to make arrangements for supply of tea & snacks etc. at the work spot itself. A supervisor should therefore be nominated for making necessary catering arrangements.

iii) If the yard involved is away from the HQrs of staff suitable arrangements for their stay at site during the phase working should also be made. Stabling of one or two passenger bogies for the purpose will be ideal.

CHAPTER – 10: CONTACT ANALYSIS OF FUNCTIONAL RELAY GROUPS

10.1 Contact Analysis of K 50 mini- Group Relays on a rack

8 Mini-Groups in each of 8 rows are fixed on a rack . The groups are numbered as below , as seen from the rear of the rack where the wiring is. The group position on the rack is as shown below:

The contact distribution of each mini group is shown in the above numbered slots as shown below :

REVIEW QUESTIONS

Subjective :

Q.1 Explain the features of Siemens Relay interlocking System?

Q.2 Write down the special features of Siemens Relays?

Q.3 Why Tag Blocks are used in Siemens Relay interlocking System?

Q.4 Make a Route Section Plan for typical 4-Line station of your Railway?

Q.5 Explain the following Relay Group

i) 2-Aspect Signal Group.

ii) 3-Aspect Signal Group.

iii) Shunt Signal Group.

Objective :

Q. a) Draw the Symbols for

i) GR1 _____

ii) RECR _____

iii) G(R) LR_____

IV) U (R) LR _____

v) TPR _____

VI) WKR 1 _____

Q. b) Give Nomenclature for following

i) UDKR _____

ii) ZDUCR_____

iii) U (R) S_____

iv) EGNR _____

v) WKR1 _____

vi) Z1UR1 _____

vii) ZU (N / R) _____

Viii) Sh G (N/R) R _____

ix) WKR1 _____

x) G(R) LR _____

Q. c) Give the Symbols for

i) RE (Mn) CR Drop contact_____ ii) W(R) LR Up contact_____

iii) UNCR drop contact _____ iv) U(N) S up contact_____

v) Sh GLSR drop contact _____